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National Education Policy 2020

Ministry of Human Resource Development

Government of India

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National Education Policy 2020

Introduction

Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country.

The global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015 - seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. Such a lofty goal will require the entire education system to be reconfigured to support and foster learning, so that all of the critical targets and goals (SDGs) of the 2030 Agenda for Sustainable Development can be achieved.

The world is undergoing rapid changes in the knowledge landscape. With various dramatic scientific and technological advances, such as the rise of big data, machine learning, and artificial intelligence, many unskilled jobs worldwide may be taken over by machines, while the need for a skilled workforce, particularly involving mathematics, computer science, and data science, in conjunction with multidisciplinary abilities across the sciences, social sciences, and humanities, will be increasingly in greater demand. With climate change, increasing pollution, and depleting natural resources, there will be a sizeable shift in how we meet the world's energy, water, food, and sanitation needs, again resulting in the need for new skilled labour, particularly in biology, chemistry, physics, agriculture, climate science, and social science. The growing emergence of epidemics and pandemics will also call for collaborative research in infectious disease management and development of vaccines and the resultant social issues heightens the need for multidisciplinary learning. There will be a growing demand for humanities and art, as India moves towards becoming a developed country as well as among the three largest economies in the world.

Indeed, with the quickly changing employment landscape and global ecosystem, it is becoming increasingly critical that children not only learn, but more importantly learn how to learn. Education thus, must move towards less content, and more towards learning about how to think critically and solve problems, how to be creative and multidisciplinary, and how to innovate, adapt, and absorb new material in novel and changing fields. Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible, and, of course, enjoyable. The curriculum must include basic arts, crafts, humanities, games, sports and fitness, languages, literature, culture, and values, in addition to science and mathematics, to develop all aspects and capabilities of learners; and make education more well-rounded, useful, and fulfilling to the learner. Education must build character, enable learners to be ethical, rational, compassionate, and caring, while at the same time prepare them for gainful, fulfilling employment.

The gap between the current state of learning outcomes and what is required must be bridged through undertaking major reforms that bring the highest quality, equity, and integrity into the system, from early childhood care and education through higher education.

The aim must be for India to have an education system by 2040 that is second to none, with equitable access to the highest-quality education for all learners regardless of social or economic background.

This National Education Policy 2020 is the first education policy of the 21st century and aims to address the many growing developmental imperatives of our country. This Policy proposes the revision and revamping of all aspects of the education structure, including its regulation and governance, to create a new system that is aligned with the aspirational goals of 21st century education, including SDG4, while building upon India's traditions and value systems. The National

Education Policy lays particular emphasis on the development of the creative potential of each individual. It is based on the principle that education must develop not only cognitive capacities - both the 'foundational capacities 'of literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving – but also social, ethical, and emotional capacities and dispositions.

The rich heritage of ancient and eternal Indian knowledge and thought has been a guiding light for this Policy. The pursuit of knowledge (*Jnan*), wisdom (*Pragyaa*), and truth (*Satya*) was always considered in Indian thought and philosophy as the highest human goal. The aim of education in ancient India was not just the acquisition of knowledge as preparation for life in this world, or life beyond schooling, but for the complete realization and liberation of the self. World-class institutions of ancient India such as Takshashila, Nalanda,Vikramshila, Vallabhi, set the highest standards of multidisciplinary teaching and research and hosted scholars and students from across backgrounds and countries. The Indian education system produced great scholars such as Charaka, Susruta, Aryabhata, Varahamihira, Bhaskaracharya, Brahmagupta, Chanakya, Chakrapani Datta, Madhava, Panini, Patanjali, Nagarjuna, Gautama, Pingala, Sankardev, Maitreyi, Gargi and Thiruvalluvar, among numerous others, who made seminal contributions to world knowledge in diverse fields such as mathematics, astronomy, metallurgy, medical science and surgery, civil engineering, architecture, shipbuilding and navigation, yoga, fine arts, chess, and more. Indian culture and philosophy have had a strong influence on the world. These rich legacies to world heritage must not only be nurtured and preserved for posterity but also researched, enhanced, and put to new uses through our education system.

The teacher must be at the centre of the fundamental reforms in the education system. The new education policy must help re-establish teachers, at all levels, as the most respected and essential members of our society, because they truly shape our next generation of citizens. It must do everything to empower teachers and help them to do their job as effectively as possible. The new education policy must help recruit the very best and brightest to enter the teaching profession at all levels, by ensuring livelihood, respect, dignity, and autonomy, while also instilling in the system basic methods of quality control and accountability.

The new education policy must provide to all students, irrespective of their place of residence, a quality education system, with particular focus on historically marginalized, disadvantaged, and underrepresented groups. Education is a great leveler and is the best tool for achieving economic and social mobility, inclusion, and equality. Initiatives must be in place to ensure that all students from such groups, despite inherent obstacles, are provided various targeted opportunities to enter and excel in the educational system.

These elements must be incorporated taking into account the local and global needs of the country, and with a respect for and deference to its rich diversity and culture. Instilling knowledge of India and its varied social, cultural, and technological needs, its inimitable artistic, language, and knowledge traditions, and its strong ethics in India's young people is considered critical for purposes of national pride, self-confidence, self-knowledge, cooperation, and integration.

Previous Policies

The implementation of previous policies on education has focused largely on issues of access and equity. The unfinished agenda of the National Policy on Education 1986, modified in 1992 (NPE 1986/92), is appropriately dealt with in this Policy. A major development since the last Policy of 1986/92 has been the Right of Children to Free and Compulsory Education Act 2009 which laid down legal underpinnings for achieving universal elementary education.

Principles of this Policy

The purpose of the education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and

creative imagination, with sound ethical moorings and values. It aims at producing engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by our Constitution.

A good education institution is one in which every student feels welcomed and cared for, where a safe and stimulating learning environment exists, where a wide range of learning experiences are offered, and where good physical infrastructure and appropriate resources conducive to learning are available to all students. Attaining these qualities must be the goal of every educational institution. However, at the same time, there must also be seamless integration and coordination across institutions and across all stages of education.

The fundamental principles that will guide both the education system at large, as well as the individual institutions within it are:

- **recognizing, identifying,** and **fostering the unique capabilities of each student,** by sensitizing teachers as well as parents to promote each student's holistic development in both academic and non-academic spheres;
- **according the** highest priority **to achieving Foundational Literacy and Numeracy** by all students by Grade 3;
- **flexibility**, so that learners have the ability to choose their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests;
- **no hard separations** between arts and sciences, between curricular and extra-curricular activities, between vocational and academic streams, etc. in order to eliminate harmful hierarchies among, and silos between different areas of learning;
- **multidisciplinarity** and a **holistic education** across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world in order to ensure the unity and integrity of all knowledge;
- **emphasis on conceptual understanding** rather than rote learning and learning-for-exams;
- **creativity and critical thinking** to encourage logical decision-making and innovation;
- **ethics and human & Constitutional values** like empathy, respect for others, cleanliness, courtesy, democratic spirit, spirit of service, respect for public property, scientific temper, liberty, responsibility, pluralism, equality, and justice;
- **promoting multilingualism and the power of language** in teaching and learning;
- **life skills** such as communication, cooperation, teamwork, and resilience;
- **focus on regular formative assessment for learning** rather than the summative assessment that encourages today's 'coaching culture';
- **extensive use of technology** in teaching and learning, removing language barriers, increasing access for *Divyang* students, and educational planning and management;
- **respect for diversity** and **respect for the local context** in all curriculum, pedagogy, and policy, always keeping in mind that education is a concurrent subject;
- **full equity and inclusion** as the cornerstone of all educational decisions to ensure that all students are able to thrive in the education system;
- **synergy in curriculum across all levels of education** from early childhood care and education to school education to higher education;
- **teachers and faculty as the heart of the learning process** – their recruitment, continuous professional development, positive working environments and service conditions;

- a **'light but tight' regulatory framework** to ensure **integrity, transparency**, and **resource efficiency** of the educational system through audit and public disclosure while encouraging innovation and out-of-the-box ideas through **autonomy, good governance, and empowerment**;
- **outstanding research** as a corequisite for outstanding education and development;
- **continuous review** of progress based on sustained research and regular assessment by educational experts;

- **a rootedness and pride in India**, and its rich, diverse, ancient and modern culture and knowledge systems and traditions;
- **education is a public service**; access to quality education must be considered a basic right of every child;
- **substantial investment in a strong, vibrant public education system** as well as the encouragement and facilitation of true philanthropic private and community participation.

The Vision of this Policy

This National Education Policy envisions an education system rooted in Indian ethos that contributes directly to transforming India, that is Bharat, sustainably into an equitable and vibrant knowledge society, by providing high-quality education to all, and thereby making India a global knowledge superpower. The Policy envisages that the curriculum and pedagogy of our institutions must develop among the students a deep sense of respect towards the Fundamental Duties and Constitutional values, bonding with one's country, and a conscious awareness of one's roles and responsibilities in a changing world. The vision of the Policy is to instill among the learners a deep-rooted pride in being Indian, not only in thought, but also in spirit, intellect, and deeds, as well as to develop knowledge, skills, values, and dispositions that support responsible commitment to human rights, sustainable development and living, and global well-being, thereby reflecting a truly global citizen.

Part I. SCHOOL EDUCATION

This policy envisages that the extant 10+2 structure in school education will be modified with a new pedagogical and curricular restructuring of 5+3+3+4 covering ages 3-18 as shown in the representative figure and elaborated in detail later under Chapter 4.

Currently, children in the age group of 3-6 are not covered in the 10+2 structure as Class 1 begins at age 6. In the new 5+3+3+4 structure, a strong base of Early Childhood Care and Education (ECCE) from age 3 is also included, which is aimed at promoting better overall learning, development, and well-being.

1. Early Childhood Care and Education: The Foundation of Learning

1.1. Over 85% of a child's cumulative brain development occurs prior to the age of 6, indicating the critical importance of appropriate care and stimulation of the brain in the early years in order to ensure healthy brain development and growth. Presently, quality ECCE is not available to crores of young children, particularly children from socio-economically disadvantaged backgrounds. Strong investment in ECCE has the potential to give all young children such access, enabling them to participate and flourish in the educational system throughout their lives. Universal provisioning of quality early childhood development, care, and education must thus be achieved as soon as possible, and no later than 2030, to ensure that all students entering Grade 1 are school ready.

1.2. ECCE ideally consists of flexible, multi-faceted, multi-level, play-based, activity-based, and inquiry-based learning, comprising of alphabets, languages, numbers, counting, colours, shapes, indoor and outdoor play, puzzles and logical thinking, problem-solving, drawing, painting and other visual art, craft, drama and puppetry, music and movement. It also includes a focus on developing social capacities, sensitivity, good behaviour, courtesy, ethics, personal and public cleanliness, teamwork, and cooperation. The overall aim of ECCE will be to attain optimal outcomes in the domains of: physical and motor development, cognitive development, socio-emotional-ethical development, cultural/artistic development, and the development of communication and early language, literacy, and numeracy.

1.3. A National Curricular and Pedagogical Framework for Early Childhood Care and Education (NCPFECCE) for children up to the age of 8 will be developed by NCERT in two parts, namely, a sub-framework for 0-3 year-olds, and a sub-framework for 3-8 year-olds, aligned with the above guidelines, the latest research on ECCE, and national and international best practices. In particular, the numerous rich local traditions of India developed over millennia in ECCE involving art, stories, poetry, games, songs, and more, will also be suitably incorporated. The framework will serve as a guide both for parents and for early childhood care and education institutions.

1.4. The overarching goal will be to ensure universal access to high-quality ECCE across the country in a phased manner. Special attention and priority will be given to districts and locations that are particularly socio-economically disadvantaged. ECCE shall be delivered through a significantly expanded and strengthened system of early-childhood education institutions consisting of (a) stand-alone Anganwadis; (b) Anganwadis co-located with primary schools; (c) pre-primary schools/sections covering at least age 5 to 6 years co-located with existing primary schools; and (d) stand-alone pre-schools - all of which would recruit workers/teachers specially trained in the curriculum and pedagogy of ECCE.

1.5. For universal access to ECCE, Anganwadi Centres will be strengthened with high-quality infrastructure, play equipment, and well-trained Anganwadi workers/teachers. Every Anganwadi will have a well-ventilated, well-designed, child-friendly and well-constructed building with an enriched learning environment. Children in Anganwadi Centres shall take activity-filled tours - and meet the teachers and students of their local primary schools, in order to make the transition from Anganwadi Centres to primary schools a smooth one. Anganwadis shall be fully integrated into school complexes/clusters, and Anganwadi children, parents, and teachers will be invited to attend and participate in school/school complex programmes and vice versa.

1.6. It is envisaged that prior to the age of 5 every child will move to a "Preparatory Class" or "Balavatika" (that is, before Class 1), which has an ECCE-qualified teacher. The learning in the Preparatory Class shall be based primarily on play-based learning with a focus on developing cognitive, affective, and psychomotor abilities and early literacy and numeracy. The mid-

day meal programme shall also be extended to the Preparatory Classes in primary schools. Health check-ups and growth monitoring that are available in the Anganwadi system shall also be made available to Preparatory Class students of Anganwadi as well as of primary schools.

1.7. To prepare an initial cadre of high-quality ECCE teachers in Anganwadis, current Anganwadi workers/teachers will be trained through a systematic effort in accordance with the curricular/pedagogical framework developed by NCERT. Anganwadi workers/teachers with qualifications of 10+2 and above shall be given a 6-month certificate programme in ECCE; and those with lower educational qualifications shall be given a one-year diploma programme covering early literacy, numeracy, and other relevant aspects of ECCE. These programmes may be run through digital/distance mode using DTH channels as well as smartphones, allowing teachers to acquire ECCE qualifications with minimal disruption to their current work. The ECCE training of Anganwadi workers/teachers will be mentored by the Cluster Resource Centres of the School Education Department which shall hold at least one monthly contact class for continuous assessment. In the longer term, State Governments shall prepare cadres of professionally qualified educators for early childhood care and education, through stage-specific professional training, mentoring mechanisms, and career mapping. Necessary facilities will also be created for the initial professional preparation of these educators and their Continuous Professional Development (CPD).

1.8. ECCE will also be introduced in Ashramshalas in tribal-dominated areas and in all formats of alternative schooling in a phased manner. The process for integration and implementation of ECCE in Ashramshalas and alternative schooling will be similar to that detailed above.

1.9. The responsibility for ECCE curriculum and pedagogy will lie with MHRD to ensure its continuity from pre-primary school through primary school, and to ensure due attention to the foundational aspects of education. The planning and implementation of early childhood care and education curriculum will be carried out jointly by the Ministries of HRD, Women and Child Development (WCD), Health and Family Welfare (HFW), and Tribal Affairs. A special joint task force will be constituted for continuous guidance of the smooth integration of early childhood care and education into school education.

2. Foundational Literacy and Numeracy: An Urgent & Necessary Prerequisite to Learning

2.1. The ability to read and write, and perform basic operations with numbers, is a necessary foundation and an indispensable prerequisite for all future schooling and lifelong learning. However, various governmental, as well as non-governmental surveys, indicate that we are currently in a learning crisis: a large proportion of students currently in elementary school - estimated to be over 5 crore in number - have not attained foundational literacy and numeracy, i.e., the ability to read and comprehend basic text and the ability to carry out basic addition and subtraction with Indian numerals.

2.2. Attaining foundational literacy and numeracy for all children will thus become an urgent national mission, with immediate measures to be taken on many fronts and with clear goals that will be attained in the short term (including that every student will attain foundational literacy and numeracy by Grade 3). The highest priority of the education system will be to achieve universal foundational literacy and numeracy in primary school by 2025. The rest of this Policy will become relevant for our students only if this most basic learning requirement (i.e., reading, writing, and arithmetic at the foundational level) is first achieved. To this end, a National Mission on Foundational Literacy and Numeracy will be set up by the Ministry of Human Resource Development (MHRD) on priority. Accordingly, all State/UT governments will immediately prepare an implementation plan for attaining universal foundational literacy and numeracy in all primary schools, identifying stage-wise targets and goals to be achieved by 2025, and closely tracking and monitoring progress of the same.

2.3. First, teacher vacancies will be filled at the earliest, in a time-bound manner - especially in disadvantaged areas and areas with large pupil-to-teacher ratios or high rates of illiteracy. Special

attention will be given to employing local teachers or those with familiarity with local languages. A pupil-teacher ratio (PTR) of under 30:1 will be ensured at the level of each school; areas having large numbers of socio-economically disadvantaged students will aim for a PTR of under 25:1. Teachers will be trained, encouraged, and supported - with continuous professional development - to impart foundational literacy and numeracy.

2.4. On the curricular side, there will be an increased focus on foundational literacy and numeracy - and generally, on reading, writing, speaking, counting, arithmetic, and mathematical thinking - throughout the preparatory and middle school curriculum, with a robust system of continuous formative/adaptive assessment to track and thereby individualize and ensure each student's learning. Specific hours daily - and regular events over the year-on activities involving these subjects will be dedicated to encourage and enthuse students. Teacher education and the early grade curriculum will be redesigned to have a renewed emphasis on foundational literacy and numeracy.

2.5. Currently, with the lack of universal access to ECCE, a large proportion of children already fall behind within the first few weeks of Grade 1. Thus, to ensure that all students are school ready, an interim 3-month play-based 'school preparation module' for all Grade 1 students, consisting of activities and workbooks around the learning of alphabets, sounds, words, colours, shapes, and numbers, and involving collaborations with peers and parents, will be developed by NCERT and SCERTs.

2.6. A national repository of high-quality resources on foundational literacy and numeracy will be made available on the Digital Infrastructure for Knowledge Sharing (DIKSHA). Technological interventions to serve as aids to teachers and to help bridge any language barriers that may exist between teachers and students, will be piloted and implemented

2.7. Due to the scale of the current learning crisis, all viable methods will be explored to support teachers in the mission of attaining universal foundational literacy and numeracy. Studies around the world show one-on-one peer tutoring to be extremely effective for learning not just for the learner, but also for the tutor. Thus, peer tutoring can be taken up as a voluntary and joyful activity for fellow students under the supervision of trained teachers and by taking due care of safety aspects. Additionally, it will also be made far easier for trained volunteers - from both the local community and beyond - to participate in this large-scale mission. Every literate member of the community could commit to teaching one student/person how to read, it would change the country's landscape very quickly. States may consider establishing innovative models to foster such peer-tutoring and volunteer activities, as well as launch other programmes to support learners, in this nationwide mission to promote foundational literacy and numeracy.

2.8. Enjoyable and inspirational books for students at all levels will be developed, including through high-quality translation (technology assisted as needed) in all local and Indian languages, and will be made available extensively in both school and local public libraries. Public and school libraries will be significantly expanded to build a culture of reading across the country. Digital libraries will also be established. School libraries will be set up - particularly in villages - to serve the community during non-school hours, and book clubs may meet in public/school libraries to further facilitate and promote widespread reading. A National Book Promotion Policy will be formulated, and extensive initiatives will be undertaken to ensure the availability, accessibility, quality, and readership of books across geographies, languages, levels, and genres.

2.9. Children are unable to learn optimally when they are undernourished or unwell. Hence, the nutrition and health (including mental health) of children will be addressed, through healthy meals and the introduction of well-trained social workers, counsellors, and community involvement into the schooling system. Furthermore, research shows that the morning hours after a nutritious breakfast can be particularly productive for the study of cognitively more demanding subjects and hence these hours may be leveraged by providing a simple but energizing breakfast in addition to midday meals. In locations where hot meals are not possible, a simple but nutritious meal, e.g., groundnuts/chana mixed with jaggery and/or local fruits may be provided. All school children shall undergo regular

health check-ups especially for 100% immunization in schools and health cards will be issued to monitor the same.

3. Curtailing Dropout Rates and Ensuring Universal Access to Education at All Levels

3.1. One of the primary goals of the schooling system must be to ensure that children are enrolled in and are attending school. Through initiatives such as the Sarva Shiksha Abhiyan (now the Samagra Shiksha) and the Right to Education Act, India has made remarkable strides in recent years in attaining near-universal enrolment in elementary education. However, the data for later grades indicates some serious issues in retaining children in the schooling system. The GER for Grades 6-8 was 90.9%, while for Grades 9-10 and 11-12 it was only 79.3% and 56.5%, respectively - indicating that a significant proportion of enrolled students drop out after Grade 5 and especially after Grade 8. As per the 75th round household survey by NSSO in 2017-18, the number of out of school children in the age group of 6 to 17 years is 3.22 crore. It will be a top priority to bring these children back into the educational fold as early as possible, and to prevent further students from dropping out, with a goal to achieve 100% Gross Enrolment Ratio in preschool to secondary level by 2030. A concerted national effort will be made to ensure universal access and afford opportunity to all children of the country to obtain quality holistic education–including vocational education - from pre-school to Grade 12.

3.2. There are two overall initiatives that will be undertaken to bring children who have dropped out back to school and to prevent further children from dropping out. The first is to provide effective and sufficient infrastructure so that all students have access to safe and engaging school education at all levels from pre-primary school to Grade 12. Besides providing regular trained teachers at each stage, special care shall be taken to ensure that no school remains deficient on infrastructure support. The credibility of Government schools shall be re-established and this will be attained by upgrading and enlarging the schools that already exist, building additional quality schools in areas where they do not exist, and providing safe and practical conveyances and/or hostels, especially for the girl children, so that all children have the opportunity to attend a quality school and learn at the appropriate level. Alternative and innovative education centres will be put in place in cooperation with civil society to ensure that children of migrant labourers, and other children who are dropping out of school due to various circumstances are brought back into mainstream education.

3.3. The second is to achieve universal participation in school by carefully tracking students, as well as their learning levels, in order to ensure that they (a) are enrolled in and attending school, and (b) have suitable opportunities to catch up and re-enter school in case they have fallen behind or dropped out. For providing equitable and quality education from the Foundational Stage through Grade 12 to all children up to the age of 18, suitable facilitating systems shall be put in place. Counsellors or well-trained social workers connected to schools/school complexes and teachers will continuously work with students and their parents and will travel through and engage with communities to ensure that all school-age children are attending and learning in school. Trained and qualified social workers from civil society organizations/departments of Social Justice and Empowerment and government functionaries dealing with empowerment of Persons with Disabilities at the State and district level, could be connected to schools, through various innovative mechanisms adopted by State/UT Governments, to help in carrying out this important work.

3.4. Once infrastructure and participation are in place, ensuring quality will be the key in retention of students, so that they (particularly, girls and students from other socio-economically disadvantaged groups) do not lose interest in attending school. This will require a system of incentives for deploying teachers with knowledge of the local language to areas with high dropout rates, as well as overhauling the curriculum to make it more engaging and useful.

3.5. To facilitate learning for all students, with special emphasis on Socio-Economically Disadvantaged Groups (SEDGs), the scope of school education will be broadened to facilitate multiple pathways to learning involving both formal and non-formal education modes. Open and Distance Learning (ODL) Programmes offered by the National Institute of Open Schooling (NIOS)

and State Open Schools will be expanded and strengthened for meeting the learning needs of young people in India who are not able to attend a physical school. NIOS and State Open Schools will offer the following programmes in addition to the present programmes: A, B and C levels that are equivalent to Grades 3, 5, and 8 of the formal school system; secondary education programmes that are equivalent to Grades 10 and 12; vocational education courses/programmes; and adult literacy and life-enrichment programmes. States will be encouraged to develop these offerings in regional languages by establishing new/strengthening existing State Institutes of Open Schooling (SIOS).

3.6. To make it easier for both governments as well as non-governmental philanthropic organizations to build schools, to encourage local variations on account of culture, geography, and demographics, and to allow alternative models of education, the requirements for schools will be made less restrictive. The focus will be to have less emphasis on input and greater emphasis on output potential concerning desired learning outcomes. Regulations on inputs will be limited to certain areas as enumerated in Chapter 8. Other models for schools will also be piloted, such as public-philanthropic partnerships.

3.7. Efforts will be made to involve community and alumni in volunteer efforts for enhancing learning by providing at schools: one-on-one tutoring; the teaching of literacy and holding of extra-help sessions; teaching support and guidance for educators; career guidance and mentoring to students; etc. In this regard, the support of active and healthy senior citizens, school alumni and local community members will be suitably garnered. Databases of literate volunteers, retired scientists/government/semi government employees, alumni, and educators will be created for this purpose.

4. Curriculum and Pedagogy in Schools: Learning Should be Holistic, Integrated, Enjoyable, and Engaging

Restructuring school curriculum and pedagogy in a new 5+3+3+4 design

4.1. The curricular and pedagogical structure of school education will be reconfigured to make it responsive and relevant to the developmental needs and interests of learners at different stages of their development, corresponding to the age ranges of 3-8, 8-11, 11-14, and 14-18 years, respectively. The curricular and pedagogical structure and the curricular framework for school education will therefore be guided by a 5+3+3+4 design, consisting of the Foundational Stage (in two parts, that is, 3 years of Anganwadi/pre-school + 2 years in primary school in Grades 1-2; both together covering ages 3-8), Preparatory Stage (Grades 3-5, covering ages 8-11), Middle Stage (Grades 6-8, covering ages 11-14), and Secondary Stage (Grades 9-12 in two phases, i.e., 9 and 10 in the first and 11 and 12 in the second, covering ages 14-18).

4.2. The Foundational Stage will consist of five years of flexible, multilevel, play/activity-based learning and the curriculum and pedagogy of ECCE as mentioned in para 1.2. The Preparatory Stage will comprise three years of education building on the play, discovery, and activity-based pedagogical and curricular style of the Foundational Stage, and will also begin to incorporate some light text books as well as aspects of more formal but interactive classroom learning, in order to lay a solid groundwork across subjects, including reading, writing, speaking, physical education, art, languages, science, and mathematics. The Middle Stage will comprise three years of education, building on the pedagogical and curricular style of the Preparatory Stage, but with the introduction of subject teachers for learning and discussion of the more abstract concepts in each subject that students will be ready for at this stage across the sciences, mathematics, arts, social sciences, and humanities. Experiential learning within each subject, and explorations of relations among different subjects, will be encouraged and emphasized despite the introduction of more specialized subjects and subject teachers. The Secondary Stage will comprise of four years of multidisciplinary study, building on the subject-oriented pedagogical and curricular style of the Middle Stage, but with greater depth, greater critical thinking, greater attention to life aspirations, and greater flexibility and student choice of subjects. In particular students would continue to have the option of exiting after Grade 10

and re-entering in the next phase to pursue vocational or any other courses available in Grades 11-12, including at a more specialized school, if so desired.

4.3. The above-described stages are purely curricular and pedagogical, designed to optimize learning for students based on the cognitive development of children; they will inform the development of National and State curricula and teaching-learning strategies at each stage, but parallel changes to physical infrastructure will not be required.

Holistic development of learners

4.4. The key overall thrust of curriculum and pedagogy reform across all stages will be to move the education system towards real understanding and towards learning how to learn - and away from the culture of rote learning as is largely present today. The aim of education will not only be cognitive development, but also building character and creating holistic and well-rounded individuals equipped with the key 21st century skills. Ultimately, knowledge is a deep-seated treasure and education helps in its manifestation as the perfection which is already within an individual. All aspects of curriculum and pedagogy will be reoriented and revamped to attain these critical goals. Specific sets of skills and values across domains will be identified for integration and incorporation at each stage of learning, from pre-school to higher education. Curriculum frameworks and transaction mechanisms will be developed for ensuring that these skills and values are imbibed through engaging processes of teaching and learning. NCERT will identify these required skill sets and include mechanisms for their transaction in the National Curriculum Framework for early childhood and school education.

Reduce curriculum content to enhance essential learning and critical thinking

4.5. Curriculum content will be reduced in each subject to its core essentials, to make space for critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning. The mandated content will focus on key concepts, ideas, applications, and problem-solving. Teaching and learning will be conducted in a more interactive manner; questions will be encouraged, and classroom sessions will regularly contain more fun, creative, collaborative, and exploratory activities for students for deeper and more experiential learning.

Experiential learning

4.6. In all stages, experiential learning will be adopted, including hands-on learning, arts-integrated and sports-integrated education, story-telling-based pedagogy, among others, as standard pedagogy within each subject, and with explorations of relations among different subjects. To close the gap in achievement of learning outcomes, classroom transactions will shift, towards competency-based learning and education. The assessment tools (including assessment "as", "of", and "for" learning) will also be aligned with the learning outcomes, capabilities, and dispositions as specified for each subject of a given class.

4.7. Art-integration is a cross-curricular pedagogical approach that utilizes various aspects and forms of art and culture as the basis for learning of concepts across subjects. As a part of the thrust on experiential learning, art-integrated education will be embedded in classroom transactions not only for creating joyful classrooms, but also for imbibing the Indian ethos through integration of Indian art and culture in the teaching and learning process at every level. This art-integrated approach will strengthen the linkages between education and culture.

4.8. Sports-integration is another cross-curricular pedagogical approach that utilizes physical activities including indigenous sports, in pedagogical practices to help in developing skills such as collaboration, self-initiative, self-direction, self-discipline, teamwork, responsibility, citizenship, etc. Sports-integrated learning will be undertaken in classroom transactions to help students adopt fitness as a lifelong attitude and to achieve the related life skills along with the levels of fitness as envisaged in the Fit India Movement. The need to integrate sports in education is well recognized as it serves to

foster holistic development by promoting physical and psychological well-being while also enhancing cognitive abilities.

Empower students through flexibility in course choices

4.9. Students will be given increased flexibility and choice of subjects to study, particularly in secondary school - including subjects in physical education, the arts and crafts, and vocational skills – so that they can design their own paths of study and life plans. Holistic development and a wide choice of subjects and courses year to year will be the new distinguishing feature of secondary school education. There will be no hard separation among 'curricular', 'extracurricular', or 'co-curricular', among 'arts', 'humanities', and 'sciences', or between 'vocational' or 'academic' streams. Subjects such as physical education, the arts and crafts, and vocational skills, in addition to science, humanities, and mathematics, will be incorporated throughout the school curriculum, with a consideration for what is interesting and safe at each age.

4.10. Each of the four stages of school education, in accordance with what may be possible in different regions, may consider moving towards a semester or any other system that allows the inclusion of shorter modules, or courses that are taught on alternate days, in order to allow an exposure to more subjects and enable greater flexibility. States may look into innovative methods to achieve these aims of greater flexibility and exposure to and enjoyment of a wider range of subjects, including across the arts, sciences, humanities, languages, sports, and vocational subjects.

Multilingualism and the power of language

4.11. It is well understood that young children learn and grasp nontrivial concepts more quickly in their home language/mother tongue. Home language is usually the same language as the mother tongue or that which is spoken by local communities. However, at times in multi-lingual families, there can be a home language spoken by other family members which may sometimes be different from mother tongue or local language. Wherever possible, the medium of instruction until at least Grade 5, but preferably till Grade 8 and beyond, will be the home language/mother tongue/local language/regional language. Thereafter, the home/local language shall continue to be taught as a language wherever possible. This will be followed by both public and private schools. High-quality textbooks, including in science, will be made available in home languages/mother tongue. All efforts will be made early on to ensure that any gaps that exist between the language spoken by the child and the medium of teaching are bridged. In cases where home language/mother tongue textbook material is not available, the language of transaction between teachers and students will still remain the home language/mother tongue wherever possible. Teachers will be encouraged to use a bilingual approach, including bilingual teaching-learning materials, with those students whose home language may be different from the medium of instruction. All languages will be taught with high quality to all students; a language does not need to be the medium of instruction for it to be taught and learned well.

4.12. As research clearly shows that children pick up languages extremely quickly between the ages of 2 and 8 and that multilingualism has great cognitive benefits to young students, children will be exposed to different languages early on (but with a particular emphasis on the mother tongue), starting from the Foundational Stage onwards. All languages will be taught in an enjoyable and interactive style, with plenty of interactive conversation, and with early reading and subsequently writing in the mother tongue in the early years, and with skills developed for reading and writing in other languages in Grade 3 and beyond. There will be a major effort from both the Central and State governments to invest in large numbers of language teachers in all regional languages around the country, and, in particular, for all languages mentioned in the Eighth Schedule of the Constitution of India. States, especially States from different regions of India, may enter into bilateral agreements to hire teachers in large numbers from each other, to satisfy the three-language formula in their respective States, and also to encourage the study of Indian languages across the country. Extensive use of technology will be made for teaching and learning of different languages and to popularize language learning.

4.13. The three-language formula will continue to be implemented while keeping in mind the Constitutional provisions, aspirations of the people, regions, and the Union, and the need to promote multilingualism as well as promote national unity. However, there will be a greater flexibility in the three-language formula, and no language will be imposed on any State. The three languages learned by children will be the choices of States, regions, and of course the students themselves, so long as at least two of the three languages are native to India. In particular, students who wish to change one or more of the three languages they are studying may do so in Grade 6 or 7, as long as they are able to demonstrate basic proficiency in three languages (including one language of India at the literature level) by the end of secondary school.

4.14. All efforts will be made in preparing high-quality bilingual textbooks and teaching-learning materials for science and mathematics, so that students are enabled to think and speak about the two subjects both in their home language/mother tongue and in English.

4.15. As so many developed countries around the world have amply demonstrated, being well educated in one's language, culture, and traditions is not a detriment but indeed a huge benefit to educational, social, and technological advancement. India's languages are among the richest, most scientific, most beautiful, and most expressive in the world, with a huge body of ancient as well as modern literature (both prose and poetry), film, and music written in these languages that help form India's national identity and wealth. For purposes of cultural enrichment as well as national integration, all young Indians should be aware of the rich and vast array of languages of their country, and the treasures that they and their literatures contain.

4.16. Thus, every student in the country will participate in a fun project/activity on 'The Languages of India', sometime in Grades 6-8, such as, under the *'Ek Bharat Shrestha Bharat'* initiative. In this project/activity, students will learn about the remarkable unity of most of the major Indian languages, starting with their common phonetic and scientifically-arranged alphabets and scripts, their common grammatical structures, their origins and sources of vocabularies from Sanskrit and other classical languages, as well as their rich inter-influences and differences. They will also learn what geographical areas speak which languages, get a sense of the nature and structure of tribal languages, and learn to say commonly spoken phrases and sentences in every major language of India and also learn a bit about the rich and uplifting literature of each (through suitable translations as necessary). Such an activity would give them both a sense of the unity and the beautiful cultural heritage and diversity of India and would be a wonderful icebreaker their whole lives as they meet people from other parts of India. This project/activity would be a joyful activity and would not involve any form of assessment.

4.17. The importance, relevance, and beauty of the classical languages and literature of India also cannot be overlooked. Sanskrit, while also an important modern language mentioned in the Eighth Schedule of the Constitution of India, possesses a classical literature that is greater in volume than that of Latin and Greek put together, containing vast treasures of mathematics, philosophy, grammar, music, politics, medicine, architecture, metallurgy, drama, poetry, storytelling, and more (known as 'Sanskrit Knowledge Systems'), written by people of various religions as well as non-religious people, and by people from all walks of life and a wide range of socio-economic backgrounds over thousands of years. Sanskrit will thus be offered at all levels of school and higher education as an important, enriching option for students, including as an option in the three-language formula. It will be taught in ways that are interesting and experiential as well as contemporarily relevant, including through the use of Sanskrit Knowledge Systems, and in particular through phonetics and pronunciation. Sanskrit textbooks at the foundational and middle school level may be written in Simple Standard Sanskrit (SSS) to teach Sanskrit through Sanskrit (STS) and make its study truly enjoyable.

4.18. India also has an extremely rich literature in other classical languages, including classical Tamil, Telugu, Kannada, Malayalam, Odia. In addition to these classical languages Pali, Persian, and Prakrit; and their works of literature too must be preserved for their richness and for the pleasure and enrichment of posterity. As India becomes a fully developed country, the next generation will want to

partake in and be enriched by India's extensive and beautiful classical literature. In addition to Sanskrit, other classical languages and literatures of India, including Tamil, Telugu, Kannada, Malayalam, Odia, Pali, Persian, and Prakrit, will also be widely available in schools as options for students, possibly as online modules, through experiential and innovative approaches, to ensure that these languages and literature stay alive and vibrant. Similar efforts will be made for all Indian languages having rich oral and written literatures, cultural traditions, and knowledge.

4.19. For the enrichment of the children, and for the preservation of these rich languages and their artistic treasures, all students in all schools, public or private, will have the option of learning at least two years of a classical language of India and its associated literature, through experiential and innovative approaches, including the integration of technology, in Grades 6-12, with the option to continue from the middle stage through the secondary stage and beyond.

4.20. In addition to high quality offerings in Indian languages and English, foreign languages, such as Korean, Japanese, Thai, French, German, Spanish, Portuguese, and Russian, will also be offered at the secondary level, for students to learn about the cultures of the world and to enrich their global knowledge and mobility according to their own interests and aspirations.

4.21. The teaching of all languages will be enhanced through innovative and experiential methods, including through gamification and apps, by weaving in the cultural aspects of the languages - such as films, theatre, storytelling, poetry, and music - and by drawing connections with various relevant subjects and with real-life experiences. Thus, the teaching of languages will also be based on experiential-learning pedagogy.

4.22. Indian Sign Language (ISL) will be standardized across the country, and National and State curriculum materials developed, for use by students with hearing impairment. Local sign languages will be respected and taught as well, where possible and relevant.

Curricular Integration of Essential Subjects, Skills, and Capacities

4.23. While students must have a large amount of flexibility in choosing their individual curricula, certain subjects, skills, and capacities should be learned by all students to become good, successful, innovative, adaptable, and productive human beings in today's rapidly changing world. In addition to proficiency in languages, these skills include: scientific temper and evidence-based thinking; creativity and innovativeness; sense of aesthetics and art; oral and written communication; health and nutrition; physical education, fitness, wellness, and sports; collaboration and teamwork; problem solving and logical reasoning; vocational exposure and skills; digital literacy, coding, and computational thinking; ethical and moral reasoning; knowledge and practice of human and Constitutional values; gender sensitivity; Fundamental Duties; citizenship skills and values; knowledge of India; environmental awareness including water and resource conservation, sanitation and hygiene; and current affairs and knowledge of critical issues facing local communities, States, the country, and the world.

4.24. Concerted curricular and pedagogical initiatives, including the introduction of contemporary subjects such as Artificial Intelligence, Design Thinking, Holistic Health, Organic Living, Environmental Education, Global Citizenship Education (GCED), etc. at relevant stages will be undertaken to develop these various important skills in students at all levels.

4.25. It is recognized that mathematics and mathematical thinking will be very important for India's future and India's leadership role in the numerous upcoming fields and professions that will involve artificial intelligence, machine learning, and data science, etc. Thus, mathematics and computational thinking will be given increased emphasis throughout the school years, starting with the foundational stage, through a variety of innovative methods, including the regular use of puzzles and games that make mathematical thinking more enjoyable and engaging. Activities involving coding will be introduced in Middle Stage.

4.26. Every student will take a fun course, during Grades 6-8, that gives a survey and hands-on experience of a sampling of important vocational crafts, such as carpentry, electric work, metal work, gardening, pottery making, etc., as decided by States and local communities and as mapped by local skilling needs. A practice-based curriculum for Grades 6-8 will be appropriately designed by NCERT while framing the NCFSE 2020-21. All students will participate in a 10-day bagless period sometime during Grades 6-8 where they intern with local vocational experts such as carpenters, gardeners, potters, artists, etc. Similar internship opportunities to learn vocational subjects may be made available to students throughout Grades 6-12, including holiday periods. Vocational courses through online mode will also be made available. Bagless days will be encouraged throughout the year for various types of enrichment activities involving arts, quizzes, sports, and vocational crafts. Children will be given periodic exposure to activities outside school through visits to places/monuments of historical, cultural and tourist importance, meeting local artists and craftsmen and visits higher educational institutions in their village/Tehsil/District/State.

4.27. "Knowledge of India" will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India's future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation. Specific courses in tribal ethno-medicinal practices, forest management, traditional (organic) crop cultivation, natural farming, etc. will also be made available. An engaging course on Indian Knowledge Systems will also be available to students in secondary school as an elective. Competitions may be held in schools for learning various topics and subjects through fun and indigenous games. Video documentaries on inspirational luminaries of India, ancient and modern, in science and beyond, will be shown at appropriate points throughout the school curriculum. Students will be encouraged to visit different States as part of cultural exchange programmes.

4.28. Students will be taught at a young age the importance of "doing what's right", and will be given a logical framework for making ethical decisions. In later years, this would then be expanded along themes of cheating, violence, plagiarism, littering, tolerance, equality, empathy, etc., with a view to enabling children to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. As consequences of such basic ethical reasoning, traditional Indian values and all basic human and Constitutional values (such as *seva, ahimsa, swachchhata, satya, nishkam karma, shanti*, sacrifice, tolerance, diversity, pluralism, righteous conduct, gender sensitivity, respect for elders, respect for all people and their inherent capabilities regardless of background, respect for environment, helpfulness, courtesy, patience, forgiveness, empathy, compassion, patriotism, democratic outlook, integrity, responsibility, justice, liberty, equality, and fraternity) will be developed in all students. Children will have the opportunity to read and learn from the original stories of the Panchatantra, Jataka, Hitopadesh, and other fun fables and inspiring tales from the Indian tradition and learn about their influences on global literature. Excerpts from the Indian Constitution will also be considered essential reading for all students. Basic training in health, including preventive health, mental health, good nutrition, personal and public hygiene, disaster response and first-aid will also be included in the curriculum, as well as scientific explanations of the detrimental and damaging effects of alcohol, tobacco, and other drugs.

4.29. All curriculum and pedagogy, from the foundational stage onwards, will be redesigned to be strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language, philosophy, geography, ancient and contemporary knowledge, societal and scientific needs, indigenous and traditional ways of learning etc. – in order to ensure that education is maximally relatable, relevant, interesting, and effective for our students. Stories, arts, games, sports, examples, problems, etc. will be chosen as much as possible to be rooted in the Indian and local geographic context. Ideas, abstractions, and creativity will indeed best flourish when learning is thus rooted.

National Curriculum Framework for School Education (NCFSE)

4.30. The formulation of a new and comprehensive National Curricular Framework for School Education, NCFSE 2020-21, will be undertaken by the NCERT - based on the principles of this National Education Policy 2020, frontline curriculum needs, and after discussions with all stakeholders including State Governments, Ministries, relevant Departments of the Central Government, and other expert bodies, and will be made available in all regional languages. The NCFSE document shall henceforth be revisited and updated once every 5-10 years, taking into account frontline curriculum.

National Textbooks with Local Content and Flavour

4.31. The reduction in content and increased flexibility of school curriculum - and the renewed emphasis on constructive rather than rote learning - must be accompanied by parallel changes in school textbooks. All textbooks shall aim to contain the essential core material (together with discussion, analysis, examples, and applications) deemed important on a national level, but at the same time contain any desired nuances and supplementary material as per local contexts and needs. Where possible, schools and teachers will also have choices in the textbooks they employ - from among a set of textbooks that contain the requisite national and local material - so that they may teach in a manner that is best suited to their own pedagogical styles as well as to their students and communities' needs.

4.32. The aim will be to provide such quality textbooks at the lowest possible cost -namely, at the cost of production/printing - in order to mitigate the burden of textbook prices on the students and on the educational system. This may be accomplished by using high-quality textbook materials developed by NCERT in conjunction with the SCERTs; additional textbook materials could be funded by public-philanthropic partnerships and crowd sourcing that incentivize experts to write such high-quality textbooks at cost price. States will prepare their own curricula (which may be based on the NCFSE prepared by NCERT to the extent possible) and prepare textbooks (which may be based on the NCERT textbook materials to the extent possible), incorporating State flavour and material as needed. While doing so, it must be borne in mind that NCERT curriculum would be taken as the nationally acceptable criterion. The availability of such textbooks in all regional languages will be a top priority so that all students have access to high-quality learning. All efforts will be made to ensure timely availability of textbooks in schools. Access to downloadable and printable versions of all textbooks will be provided by all States/UTs and NCERT to help conserve the environment and reduce the logistical burden.

4.33. Concerted efforts, through suitable changes in curriculum and pedagogy, will be made by NCERT, SCERTs, schools, and educators to significantly reduce the weight of school bags and textbooks.

Transforming Assessment for Student Development

4.34. The aim of assessment in the culture of our schooling system will shift from one that is summative and primarily tests rote memorization skills to one that is more regular and formative, is more competency-based, promotes learning and development for our students, and tests higher-order skills, such as analysis, critical thinking, and conceptual clarity. The primary purpose of assessment will indeed be for learning; it will help the teacher and student, and the entire schooling system, continuously revise teaching-learning processes to optimize learning and development for all students. This will be the underlying principle for assessment at all levels of education.

4.35. The progress card of all students for school-based assessment, which is communicated by schools to parents, will be completely redesigned by States/UTs under guidance from the proposed National Assessment Centre, NCERT, and SCERTs. The progress card will be a holistic, 360-degree, multidimensional report that reflects in great detail the progress as well as the uniqueness of each

learner in the cognitive, affective, and psychomotor domains. It will include self-assessment and peer assessment, and progress of the child in project-based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment. The holistic progress card will form an important link between home and school and will be accompanied by parent-teacher meetings in order to actively involve parents in their children's holistic education and development. The progress card would also provide teachers and parents with valuable information on how to support each student in and out of the classroom. AI-based software could be developed and used by students to help track their growth through their school years based on learning data and interactive questionnaires for parents, students, and teachers, in order to provide students with valuable information on their strengths, areas of interest, and needed areas of focus, and to thereby help them make optimal career choices.

4.36. The current nature of secondary school exams, including Board exams and entrance exams - and the resulting coaching culture of today - are doing much harm, especially at the secondary school level, replacing valuable time for true learning with excessive exam coaching and preparation. These exams also force students to learn a very narrow band of material in a single stream, rather than allowing the flexibility and choice that will be so important in the education system of the future.

4.37. While the Board exams for Grades 10 and 12 will be continued, the existing system of Board and entrance examinations shall be reformed to eliminate the need for undertaking coaching classes. To reverse these harmful effects of the current assessment system, Board exams will be redesigned to encourage holistic development; students will be able to choose many of the subjects in which they take Board exams, depending on their individualized interests. Board exams will also be made 'easier', in the sense that they will test primarily core capacities/competencies rather than months of coaching and memorization; any student who has been going to and making a basic effort in a school class will be able to pass and do well in the corresponding subject Board Exam without much additional effort. To further eliminate the 'high stakes' aspect of Board Exams, all students will be allowed to take Board Exams on up to two occasions during any given school year, one main examination and one for improvement, if desired.

4.38. In addition to introducing greater flexibility, student choice, and best-of-two attempts, assessments that primarily test core capacities must be the immediate key reforms to all Board exams. Boards may over time also develop further viable models of Board Exams that reduce pressure and the coaching culture. Some possibilities include: a system of annual/semester/modular Board Exams could be developed - that each test far less material, and are taken immediately after the corresponding course is taken in school - so that the pressure from exams is better distributed, less intense, and less high-stakes across the Secondary Stage; all subjects and corresponding assessments, beginning with mathematics, could be offered at two levels, with students doing some of their subjects at the standard level and some at a higher level; and Board exams in certain subjects could be redesigned to have two parts – one part of an objective type with multiple-choice questions and the other of a descriptive type.

4.39. With regard to all of the above, guidelines will be prepared by NCERT, in consultation with major stakeholders, such as SCERTs, Boards of Assessment (BoAs), the proposed new National Assessment Centre etc., and teachers prepared, for a transformation in the assessment system by the 2022-23 academic session, to align with the NCFSE 2020-21.

4.40. To track progress throughout the school years, and not just at the end of Grades 10 and 12 - for the benefit of students, parents, teachers, principals, and the entire schooling system in planning improvements to schools and teaching-learning processes - all students will take school examinations in Grades 3, 5, and 8 which will be conducted by the appropriate authority. These examinations would test achievement of basic learning outcomes, through assessment of core concepts and knowledge from the national and local curricula, along with relevant higher-order skills and application of knowledge in real-life situations, rather than rote memorization. The Grade 3 examination, in particular, would test basic literacy, numeracy, and other foundational skills. The results of school examinations will be used only for developmental purposes of the school education

system, including for public disclosure by schools of their overall (anonymized) student outcomes, and for continuous monitoring and improvement of the schooling system.

4.41. It is proposed to set up a National Assessment Centre, PARAKH (Performance Assessment, Review, and Analysis of Knowledge for Holistic Development), as a standard-setting body under MHRD that fulfils the basic objectives of setting norms, standards, and guidelines for student assessment and evaluation for all recognized school boards of India, guiding the State Achievement Survey (SAS) and undertaking the National Achievement Survey (NAS), monitoring achievement of learning outcomes in the country, and encouraging and helping school boards to shift their assessment patterns towards meeting the skill requirements of the 21st century in consonance with the stated objectives of this Policy. This Centre will also advise school boards regarding new assessment patterns and latest researches, promote collaborations between school boards. It will also become an instrument for the sharing of best practices among school boards, and for ensuring equivalence of academic standards among learners across all school boards.

4.42. The principles for university entrance exams will be similar. The National Testing Agency (NTA) will work to offer a high-quality common aptitude test, as well as specialized common subject exams in the sciences, humanities, languages, arts, and vocational subjects, at least twice every year. These exams shall test conceptual understanding and the ability to apply knowledge and shall aim to eliminate the need for taking coaching for these exams. Students will be able to choose the subjects for taking the test, and each university will be able to see each student's individual subject portfolio and admit students into their programmes based on individual interests and talents. The NTA will serve as a premier, expert, autonomous testing organization to conduct entrance examinations for undergraduate and graduate admissions and fellowships in higher education institutions. The high quality, range, and flexibility of the NTA testing services will enable most universities to use these common entrance exams - rather than having hundreds of universities each devising their own entrance exams - thereby drastically reducing the burden on students, universities and colleges, and the entire education system. It will be left up to individual universities and colleges to use NTA assessments for their admissions.

Support for Gifted Students/Students with Special Talents

4.43. There are innate talents in every student, which must be discovered, nurtured, fostered, and developed. These talents may express themselves in the form of varying interests, dispositions, and capacities. Those students that show particularly strong interests and capacities in a given realm must be encouraged to pursue that realm beyond the general school curriculum. Teacher education will include methods for the recognition and fostering of such student talents and interests. The NCERT and NCTE will develop guidelines for the education of gifted children. B.Ed. programmes may also allow a specialization in the education of gifted children.

4.44. Teachers will aim to encourage students with singular interests and/or talents in the classroom by giving them supplementary enrichment material and guidance and encouragement. Topic-centered and Project-based Clubs and Circles will be encouraged and supported at the levels of schools, school complexes, districts, and beyond. Examples include Science Circles, Math Circles, Music & Dance Performance Circles, Chess Circles, Poetry Circles, Language Circles, Drama Circles, Debate Circles, Sports Circles, Eco-Clubs, Health & Well-being Clubs/ Yoga Clubs and so on. Along these lines, high-quality national residential summer programmes for secondary school students in various subjects will also be encouraged, with a rigorous merit-based but equitable admission process to attract the very best students and teachers from across the country including from socio-economically disadvantaged groups.

4.45. Olympiads and competitions in various subjects will be conducted across the country, with clear coordination and progression from school to local to state to national levels, to ensure that all students may participate at all levels for which they qualify. Efforts will be made to make these available in rural areas and in regional languages to ensure widespread participation. Public and private universities, including premier institutions like the IITs and NITs, would be encouraged to use merit-

based results from National, and International Olympiads, and results from other relevant national programmes, as part of the criteria for admissions into their undergraduate programmes.

4.46. Once internet-connected smart phones or tablets are available in all homes and/or schools, online apps with quizzes, competitions, assessments, enrichment materials, and online communities for shared interests will be developed, and will work to enhance all the aforementioned initiatives, as group activities for students with appropriate supervision of parents and teachers. Schools will develop smart classrooms, in a phased manner, for using digital pedagogy and thereby enriching the teaching-learning process with online resources and collaborations.

5. Teachers

5.1. Teachers truly shape the future of our children - and, therefore, the future of our nation. It is because of this noblest role that the teacher in India was the most respected member of society. Only the very best and most learned became teachers. Society gave teachers, or gurus, what they needed to pass on their knowledge, skills, and ethics optimally to students. The quality of teacher education, recruitment, deployment, service conditions, and empowerment of teachers is not where it should be, and consequently the quality and motivation of teachers does not reach the desired standards. The high respect for teachers and the high status of the teaching profession must be restored so as to inspire the best to enter the teaching profession. The motivation and empowerment of teachers is required to ensure the best possible future for our children and our nation.

Recruitment and Deployment

5.2. To ensure that outstanding students enter the teaching profession - especially from rural areas - a large number of merit-based scholarships shall be instituted across the country for studying quality 4-year integrated B.Ed. programmes. In rural areas, special merit-based scholarships will be established that also include preferential employment in their local areas upon successful completion of their B.Ed. programmes. Such scholarships will provide local job opportunities to local students, especially female students, so that these students serve as local-area role models and as highly qualified teachers who speak the local language. Incentives will be provided for teachers to take up teaching jobs in rural areas, especially in areas that are currently facing acute shortage of quality teachers. A key incentive for teaching in rural schools will be the provision of local housing near or on the school premises or increased housing allowances.

5.3. The harmful practice of excessive teacher transfers will be halted, so that students have continuity in their role models and educational environments. Transfers will occur in very special circumstances, as suitably laid down in a structured manner by State/UT governments. Furthermore, transfers will be conducted through an online computerized system that ensures transparency.

5.4. Teacher Eligibility Tests (TETs) will be strengthened to inculcate better test material, both in terms of content and pedagogy. The TETs will also be extended to cover teachers across all stages (Foundational, Preparatory, Middle and Secondary) of school education. For subject teachers, suitable TET or NTA test scores in the corresponding subjects will also be taken into account for recruitment. To gauge passion and motivation for teaching, a classroom demonstration or interview will become an integral part of teacher hiring at schools and school complexes. These interviews would also be used to assess comfort and proficiency in teaching in the local language, so that every school/school complex has at least some teachers who can converse with students in the local language and other prevalent home languages of students. Teachers in private schools also must have qualified similarly through TET, a demonstration/interview, and knowledge of local language(s).

5.5. To ensure an adequate number of teachers across subjects - particularly in subjects such as art, physical education, vocational education, and languages - teachers could be recruited to a school or school complex and the sharing of teachers across schools could be considered in accordance with the grouping-of-schools adopted by State/UT governments.

5.6. Schools/school complexes will be encouraged to hire local eminent persons or experts as 'master instructors' in various subjects, such as in traditional local arts, vocational crafts, entrepreneurship, agriculture, or any other subject where local expertise exists, to benefit students and help preserve and promote local knowledge and professions.

5.7. A technology-based comprehensive teacher-requirement planning forecasting exercise will be conducted by each State to assess expected subject-wise teacher vacancies over the next two decades. The above described initiatives in recruitment and deployment will be scaled as needed over time, to fill all vacancies with qualified teachers, including local teachers, with suitable incentives for career management and progression as described below. Teacher education programmes and offerings will also align with the vacancies thus projected.

Service Environment and Culture

5.8. The primary goal of overhauling the service environment and culture of schools will be to maximize the ability of teachers to do their jobs effectively, and to ensure that they are part of vibrant, caring, and inclusive communities of teachers, students, parents, principals, and other support staff, all of whom share a common goal: to ensure that our children are learning.

5.9. The first requirement in this direction will be to ensure decent and pleasant service conditions at schools. Adequate and safe infrastructure, including working toilets, clean drinking water, clean and attractive spaces, electricity, computing devices, internet, libraries, and sports and recreational resources will be provided to all schools to ensure that teachers and students, including children of all genders and children with disabilities, receive a safe, inclusive, and effective learning environment and are comfortable and inspired to teach and learn in their schools. In-service training will have inputs on safety, health and environment at workplace in schools to ensure that all teachers are sensitized to these requirements.

5.10. State/UT Governments may adopt innovative formats, such as school complex, rationalization of schools, without in any way reducing accessibility, for effective school governance, resource sharing, and community building. The creation of school complexes could go a long way towards building vibrant teacher communities. The hiring of teachers to school complexes could automatically create relationships among schools across the school complex; it would also help ensure excellent subject-wise distribution of teachers, creating a more vibrant teacher knowledge base. Teachers at very small schools will not remain isolated any longer and may become part of and work with larger school complex communities, sharing best practices with each other and working collaboratively to ensure that all children are learning. School complexes could also share counsellors, trained social workers, technical and maintenance staff, etc. to further support teachers and help create an effective learning environment.

5.11. In collaboration with parents and other key local stakeholders, teachers will also be more involved in the governance of schools/school complexes, including as members of the School Management Committees/School Complex Management Committees.

5.12. To prevent the large amounts of time spent currently by teachers on non-teaching activities, teachers will not be engaged any longer in work that is not directly related to teaching; in particular, teachers will not be involved in strenuous administrative tasks and more than a rationalized minimum time for mid-day meal related work, so that they may fully concentrate on their teaching-learning duties.

5.13. To help ensure that schools have positive learning environments, the role expectations of principals and teachers will explicitly include developing a caring and inclusive culture at their schools, for effective learning and the benefit of all stakeholders.

5.14. Teachers will be given more autonomy in choosing aspects of pedagogy, so that they may teach in the manner they find most effective for the students in their classrooms. Teachers will also focus

on socio-emotional learning - a critical aspect of any student's holistic development. Teachers will be recognized for novel approaches to teaching that improve learning outcomes in their classrooms.

Continuous Professional Development (CPD)

5.15. Teachers will be given continuous opportunities for self-improvement and to learn the latest innovations and advances in their professions. These will be offered in multiple modes, including in the form of local, regional, state, national, and international workshops as well as online teacher development modules. Platforms (especially online platforms) will be developed so that teachers may share ideas and best practices. Each teacher will be expected to participate in at least 50 hours of CPD opportunities every year for their own professional development, driven by their own interests. CPD opportunities will, in particular, systematically cover the latest pedagogies regarding foundational literacy and numeracy, formative and adaptive assessment of learning outcomes, competency-based learning, and related pedagogies, such as experiential learning, arts-integrated, sports-integrated, and storytelling-based approaches, etc.

5.16. School Principals and school complex leaders will have similar modular leadership/management workshops and online development opportunities and platforms to continuously improve their own leadership and management skills, and so that they too may share best practices with each other. Such leaders will also be expected to participate in 50 hours or more of CPD modules per year, covering leadership and management, as well as content and pedagogy with a focus on preparing and implementing pedagogical plans based on competency-based education.

Career Management and Progression (CMP)

5.17. Teachers doing outstanding work must be recognized and promoted, and given salary raises, to incentivize all teachers to do their best work. Therefore, a robust merit-based structure of tenure, promotion, and salary structure will be developed, with multiple levels within each teacher stage, that incentivizes and recognizes outstanding teachers. A system of multiple parameters for proper assessment of performance will be developed for the same by State/UT Governments that is based on peer reviews, attendance, commitment, hours of CPD, and other forms of service to the school and the community or based on NPST given in Para 5.20. In this Policy, in the context of careers, 'tenure' refers to confirmation for permanent employment, after due assessment of performance and contribution, while 'tenure track' refers to the period of probation preceding tenure.

5.18. Further, it will be ensured that career growth (in terms of tenure, promotions, salary increases, etc.) is available to teachers within a single school stage (i.e., Foundational, Preparatory, Middle, or Secondary), and that there is no career progression-related incentive to move from being teachers in early stages to later stages or vice versa (though such career moves across stages will be allowed, provided the teacher has the desire and qualifications for such a move). This is to support the fact that all stages of school education will require the highest-quality teachers, and no stage will be considered more important than any other.

5.19. Vertical mobility of teachers based on merit will also be paramount; outstanding teachers with demonstrated leadership and management skills would be trained over time to take on academic leadership positions in schools, school complexes, BRCs, CRCs, BITEs, DIETs as well as relevant government departments.

Professional Standards for Teachers

5.20. A common guiding set of National Professional Standards for Teachers (NPST) will be developed by 2022, by the National Council for Teacher Education in its restructured new form as a Professional Standard Setting Body (PSSB) under the General Education Council (GEC), in consultation with NCERT, SCERTs, teachers from across levels and regions, expert organizations in teacher preparation and development, expert bodies in vocational education, and higher education institutions. The standards would cover expectations of the role of the teacher at different levels of expertise/stage, and the competencies required for that stage. It will also comprise standards for

performance appraisal, for each stage, that would be carried out on a periodic basis. The NPST will also inform the design of pre-service teacher education programmes. This could be then adopted by States and determine all aspects of teacher career management, including tenure, professional development efforts, salary increases, promotions, and other recognitions. Promotions and salary increases will not occur based on the length of tenure or seniority, but only on the basis of such appraisal. The professional standards will be reviewed and revised in 2030, and thereafter every ten years, on the basis of rigorous empirical analysis of the efficacy of the system.

Special educators

5.21. There is an urgent need for additional special educators for certain areas of school education. Some examples of such specialist requirements include subject teaching for children with disabilities/*Divyang* children at the Middle and Secondary school level, including teaching for specific learning disabilities. Such teachers would require not only subject-teaching knowledge and understanding of subject-related aims of education, but also the relevant skills for understanding of special requirements of children. Therefore, such areas could be developed as secondary specializations for subject teachers or generalist teachers, during or after pre-service teacher preparation. They will be offered as certificate courses, in the pre-service as well as in-service mode, either full time or as part-time/blended courses - again, necessarily, at multidisciplinary colleges or universities. Greater synergy will be enabled between the course curriculum of NCTE and RCI to ensure adequate availability of qualified special educators who can handle subject teaching as well.

Approach to Teacher Education

5.22. Recognizing that the teachers will require training in high-quality content as well as pedagogy, teacher education will gradually be moved by 2030 into multidisciplinary colleges and universities. As colleges and universities all move towards becoming multidisciplinary, they will also aim to house outstanding education departments that offer B.Ed., M.Ed., and Ph.D. degrees in education.

5.23. By 2030, the minimum degree qualification for teaching will be a 4-year integrated B.Ed. degree that teaches a range of knowledge content and pedagogy and includes strong practicum training in the form of student-teaching at local schools. The 2-year B.Ed. programmes will also be offered, by the same multidisciplinary institutions offering the 4-year integrated B.Ed., and will be intended only for those who have already obtained Bachelor's Degrees in other specialized subjects. These B.Ed. programmes may also be suitably adapted as 1-year B.Ed. programmes, and will be offered only to those who have completed the equivalent of 4-year multidisciplinary Bachelor's Degrees or who have obtained a Master's degree in a specialty and wish to become a subject teacher in that specialty. All such B.Ed. degrees would be offered only by accredited multidisciplinary higher education institutions offering 4-year integrated B.Ed. programmes. Multidisciplinary higher education institutions offering the 4-year in-class integrated B.Ed. programme and having accreditation for ODL may also offer high-quality B.Ed. programmes in blended or ODL mode to students in remote or difficult-to-access locations and also to in-service teachers who are aiming to enhance their qualification, with suitable robust arrangements for mentoring and for the practicum-training and student-teaching components of the programme.

5.24. All B.Ed. programmes will include training in time-tested as well as the most recent techniques in pedagogy, including pedagogy with respect to foundational literacy and numeracy, multi-level teaching and evaluation, teaching children with disabilities, teaching children with special interests or talents, use of educational technology, and learner-centered and collaborative learning. All B.Ed. programmes will include strong practicum training in the form of in-classroom teaching at local schools. All B.Ed. programmes will also emphasize the practice of the Fundamental Duties (Article 51A) of the Indian Constitution along with other Constitutional provisions while teaching any subject or performing any activity. It will also appropriately integrate environmental awareness and sensitivity towards its conservation and sustainable development, so that environment education becomes an integral part of school curricula.

5.25. Special shorter local teacher education programmes will also be available at BITEs, DIETs, or at school complexes themselves for eminent local persons who can be hired to teach at schools or school complexes as 'master instructors', for the purpose of promoting local professions, knowledge, and skills, e.g., local art, music, agriculture, business, sports, carpentry, and other vocational crafts.

5.26. Shorter post-B.Ed. certification courses will also be made widely available, at multidisciplinary colleges and universities, to teachers who may wish to move into more specialized areas of teaching, such as the teaching of students with disabilities, or into leadership and management positions in the schooling system, or to move from one stage to another between foundational, preparatory, middle, and secondary stages.

5.27. It is recognized that there may be several pedagogical approaches internationally for teaching particular subjects; NCERT will study, research, document, and compile the varied international pedagogical approaches for teaching different subjects and make recommendations on what can be learnt and assimilated from these approaches into the pedagogies being practiced in India.

5.28. By 2021, a new and comprehensive National Curriculum Framework for Teacher Education, NCFTE 2021, will be formulated by the NCTE in consultation with NCERT, based on the principles of this National Education Policy 2020. The framework will be developed after discussions with all stakeholders including State Governments, relevant Ministries/Departments of Central Government and various expert bodies, and will be made available in all regional languages. The NCFTE 2021 will also factor in the requirements of teacher education curricula for vocational education. The NCFTE will thereafter be revised once every 5-10 years by reflecting the changes in revised NCFs as well as emerging needs in teacher education.

5.29. Finally, in order to fully restore the integrity of the teacher education system, stringent action will be taken against substandard stand-alone Teacher Education Institutions (TEIs) running in the country, including shutting them down, if required.

6. Equitable and Inclusive Education: Learning for All

6.1. Education is the single greatest tool for achieving social justice and equality. Inclusive and equitable education - while indeed an essential goal in its own right - is also critical to achieving an inclusive and equitable society in which every citizen has the opportunity to dream, thrive, and contribute to the nation. The education system must aim to benefit India's children so that no child loses any opportunity to learn and excel because of circumstances of birth or background. This Policy reaffirms that bridging the social category gaps in access, participation, and learning outcomes in school education will continue to be one of the major goals of all education sector development programmes. This Chapter may be read in conjunction with Chapter 14 which discusses analogous issues of Equity and Inclusion in Higher Education.

6.2. While the Indian education system and successive government policies have made steady progress towards bridging gender and social category gaps in all levels of school education, large disparities still remain - especially at the secondary level - particularly for socio-economically disadvantaged groups that have been historically underrepresented in education. Socio-Economically Disadvantaged Groups (SEDGs) can be broadly categorized based on gender identities (particularly female and transgender individuals), socio-cultural identities (such as Scheduled Castes, Scheduled Tribes, OBCs, and minorities), geographical identities (such as students from villages, small towns, and aspirational districts), disabilities (including learning disabilities), and socio-economic conditions (such as migrant communities, low income households, children in vulnerable situations, victims of or children of victims of trafficking, orphans including child beggars in urban areas, and the urban poor). While overall enrolments in schools decline steadily from Grade 1 to Grade 12, this decline in enrolments is significantly more pronounced for many of these SEDGs, with even greater declines for female students within each of these SEDGs and often even steeper in higher education. A brief status overview of the SEDGs that come within socio-cultural identities is given in following sub-sections.

6.2.1. According to U-DISE 2016-17 data, about 19.6% of students belong to Scheduled Castes at the primary level, but this fraction falls to 17.3% at the higher secondary level. These enrolment drop-offs are more severe for Scheduled Tribes students (10.6% to 6.8%), and differently-abled children (1.1% to 0.25%), with even greater declines for female students within each of these categories. The decline in enrolment in higher education is even steeper.

6.2.2. A multiplicity of factors, including lack of access to quality schools, poverty, social mores & customs, and language have had a detrimental effect on rates of enrolment and retention among the Scheduled Castes. Bridging these gaps in access, participation, and learning outcomes of children belonging to Scheduled Castes will continue to be one of the major goals. Also, the Other Backward Classes (OBCs) which have been identified on the basis of historically being socially and educationally backward also need special focus.

6.2.3. Tribal communities and children from Scheduled Tribes also face disadvantages at multiple levels due to various historical and geographical factors. Children from tribal communities often find their school education irrelevant and foreign to their lives, both culturally and academically. While several programmatic interventions to uplift children from tribal communities are currently in place, and will continue to be pursued, special mechanisms need to be made to ensure that children belonging to tribal communities receive the benefits of these interventions.

6.2.4. Minorities are also relatively underrepresented in school and higher education. The Policy acknowledges the importance of interventions to promote education of children belonging to all minority communities, and particularly those communities that are educationally underrepresented.

6.2.5. The Policy also recognizes the importance of creating enabling mechanisms for providing Children With Special Needs (CWSN) or *Divyang*, the same opportunities of obtaining quality education as any other child.

6.2.6. Separate strategies will be formulated for focused attention on reducing the social category gaps in school education as outlined in the following sub-sections.

6.3. The critical problems and recommendations regarding ECCE, foundational literacy and numeracy, access, enrolment and attendance discussed in Chapters 1–3, are particularly relevant and important for underrepresented and disadvantaged groups. Therefore, the measures from Chapters 1–3 will be targeted in a concerted way for SEDGs.

6.4. In addition, there have been various successful policies and schemes such as targeted scholarships, conditional cash transfers to incentivize parents to send their children to school, providing bicycles for transport, etc., that have significantly increased participation of SEDGs in the schooling system in certain areas. These successful policies and schemes must be significantly strengthened across the country.

6.5. It will also be essential to take into account research that ascertains which measures are particularly effective for certain SEDGs. For example, providing bicycles and organizing cycling and walking groups to provide access to school have been shown to be particularly powerful methods in increasing participation of female students - even at lesser distances - because of the safety benefits and comfort to parents that they provide. One-on-one teachers and tutors, peer tutoring, open schooling, appropriate infrastructure, and suitable technological interventions to ensure access can be particularly effective for certain children with disabilities. Schools providing quality ECCE reap the greatest dividends for children who come from families that are economically disadvantaged. Meanwhile, counsellors and/or well-trained social workers that work with and connect with students, parents, schools, and teachers in order to improve attendance and learning outcomes have been found to be especially effective for children in urban poor areas.

6.6. Data shows that certain geographical areas contain significantly larger proportions of SEDGs. Also, there are geographical locations that have been identified as Aspirational Districts which require special interventions for promoting their educational development. Hence, it is recommended that regions of the country with large populations from educationally-disadvantaged SEDGs should be declared Special Education Zones (SEZs), where all the schemes and policies are implemented to the maximum through additional concerted efforts, in order to truly change their educational landscape.

6.7. It must be noted that women cut across all underrepresented groups, making up about half of all SEDGs. Unfortunately, the exclusion and inequity that SEDGs face is only amplified for the women in these SEDGs. The policy additionally recognizes the special and critical role that women play in society and in shaping social mores; therefore, providing a quality education to girls is the best way to increase the education levels for these SEDGs, not just in the present but also in future generations. The policy thus recommends that the policies and schemes designed to include students from SEDGs should be especially targeted towards girls in these SEDGs.

6.8. In addition, the Government of India will constitute a 'Gender-Inclusion Fund' to build the nation's capacity to provide equitable quality education for all girls as well as transgender students. The fund will be available to States to implement priorities determined by the Central government critical for assisting female and transgender children in gaining access to education (such as the provisions of sanitation and toilets, bicycles, conditional cash transfers, etc.); funds will also enable States to support and scale effective community-based interventions that address local context-specific barriers to female and transgender children's access to and participation in education. Similar 'Inclusion Fund' schemes shall also be developed to address analogous access issues for other SEDGs. In essence, this Policy aims to eliminate any remaining disparity in access to education (including vocational education) for children from any gender or other socio-economically disadvantaged group.

6.9. Free boarding facilities will be built - matching the standard of Jawahar Navodaya Vidyalayas - in school locations where students may have to come from far, and particularly for students who from socio-economically disadvantaged backgrounds, with suitable arrangements for the safety of all children, especially girls. Kasturba Gandhi Balika Vidyalayas will be strengthened and expanded to increase the participation in quality schools (up to Grade 12) of girls from socio-economically disadvantaged backgrounds. Additional Jawahar Navodaya Vidyalayas and Kendriya Vidyalayas will be built around the country, especially in aspirational districts, Special Education Zones, and other disadvantaged areas, to increase high-quality educational opportunities. Pre-school sections covering at least one year of early childhood care and education will be added to Kendriya Vidyalayas and other primary schools around the nation, particularly in disadvantaged areas.

6.10. Ensuring the inclusion and equal participation of children with disabilities in ECCE and the schooling system will also be accorded the highest priority. Children with disabilities will be enabled to fully participate in the regular schooling process from the Foundational Stage to higher education. The Rights of Persons with Disabilities (RPWD) Act 2016 defines inclusive education as a 'system of education wherein students with and without disabilities learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities'. This Policy is in complete consonance with the provisions of the RPWD Act 2016 and endorses all its recommendations with regard to school education. While preparing the National Curriculum Framework, NCERT will ensure that consultations are held with expert bodies such as National Institutes of DEPwD.

6.11. To this end, schools/school complexes will be provided resources for the integration of children with disabilities, recruitment of special educators with cross-disability training, and for the establishment of resource centres, wherever needed, especially for children with severe or multiple disabilities. Barrier free access for all children with disabilities will be enabled as per the RPWD Act. Different categories of children with disabilities have differing needs. Schools and school complexes will work and be supported for providing all children with disabilities accommodations and support

mechanisms tailored to suit their needs and to ensure their full participation and inclusion in the classroom. In particular, assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) will be made available to help children with disabilities integrate more easily into classrooms and engage with teachers and their peers. This will apply to all school activities including arts, sports, and vocational education. NIOS will develop high-quality modules to teach Indian Sign Language, and to teach other basic subjects using Indian Sign Language. Adequate attention will be paid to the safety and security of children with disabilities.

6.12. As per the RPWD Act 2016, children with benchmark disabilities shall have the choice of regular or special schooling. Resource centres in conjunction with special educators will support the rehabilitation and educational needs of learners with severe or multiple disabilities and will assist parents/guardians in achieving high-quality home schooling and skilling for such students as needed. Home-based education will continue to be a choice available for children with severe and profound disabilities who are unable to go to schools. The children under home-based education must be treated as equal to any other child in the general system. There shall be an audit of home-based education for its efficiency and effectiveness using the principle of equity and equality of opportunity. Guidelines and standards for home-based schooling shall be developed based on this audit in line with the RPWD Act 2016. While it is clear that the education of all children with disabilities is the responsibility of the State, technology-based solutions will be used for the orientation of parents/caregivers along with wide-scale dissemination of learning materials to enable parents/caregivers to actively support their children's learning needs will be accorded priority.

6.13. Most classrooms have children with specific learning disabilities who need continuous support. Research is clear that the earlier such support begins, the better the chances of progress. Teachers must be helped to identify such learning disabilities early and plan specifically for their mitigation. Specific actions will include the use of appropriate technology allowing and enabling children to work at their own pace, with flexible curricula to leverage each child's strengths, and creating an ecosystem for appropriate assessment and certification. Assessment and certification agencies, including the proposed new National Assessment Centre, PARAKH, will formulate guidelines and recommend appropriate tools for conducting such assessment, from the foundational stage to higher education (including for entrance exams), in order to ensure equitable access and opportunities for all students with learning disabilities.

6.14. The awareness and knowledge of how to teach children with specific disabilities (including learning disabilities) will be an integral part of all teacher education programmes, along with gender sensitization and sensitization towards all underrepresented groups in order to reverse their underrepresentation.

6.15. Alternative forms of schools, will be encouraged to preserve their traditions or alternative pedagogical styles. At the same time, they will be supported to integrate the subject and learning areas prescribed by the NCFSE into their curricula in order to reduce and eventually eliminate the underrepresentation of children from these schools in higher education. In particular, financial assistance will be provided to introduce science, mathematics, social studies, Hindi, English, State languages, or other relevant subjects in the curriculum, as may be desired by these schools. This would enable children studying in these schools to attain the learning outcomes defined for Grades 1–12. Furthermore, students in such schools would be encouraged to appear for State or other Board examinations and assessments by the NTA, and thereby enroll in higher education institutions. Capacities of teachers in the teaching of science, mathematics, language, and social studies will be developed including orientation to new pedagogical practices. Libraries and laboratories will be strengthened and adequate reading materials like books, journals, etc., and other teaching-learning materials will be made available.

6.16. Within SEDGs, and with respect to all the above policy points, special attention will be given to reduce the disparities in the educational development of Scheduled Castes and Scheduled Tribes. As a part of the efforts to enhance participation in school education, special hostels in dedicated regions, bridge courses, and financial assistance through fee waivers and scholarships will be offered to

talented and meritorious students from all SEDGs on a larger scale, especially at the secondary stage of education, to facilitate their entry into higher education.

6.17. Under the aegis of the Ministry of Defence, State Governments may encourage opening NCC wings in their secondary and higher secondary schools, including those located in tribal dominated areas. This will enable harnessing of the natural talent and unique potential of students, which in turn would help them to aspire to a successful career in the defence forces.

6.18. All scholarships and other opportunities and schemes available to students from SEDGs will be coordinated and announced by a single agency and website to ensure that all students are aware of, and may apply in a simplified manner on such a 'single window system', as per eligibility.

6.19. All the above policies and measures are absolutely critical to attaining full inclusion and equity for all SEDGs - but they are not sufficient. What is also required is a change in school culture. All participants in the school education system, including teachers, principals, administrators, counsellors, and students, will be sensitized to the requirements of all students, the notions of inclusion and equity, and the respect, dignity, and privacy of all persons. Such an educational culture will provide the best pathway to help students become empowered individuals who, in turn, will enable society to transform into one that is responsible towards its most vulnerable citizens. Inclusion and equity will become a key aspect of teacher education (and training for all leadership, administrative, and other positions in schools); efforts will be made to recruit more high-quality teachers and leaders from SEDGs in order to bring in excellent role models for all students.

6.20. Students will be sensitized through this new school culture, brought in by teachers, trained social workers and counsellors as well as through corresponding changes to bring in an inclusive school curriculum. The school curriculum will include, early on, material on human values such as respect for all persons, empathy, tolerance, human rights, gender equality, non-violence, global citizenship, inclusion, and equity. It would also include more detailed knowledge of various cultures, religions, languages, gender identities, etc. to sensitize and develop respect for diversity. Any biases and stereotypes in school curriculum will be removed, and more material will be included that is relevant and relatable to all communities.

7. Efficient Resourcing and Effective Governance through School Complexes/Clusters

7.1. While the establishment of primary schools in every habitation across the country-driven by the Sarva Shiksha Abhiyan (SSA), now subsumed under the Samagra Shiksha Scheme and other important efforts across the States - has helped to ensure near-universal access to primary schools, it has also led to the development of numerous very small schools. According to U-DISE 2016–17 data, nearly 28% of India's public primary schools and 14.8% of India's upper primary schools have less than 30 students. The average number of students per grade in the elementary schooling system (primary and upper primary, i.e., Grades 1–8) is about 14, with a notable proportion having below 6; during the year 2016–17, there were 1,08,017 single-teacher schools, the majority of them (85743) being primary schools serving Grades 1–5.

7.2. These small school sizes have rendered it economically suboptimal and operationally complex to run good schools, in terms of deployment of teachers as well as the provision of critical physical resources. Teachers often teach multiple grades at a time, and teach multiple subjects, including subjects in which they may have no prior background; key areas such as music, arts, and sports are too often simply not taught; and physical resources, such as lab and sports equipment and library books, are simply not available across schools.

7.3. The isolation of small schools also has a negative effect on education and the teaching-learning process. Teachers function best in communities and teams, and so do students. Small schools also present a systemic challenge for governance and management. The geographical dispersion, challenging access conditions, and the very large numbers of schools make it difficult to reach all schools equally. Administrative structures have not been aligned with the increases in the number of school or with the unified structure of the Samagra Shiksha Scheme.

7.4. Although consolidation of schools is an option that is often discussed, it must be carried out very judiciously, and only when it is ensured that there is no impact on access. Such measures are nevertheless likely to result only in limited consolidation, and would not solve the overall structural problem and challenges presented by the large numbers of small schools.

7.5. These challenges will, by 2025, be addressed by State/UT governments by adopting innovative mechanisms to group or rationalize schools. The objective behind this intervention would be to ensure that every school has: (a) adequate number of counsellors/trained social workers and teachers (shared or otherwise) for teaching all subjects including art, music science, sports, languages, vocational subjects, etc; (b) adequate resources (shared or otherwise), such as a library, science labs, computer labs, skill labs, playgrounds, sports equipment and facilities, etc.; (c) a sense of community is built to overcome the isolation of teachers, students, and schools, through joint professional development programmes, sharing of teaching-learning content, joint content development, holding joint activities such as art and science exhibitions, sports meets, quizzes and debates, and fairs; (d) cooperation and support across schools for the education of children with disabilities; and (e) improved governance of the schooling system by devolving all finer decisions, to Principals, teachers, and other stakeholders within each group of schools and treating such a group of schools, which range from the foundational stage through the secondary stage, as an integrated semi-autonomous unit.

7.6. One possible mechanism for accomplishing the above would be the establishment of a grouping structure called the school complex, consisting of one secondary school together with all other schools offering lower grades in its neighbourhood including Anganwadis, in a radius of five to ten kilometers. This suggestion was first made by the Education Commission (1964–66) but was left unimplemented. This Policy strongly endorses the idea of the school complex/cluster, wherever possible. The aim of the school complex/cluster will be greater resource efficiency and more effective functioning, coordination, leadership, governance, and management of schools in the cluster.

7.7. The establishment of school complexes/clusters and the sharing of resources across complexes will have a number of other benefits as a consequence, such as improved support for children with disabilities, more topic-centred clubs and academic/sports/arts/crafts events across school complexes, better incorporation of art, music, language, vocational subjects, physical education, and other subjects in the classroom through the sharing of teachers in these subjects including use of ICT tools to conduct virtual classes, better student support, enrolment, attendance, and performance through the sharing of social workers and counsellors, and School Complex Management Committees (rather than simply School Management Committees) for more robust and improved governance, monitoring, oversight, innovations, and initiatives by local stakeholders. Building such larger communities of schools, school leaders, teachers, students, supporting staff, parents, and local citizens would energize and empower the schooling system, and in a resource-efficient manner.

7.8. The governance of schools will also improve and become far more efficient with school complexes/clusters. First, the DSE will devolve authority to the school complex/cluster, which will act as a semi-autonomous unit. The District Education Officer (DEO) and the Block Education Officers (BEO) will interact primarily with each school complex/cluster as a single unit and facilitate its work. The complex itself will perform certain tasks delegated by the DSE and will deal with the individual schools within it. The school complex/cluster will be given significant autonomy by the DSE to innovate towards providing integrated education and to experiment with pedagogies, curriculum, etc., while adhering to the National Curricular Framework (NCF) and State Curricular Framework (SCF). Under this organization, schools will gain in strength, will be able to exercise greater freedom, and will contribute towards making the complex more innovative and responsive. Meanwhile, the DSE will be able to focus on the aggregate level goals that need to be achieved, improving overall system effectiveness.

7.9. The culture of working to a plan, both short-term and long-term ones, will be developed through such complexes/clusters. Schools will develop their plans (SDPs) with the involvement of their SMCs. These plans will then become the basis for the creation of School Complex/Cluster Development Plans (SCDPs). The SCDP will also involve the plans of all other institutions

associated with the school complex, such as vocational education institutions, and will be created by the principals and teachers of the school complex with the involvement of the SCMC and will be made available publicly. The plans will include human resources, learning resources, physical resources and infrastructure, improvement initiatives, financial resources, school culture initiatives, teacher development plans, and educational outcomes. It will detail the efforts to leverage the teachers and students across the school complex to develop vibrant learning communities. The SDP and SCDP will be the primary mechanism to align all stakeholders of the school, including the DSE. The SMC and SCMC will use the SDP and SCDP for oversight of the functioning and direction of the school and will assist in the execution of these plans. The DSE, through its relevant official, e.g., the BEO, will endorse and confirm the SCDP of each school complex. It will then provide the resources (financial, human, physical, etc.) necessary to achieve the SCDPs, both short-term (1-year) and long-term (3-5 years). It will also provide all other relevant support to the school complexes to achieve the educational outcomes. The DSE and the SCERT may share specific norms (e.g., financial, staffing, process) and frameworks for development of the SDP and SCDP with all schools, which may be revised periodically.

7.10. To further enhance cooperation and positive synergy among schools, including between public and private schools, the twinning/pairing of one public school with one private school will be adopted across the country, so that such paired schools may meet/interact with each other, learn from each other, and also share resources, if possible. Best practices of private schools will be documented, shared, and institutionalized in public schools, and vice versa, where possible.

7.11. Every State will be encouraged to strengthen existing or establish "Bal Bhavans" where children of all ages can visit once a week (e.g., on weekends) or more often, as a special daytime boarding school, to partake in art-related, career-related, and play-related activities. Such Bal Bhavans may be incorporated as a part of school complexes/clusters if possible.

7.12. The school should be a point of celebration and honour for the whole community. The dignity of the school as an institution should be restored and important dates, such as the foundation day of the school, will be celebrated along with the community and the list of important alumni may be displayed and honoured. Furthermore, the un-utilized capacity of school infrastructure could be used to promote social, intellectual, and volunteer activities for the community and to promote social cohesion during non-teaching / schooling hours and may be used as a "Samajik Chetna Kendra".

8. Standard-setting and Accreditation for School Education

8.1. The goal of the school education regulatory system must be to continually improve educational outcomes; it must not overly restrict schools, prevent innovation, or demoralize teachers, principals, and students. All in all, regulation must aim to empower schools and teachers with trust, enabling them to strive for excellence and perform at their very best, while ensuring the integrity of the system through the enforcement of complete transparency and full public disclosure of all finances, procedures, and educational outcomes.

8.2. At present, all main functions of governance and regulation of the school education system - namely, the provision of public education, the regulation of education institutions, and policymaking - are handled by a single body, i.e., the Department of School Education or its arms. This leads to conflict of interests and excessive centralized concentration of power; it also leads to ineffective management of the school system, as efforts towards quality educational provision are often diluted by the focus on the other roles, particularly regulation, that the Departments of School Education also perform.

8.3. The current regulatory regime also has not been able to curb the commercialization and economic exploitation of parents by many for-profit private schools, yet at the same time it has all too often inadvertently discouraged public-spirited private/philanthropic schools. There has been far too much asymmetry between the regulatory approaches to public and private schools, even though the goals of both types of schools should be the same: to provide quality education.

8.4. The public education system is the foundation of a vibrant democratic society, and the way it is run must be transformed and invigorated in order to achieve the highest levels of educational outcomes for the nation. At the same time, the private/philanthropic school sector must also be encouraged and enabled to play a significant and beneficial role.

8.5. The key principles and recommendations of this Policy regarding the State school education system, the independent responsibilities within that system, and the approach to its regulation are as follows:

(a) The Department of School Education, which is the apex state-level body in school education, will be responsible for overall monitoring and policymaking for continual improvement of the public education system; it will not be involved with the provision and operation of schools or with the regulation of schools, in order to ensure due focus on the improvement of public schools and to eliminate conflict of interests.

(b) The educational operations and service provision for the public schooling system of the whole State will be handled by the Directorate of School Education (including the offices of the DEO and BEO, etc.); it will work independently to implement policies regarding educational operations and provision.

(c) An effective quality self-regulation or accreditation system will be instituted for all stages of education including pre-school education - private, public, and philanthropic - to ensure compliance with essential quality standards. To ensure that all schools follow certain minimal professional and quality standards, States/UTs will set up an independent, State-wide, body called the State School Standards Authority (SSSA). The SSSA will establish a minimal set of standards based on basic parameters (namely, safety, security, basic infrastructure, number of teachers across subjects and grades, financial probity, and sound processes of governance), which shall be followed by all schools. The framework for these parameters will be created by the SCERT in consultation with various stakeholders, especially teachers and schools.

    Transparent public self-disclosure of all the basic regulatory information, as laid down by the SSSA, will be used extensively for public oversight and accountability. The dimensions on which information has to be self-disclosed, and the format of disclosure will be decided by the SSSA in accordance with global best practices for standard-setting for schools. This information will have to be made available and kept updated and accurate by all schools, on the aforementioned public website maintained by the SSSA and on the schools' websites. Any complaints or grievances from stakeholders or others arising out of the information placed in the public domain shall be adjudicated by the SSSA. Feedback from randomly selected students will be solicited online to ensure valuable input at regular intervals. Technology will be employed suitably to ensure efficiency and transparency in all work of the SSSA. This will bring down significantly the heavy load of regulatory mandates currently borne by schools.

(d) Academic matters, including academic standards and curricula in the State will be led by the SCERT (with close consultation and collaboration with the NCERT), which will be reinvigorated as an institution. The SCERT will develop a School Quality Assessment and Accreditation Framework (SQAAF) through wide consultations with all stakeholders. The SCERT will also lead a "change management process" for the reinvigoration of CRCs, BRCs, and DIETs which must change the capacity and work culture of these institutions in 3 years, developing them into vibrant institutions of excellence. Meanwhile, certification of competencies of students at the school-leaving stage will be handled by the Boards of Assessment/Examination in each State.

8.6. The culture, structures, and systems that empower and provide adequate resources to schools, institutions, teachers, officials, communities, and other stakeholders, will also build concomitant accountability. Each stakeholder and participant of the education system will be accountable to perform their role with the highest level of integrity, full commitment, and exemplary work ethic.

Each role of the system will have explicitly articulated role expectations and rigorous assessment of their performance vis-à-vis these expectations. The assessment system will be objective and developmentally oriented, while ensuring accountability. It will have multiple sources of feedback and assessment, to ensure a full view of the performance (and will not just be linked simplistically, e.g., to 'marks' of students). The assessment will recognize that outcomes such as educational attainment of students have multiple intervening variables and extraneous influences. It will also recognize that education requires teamwork, particularly at the level of the school. Promotion, recognition, and accountability of all individuals will be based on such performance assessment. All functionaries will be responsible to ensure that this development, performance, and accountability system is run with high integrity, and systematically, within their span of control.

8.7. Public and private schools (except the schools that are managed/aided/controlled by the Central government) will be assessed and accredited on the same criteria, benchmarks, and processes, emphasizing online and offline public disclosure and transparency, so as to ensure that public-spirited private schools are encouraged and not stifled in any way. Private philanthropic efforts for quality education will be encouraged - thereby affirming the public-good nature of education - while protecting parents and communities from arbitrary increases in tuition fees. Public disclosure on the school website and on the SSSA website - for both public and private schools - would include (at the very least) information on the numbers of classrooms, students, and teachers, subjects taught, any fees, and overall student outcomes on standardized evaluations such as the NAS and SAS. For schools controlled/managed/aided by the Central government, the CBSE in consultation with the MHRD shall prepare a framework. All the education institutions will be held to similar standards of audit and disclosure as a 'not-for-profit' entity. Surpluses, if any, will be reinvested in the educational sector.

8.8. The standard-setting/regulatory framework and the facilitating systems for school regulation, accreditation, and governance shall be reviewed to enable improvements on the basis of the learnings and experiences gained in the last decade. This review will aim to ensure that all students, particularly students from underprivileged and disadvantaged sections, shall have universal, free and compulsory access to high-quality and equitable schooling from early childhood care and education (age 3 onwards) through higher secondary education (i.e., until Grade 12). The overemphasis on inputs, and the mechanistic nature of their specifications – physical and infrastructural – will be changed and requirements made more responsive to realities on the ground, e.g., regarding land areas and room sizes, practicalities of playgrounds in urban areas, etc. These mandates will be adjusted and loosened, leaving suitable flexibility for each school to make its own decisions based on local needs and constraints, while ensuring safety, security, and a pleasant and productive learning space. Educational outcomes and the transparent disclosure of all financial, academic, and operational matters will be given due importance and will be incorporated suitably in the assessment of schools. This will further improve India's progress towards achieving Sustainable Development Goal 4 (SDG4) of ensuring free, equitable, and quality primary and secondary education for all children.

8.9. The aim of the public-school education system will be to impart the highest quality education so that it becomes the most attractive option for parents from all walks of life for educating their children.

8.10. For a periodic 'health check-up' of the overall system, a sample-based National Achievement Survey (NAS) of student learning levels will be carried out by the proposed new National Assessment Centre, PARAKH with suitable cooperation with other governmental bodies- such as the NCERT– that may assist in assessment procedures as well as data analysis. The assessment will cover students across government as well as private schools. States will also be encouraged to conduct their own census-based State Assessment Survey (SAS), the results of which will be used only for developmental purposes, public disclosure by schools of their overall and anonymized student outcomes, and for continuous improvement of the school education system. Until the establishment of the proposed new National Assessment Centre, PARAKH, NCERT may continue to carry out NAS.

8.11. Finally, the children and adolescents enrolled in schools must not be forgotten in this whole process; after all, the school system is designed for them. Careful attention must be paid to their safety and rights- particularly girl children - and the various difficult issues faced by adolescents, such as substance or drug abuse and forms of discrimination and harassment including violence, with clear, safe, and efficient mechanisms for reporting and for due process on any infractions against children's/adolescents' rights or safety. The development of such mechanisms that are effective, timely, and well-known to all students will be accorded high priority.

Part II. HIGHER EDUCATION

9. Quality Universities and Colleges: A New and Forward-looking Vision for India's Higher Education System

9.1. Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially-conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. Higher education significantly contributes towards sustainable livelihoods and economic development of the nation. As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education.

9.1.1. Given the 21st century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. It must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education must enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. It must prepare students for more meaningful and satisfying lives and work roles and enable economic independence.

9.1.2. For the purpose of developing holistic individuals, it is essential that an identified set of skills and values will be incorporated at each stage of learning, from pre-school to higher education.

9.1.3. At the societal level, higher education must enable the development of an enlightened, socially conscious, knowledgeable, and skilled nation that can find and implement robust solutions to its own problems. Higher education must form the basis for knowledge creation and innovation thereby contributing to a growing national economy. The purpose of quality higher education is, therefore, more than the creation of greater opportunities for individual employment. It represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.

9.2. Some of the major problems currently faced by the higher education system in India include:

(a) a severely fragmented higher educational ecosystem;
(b) less emphasis on the development of cognitive skills and learning outcomes;
(c) a rigid separation of disciplines, with early specialisation and streaming of students into narrow areas of study;
(d) limited access particularly in socio-economically disadvantaged areas, with few HEIs that teach in local languages
(e) limited teacher and institutional autonomy;
(f) inadequate mechanisms for merit-based career management and progression of faculty and institutional leaders;
(g) lesser emphasis on research at most universities and colleges, and lack of competitive peer-reviewed research funding across disciplines;
(h) suboptimal governance and leadership of HEIs;
(i) an ineffective regulatory system; and
(j) large affiliating universities resulting in low standards of undergraduate education.

9.3. This policy envisions a complete overhaul and re-energising of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion. The policy's vision includes the following key changes to the current system:

(a) moving towards a higher educational system consisting of large, multidisciplinary universities and colleges, with at least one in or near every district, and with more HEIs across India that offer medium of instruction or programmes in local/Indian languages;
(b) moving towards a more multidisciplinary undergraduate education;
(c) moving towards faculty and institutional autonomy;
(d) revamping curriculum, pedagogy, assessment, and student support for enhanced student experiences;
(e) reaffirming the integrity of faculty and institutional leadership positions through merit-appointments and career progression based on teaching, research, and service;
(f) establishment of a National Research Foundation to fund outstanding peer-reviewed research and to actively seed research in universities and colleges;
(g) governance of HEIs by high qualified independent boards having academic and administrative autonomy;
(h) "light but tight" regulation by a single regulator for higher education;
(i) increased access, equity, and inclusion through a range of measures, including greater opportunities for outstanding public education; scholarships by private/philanthropic universities for disadvantaged and underprivileged students; online education, and Open Distance Learning (ODL); and all infrastructure and learning materials accessible and available to learners with disabilities.

10. Institutional Restructuring and Consolidation

10.1. The main thrust of this policy regarding higher education is to end the fragmentation of higher education by transforming higher education institutions into large multidisciplinary universities, colleges, and HEI clusters/Knowledge Hubs, each of which will aim to have 3,000 or more students. This would help build vibrant communities of scholars and peers, break down harmful silos, enable students to become well-rounded across disciplines including artistic, creative, and analytic subjects as well as sports, develop active research communities across disciplines including cross-disciplinary research, and increase resource efficiency, both material and human, across higher education.

10.2. Moving to large multidisciplinary universities and HEI clusters is thus the highest recommendation of this policy regarding the structure of higher education. The ancient Indian universities Takshashila, Nalanda, Vallabhi, and Vikramshila, which had thousands of students from India and the world studying in vibrant multidisciplinary environments, amply demonstrated the type of great success that large multidisciplinary research and teaching universities could bring. India urgently needs to bring back this great Indian tradition to create well-rounded and innovative individuals, and which is already transforming other countries educationally and economically.

10.3. This vision of higher education will require, in particular, a new conceptual perception/understanding for what constitutes a higher education institution (HEI), i.e., a university or a college. A university will mean a multidisciplinary institution of higher learning that offers undergraduate and graduate programmes, with high quality teaching, research, and community engagement. The definition of university will thus allow a spectrum of institutions that range from those that place equal emphasis on teaching and research i.e., Research-intensive Universities, those that place greater emphasis on teaching but still conduct significant research i.e. Teaching-intensive Universities. Meanwhile, an Autonomous degree-granting College (AC) will refer to a large multidisciplinary institution of higher learning that grants undergraduate degrees and is primarily focused on undergraduate teaching though it would not be restricted to that and it need not be restricted to that and it would generally be smaller than a typical university.

10.4. A stage-wise mechanism for granting graded autonomy to colleges, through a transparent system of graded accreditation, will be established. Colleges will be encouraged, mentored, supported, and incentivized to gradually attain the minimum benchmarks required for each level of

accreditation. Over a period of time, it is envisaged that every college would develop into either an Autonomous degree-granting College, or a constituent college of a university - in the latter case, it would be fully a part of the university. With appropriate accreditations, Autonomous degree-granting Colleges could evolve into Research-intensive or Teaching-intensive Universities, if they so aspire.

10.5. It must be clearly stated that these three broad types of institutions are not in any natural way a rigid, exclusionary categorization, but are along a continuum. HEIs will have the autonomy and freedom to move gradually from one category to another, based on their plans, actions, and effectiveness. The most salient marker for these categories of institutions will be the focus of their goals and work. The Accreditation System will develop and use appropriately different and relevant norms across this range of HEIs. However, the expectations of high quality of education, and of teaching-learning, across all HEIs will be the same.

10.6. In addition to teaching and research, HEIs will have other crucial responsibilities, which they will discharge through appropriate resourcing, incentives, and structures. These include supporting other HEIs in their development, community engagement and service, contribution to various fields of practice, faculty development for the higher education system, and support to school education.

10.7. By 2040, all higher education institutions (HEIs) shall aim to become multidisciplinary institutions and shall aim to have larger student enrolments preferably in the thousands, for optimal use of infrastructure and resources, and for the creation of vibrant multidisciplinary communities. Since this process will take time, all HEIs will firstly plan to become multidisciplinary by 2030, and then gradually increase student strength to the desired levels.

10.8. More HEIs shall be established and developed in underserved regions to ensure full access, equity, and inclusion. There shall, by 2030, be at least one large multidisciplinary HEI in or near every district. Steps shall be taken towards developing high-quality higher education institutions both public and private that have medium of instruction in local/Indian languages or bilingually. The aim will be to increase the Gross Enrolment Ratio in higher education including vocational education from 26.3% (2018) to 50% by 2035. While a number of new institutions may be developed to attain these goals, a large part of the capacity creation will be achieved by consolidating, substantially expanding, and also improving existing HEIs.

10.9. Growth will be in both public and private institutions, with a strong emphasis on developing a large number of outstanding public institutions. There will be a fair and transparent system for determining increased levels of public funding support for public HEIs. This system will give an equitable opportunity for all public institutions to grow and develop, and will be based on transparent, pre-announced criteria from within the accreditation norms of the Accreditation System. HEIs delivering education of the highest quality as laid down in this Policy will be incentivized in expanding their capacity.

10.10. Institutions will have the option to run Open Distance Learning (ODL) and online programmes, provided they are accredited to do so, in order to enhance their offerings, improve access, increase GER, and provide opportunities for lifelong learning (SDG 4). All ODL programmes and their components leading to any diploma or degree will be of standards and quality equivalent to the highest quality programmes run by the HEIs on their campuses. Top institutions accredited for ODL will be encouraged and supported to develop high-quality online courses. Such quality online courses will be suitably integrated into curricula of HEIs, and blended mode will be preferred.

10.11. Single-stream HEIs will be phased out over time, and all will move towards becoming vibrant multidisciplinary institutions or parts of vibrant multidisciplinary HEI clusters, in order to enable and encourage high-quality multidisciplinary and cross-disciplinary teaching and research across fields. Single-stream HEIs will, in particular, add departments across different fields that would strengthen the single stream that they currently serve. Through the attainment of suitable accreditations, all HEIs will gradually move towards full autonomy - academic and administrative - in order to enable this vibrant culture. The autonomy of public institutions will be backed by adequate public financial

support and stability. Private institutions with a public-spirited commitment to high-quality equitable education will be encouraged.

10.12. The new regulatory system envisioned by this Policy will foster this overall culture of empowerment and autonomy to innovate, including by gradually phasing out the system of 'affiliated colleges' over a period of fifteen years through a system of graded autonomy, and to be carried out in a challenge mode. Each existing affiliating university will be responsible for mentoring its affiliated colleges so that they can develop their capabilities and achieve minimum benchmarks in academic and curricular matters; teaching and assessment; governance reforms; financial robustness; and administrative efficiency. All colleges currently affiliated to a university shall attain the required benchmarks over time to secure the prescribed accreditation benchmarks and eventually become autonomous degree-granting colleges. This will be achieved through a concerted national effort including suitable mentoring and governmental support for the same.

10.13. The overall higher education sector will aim to be an integrated higher education system, including professional and vocational education. This Policy and its approach will be equally applicable to all HEIs across all current streams, which would eventually merge into one coherent ecosystem of higher education.

10.14. University, worldwide, means a multidisciplinary institution of higher learning that offers undergraduate, graduate, and Ph.D programmes, and engages in high-quality teaching and research. The present complex nomenclature of HEIs in the country such as 'deemed to be university', 'affiliating university', 'affiliating technical university', 'unitary university' shall be replaced simply by 'university' on fulfilling the criteria as per norms.

11. Towards a More Holistic and Multidisciplinary Education

11.1. India has a long tradition of holistic and multidisciplinary learning, from universities such as Takshashila and Nalanda, to the extensive literatures of India combining subjects across fields. Ancient Indian literary works such as Banabhatta's Kadambari described a good education as knowledge of the 64 Kalaas or arts; and among these 64 'arts' were not only subjects, such as singing and painting, but also 'scientific 'fields, such as chemistry and mathematics, 'vocational ' fields such as carpentry and clothes-making, 'professional 'fields, such as medicine and engineering, as well as 'soft skills' such as communication, discussion, and debate. The very idea that all branches of creative human endeavour, including mathematics, science, vocational subjects, professional subjects, and soft skills should be considered 'arts', has distinctly Indian origins. This notion of a 'knowledge of many arts' or what in modern times is often called the 'liberal arts' (i.e., a liberal notion of the arts) must be brought back to Indian education, as it is exactly the kind of education that will be required for the 21st century.

11.2. Assessments of educational approaches in undergraduate education that integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) have consistently showed positive learning outcomes, including increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. Research is also improved and enhanced through a holistic and multidisciplinary education approach.

11.3. A holistic and multidisciplinary education would aim to develop all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

11.4. A holistic and multidisciplinary education, as described so beautifully in India's past, is indeed what is needed for the education of India to lead the country into the 21st century and the fourth industrial revolution. Even engineering institutions, such as IITs, will move towards more holistic and multidisciplinary education with more arts and humanities. Students of arts and humanities will aim to learn more science and all will make an effort to incorporate more vocational subjects and soft skills.

11.5. Imaginative and flexible curricular structures will enable creative combinations of disciplines for study, and would offer multiple entry and exit points, thus, removing currently prevalent rigid boundaries and creating new possibilities for life-long learning. Graduate-level, master's and doctoral education in large multidisciplinary universities, while providing rigorous research-based specialization, would also provide opportunities for multidisciplinary work, including in academia, government, and industry.

11.6. Large multidisciplinary universities and colleges will facilitate the move towards high-quality holistic and multidisciplinary education. Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialization in a subject or subjects. This will be encouraged by increased faculty and institutional autonomy in setting curricula. Pedagogy will have an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking.

11.7. Departments in Languages, Literature, Music, Philosophy, Indology, Art, Dance, Theatre, Education, Mathematics, Statistics, Pure and Applied Sciences, Sociology, Economics, Sports, Translation and Interpretation, and other such subjects needed for a multidisciplinary, stimulating Indian education and environment will be established and strengthened at all HEIs. Credits will be given in all Bachelor's Degree programmes for these subjects if they are done from such departments or through ODL mode when they are not offered in-class at the HEI.

11.8. Towards the attainment of such a holistic and multidisciplinary education, the flexible and innovative curricula of all HEIs shall include credit-based courses and projects in the areas of community engagement and service, environmental education, and value-based education. Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living. Value-based education will include the development of humanistic, ethical, Constitutional, and universal human values of truth (*satya*), righteous conduct (*dharma*), peace (*shanti*), love (*prem*), nonviolence (*ahimsa*), scientific temper, citizenship values, and also life-skills; lessons in *seva*/service and participation in community service programmes will be considered an integral part of a holistic education. As the world is becoming increasingly interconnected, Global Citizenship Education (GCED), a response to contemporary global challenges, will be provided to empower learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies. Finally, as part of a holistic education, students at all HEIs will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, etc., as well as research internships with faculty and researchers at their own or other HEIs/research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

11.9. The structure and lengths of degree programmes shall be adjusted accordingly. The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student. An Academic Bank of Credit (ABC) shall be established which would digitally store the academic credits earned from various recognized HEIs so that the degrees from an HEI can be awarded taking into account credits earned. The 4-year programme may also lead to a degree 'with

Research' if the student completes a rigorous research project in their major area(s) of study as specified by the HEI.

11.10. HEIs will have the flexibility to offer different designs of Master's programmes: (a) there may be a 2-year programme with the second year devoted entirely to research for those who have completed the 3-year Bachelor's programme; (b) for students completing a 4-year Bachelor's programme with Research, there could be a 1-year Master's programme; and (c) there may be an integrated 5-year Bachelor's/Master's programme. Undertaking a Ph.D. shall require either a Master's degree or a 4-year Bachelor's degree with Research. The M.Phil. programme shall be discontinued.

11.11. Model public universities for holistic and multidisciplinary education, at par with IITs, IIMs, etc., called MERUs (Multidisciplinary Education and Research Universities) will be set up and will aim to attain the highest global standards in quality education. They will also help set the highest standards for multidisciplinary education across India.

11.12. HEIs will focus on research and innovation by setting up start-up incubation centres; technology development centres; centres in frontier areas of research; greater industry-academic linkages; and interdisciplinary research including humanities and social sciences research. Given the scenario of epidemics and pandemics, it is critical that HEIs take the lead to undertake research in areas of infectious diseases, epidemiology, virology, diagnostics, instrumentation, vaccinology and other relevant areas. HEIs will develop specific hand holding mechanisms and competitions for promoting innovation among student communities. The NRF will function to help enable and support such a vibrant research and innovation culture across HEIs, research labs, and other research organizations.

12. Optimal Learning Environments and Support for Students

12.1. Effective learning requires a comprehensive approach that involves appropriate curriculum, engaging pedagogy, continuous formative assessment, and adequate student support. The curriculum must be interesting and relevant, and updated regularly to align with the latest knowledge requirements and to meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students, thus directly influencing learning outcomes. The assessment methods must be scientific, designed to continuously improve learning and test the application of knowledge. Last but not least, the development of capacities that promote student wellness such as fitness, good health, psycho-social well-being, and sound ethical grounding are also critical for high-quality learning.

Thus, curriculum, pedagogy, continuous assessment, and student support are the cornerstones for quality learning. Along with providing suitable resources and infrastructure, such as quality libraries, classrooms, labs, technology, sports/recreation areas, student discussion spaces, and dining areas, a number of initiatives will be required to ensure that learning environments are engaging and supportive, and enable all students to succeed.

12.2. First, in order to promote creativity, institutions and faculty will have the autonomy to innovate on matters of curriculum, pedagogy, and assessment within a broad framework of higher education qualifications that ensures consistency across institutions and programmes and across the ODL, online, and traditional 'in-class' modes. Accordingly, curriculum and pedagogy will be designed by institutions and motivated faculty to ensure a stimulating and engaging learning experience for all students, and continuous formative assessment will be used to further the goals of each programme. All assessment systems shall also be decided by the HEI, including those that lead to final certification. The Choice Based Credit System (CBCS) will be revised for instilling innovation and flexibility. HEIs shall move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs shall also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

12.3. Second, each institution will integrate its academic plans ranging from curricular improvement to quality of classroom transaction - into its larger Institutional Development Plan (IDP). Each institution will be committed to the holistic development of students and create strong internal systems for supporting diverse student cohorts in academic and social domains both inside and outside formal academic interactions in the classroom. For example, all HEIs will have mechanisms and opportunities for funding of topic-centred clubs and activities organized by students with the help of faculty and other experts as needed, such as clubs and events dedicated to science, mathematics, poetry, language, literature, debate, music, sports, etc. Over time, such activities could be incorporated into the curriculum once appropriate faculty expertise and campus student demand is developed. Faculty will have the capacity and training to be able to approach students not just as teachers, but also as mentors and guides.

12.4. Third, students from socio-economically disadvantaged backgrounds require encouragement and support to make a successful transition to higher education. Universities and colleges will thus be required to set up high-quality support centres and will be given adequate funds and academic resources to carry this out effectively. There will also be professional academic and career counselling available to all students, as well as counsellors to ensure physical, psychological and emotional well-being.

12.5. Fourth, ODL and online education provide a natural path to increase access to quality higher education. In order to leverage its potential completely, ODL will be renewed through concerted, evidence-based efforts towards expansion while ensuring adherence to clearly articulated standards of quality. ODL programmes will aim to be equivalent to the highest quality in-class programmes available. Norms, standards, and guidelines for systemic development, regulation, and accreditation of ODL will be prepared, and a framework for quality of ODL that will be recommendatory for all HEIs will be developed.

12.6. Finally, all programmes, courses, curricula, and pedagogy across subjects, including those in-class, online, and in ODL modes as well as student support will aim to achieve global standards of quality.

Internationalization

12.7. The various initiatives mentioned above will also help in having larger numbers of international students studying in India, and provide greater mobility to students in India who may wish to visit, study at, transfer credits to, or carry out research at institutions abroad, and vice versa. Courses and programmes in subjects, such as Indology, Indian languages, AYUSH systems of medicine, yoga, arts, music, history, culture, and modern India, internationally relevant curricula in the sciences, social sciences, and beyond, meaningful opportunities for social engagement, quality residential facilities and on-campus support, etc. will be fostered to attain this goal of global quality standards, attract greater numbers of international students, and achieve the goal of 'internationalization at home'.

12.8. India will be promoted as a global study destination providing premium education at affordable costs thereby helping to restore its role as a Vishwa Guru. An International Students Office at each HEI hosting foreign students will be set up to coordinate all matters relating to welcoming and supporting students arriving from abroad. Research/teaching collaborations and faculty/student exchanges with high-quality foreign institutions will be facilitated, and relevant mutually beneficial MOUs with foreign countries will be signed. High performing Indian universities will be encouraged to set up campuses in other countries, and similarly, selected universities e.g., those from among the top 100 universities in the world will be facilitated to operate in India. A legislative framework facilitating such entry will be put in place, and such universities will be given special dispensation regarding regulatory, governance, and content norms on par with other autonomous institutions of India. Furthermore, research collaboration and student exchanges between Indian institutions and global institutions will be promoted through special efforts. Credits acquired in foreign universities will be permitted, where appropriate as per the requirements of each HEI, to be counted for the award of a degree.

Student Activity and Participation

12.9. Students are the prime stakeholders in the education system. Vibrant campus life is essential for high-quality teaching-learning processes. Towards this end, students will be given plenty of opportunities for participation in sports, culture/arts clubs, eco-clubs, activity clubs, community service projects, etc. In every education institution, there shall be counselling systems for handling stress and emotional adjustments. Furthermore, a systematized arrangement shall be created to provide the requisite support to students from rural backgrounds, including increasing hostel facilities as needed. All HEIs will ensure quality medical facilities for all students in their institutions.

Financial support for students

12.10. Financial assistance to students shall be made available through various measures. Efforts will be made to incentivize the merit of students belonging to SC, ST, OBC, and other SEDGs. The National Scholarship Portal will be expanded to support, foster, and track the progress of students receiving scholarships. Private HEIs will be encouraged to offer larger numbers of free ships and scholarships to their students.

13. Motivated, Energized, and Capable Faculty

13.1. The most important factor in the success of higher education institutions is the quality and engagement of its faculty. Acknowledging the criticality of faculty in achieving the goals of higher education, various initiatives have been introduced in the past several years to systematize recruitment and career progression, and to ensure equitable representation from various groups in the hiring of faculty. Compensation levels of permanent faculty in public institutions have also been increased substantially. Various initiatives have also been taken towards providing faculty with professional development opportunities. However, despite these various improvements in the status of the academic profession, faculty motivation in terms of teaching, research, and service in HEIs remains far lower than the desired level. The various factors that lie behind low faculty motivation levels must be addressed to ensure that each faculty member is happy, enthusiastic, engaged, and motivated towards advancing her/his students, institution, and profession. To this end, the policy recommends the following initiatives to achieve the best, motivated, and capable faculty in HEIs.

13.2. As the most basic step, all HEIs will be equipped with the basic infrastructure and facilities, including clean drinking water, clean working toilets, blackboards, offices, teaching supplies, libraries, labs, and pleasant classroom spaces and campuses. Every classroom shall have access to the latest educational technology that enables better learning experiences.

13.3. Teaching duties also will not be excessive, and student-teacher ratios not too high, so that the activity of teaching remains pleasant and there is adequate time for interaction with students, conducting research, and other university activities. Faculty will be appointed to individual institutions and generally not be transferable across institutions so that they may feel truly invested in, connected to, and committed to their institution and community.

13.4. Faculty will be given the freedom to design their own curricular and pedagogical approaches within the approved framework, including textbook and reading material selections, assignments, and assessments. Empowering the faculty to conduct innovative teaching, research, and service as they see best will be a key motivator and enabler for them to do truly outstanding, creative work.

13.5. Excellence will be further incentivized through appropriate rewards, promotions, recognitions, and movement into institutional leadership. Meanwhile, faculty not delivering on basic norms will be held accountable.

13.6. In keeping with the vision of autonomous institutions empowered to drive excellence, HEIs will have clearly defined, independent, and transparent processes and criteria for faculty recruitment. Whereas the current recruitment process will be continued, a ‘tenure-track’ i.e., suitable probation period shall be put in place to further ensure excellence. There shall be a fast-track promotion system

for recognizing high impact research and contribution. A system of multiple parameters for proper performance assessment, for the purposes of 'tenure' i.e., confirmed employment after probation, promotion, salary increases, recognitions, etc., including peer and student reviews, innovations in teaching and pedagogy, quality and impact of research, professional development activities, and other forms of service to the institution and the community, shall be developed by each HEI and clearly enunciated in it's Institutional Development Plan (IDP).

13.7. The presence of outstanding and enthusiastic institutional leaders that cultivate excellence and innovation is the need of the hour. Outstanding and effective institutional leadership is extremely important for the success of an institution and of its faculty. Excellent faculty with high academic and service credentials as well as demonstrated leadership and management skills will be identified early and trained through a ladder of leadership positions. Leadership positions shall not remain vacant, but rather an overlapping time period during transitions in leadership shall be the norm to ensure the smooth running of institutions. Institutional leaders will aim to create a culture of excellence that will motivate and incentivize outstanding and innovative teaching, research, institutional service, and community outreach from faculty members and all HEI leaders.

14. Equity and Inclusion in Higher Education

14.1. Entry into quality higher education can open a vast array of possibilities that can lift both individuals as well as communities out of the cycles of disadvantage. For this reason, making quality higher education opportunities available to all individuals must be among the highest priorities. This Policy envisions ensuring equitable access to quality education to all students, with a special emphasis on SEDGs.

14.2. The dynamics and also many of the reasons for exclusion of SEDGs from the education system are common across school and higher education sectors. Therefore, the approach to equity and inclusion must be common across school and higher education. Furthermore, there must be continuity across the stages to ensure sustainable reform. Thus, the policy initiatives required to meet the goals of equity and inclusion in higher education must be read in conjunction with those for school education.

14.3. There are certain facets of exclusion, that are particular to or substantially more intense in higher education. These must be addressed specifically, and include lack of knowledge of higher education opportunities, economic opportunity cost of pursuing higher education, financial constraints, admission processes, geographical and language barriers, poor employability potential of many higher education programmes, and lack of appropriate student support mechanisms.

14.4. For this purpose, additional actions that are specific to higher education shall be adopted by all Governments and HEIs:

14.4.1. Steps to be taken by Governments

(a) Earmark suitable Government funds for the education of SEDGs
(b) Set clear targets for higher GER for SEDGs
(c) Enhance gender balance in admissions to HEIs
(d) Enhance access by establishing more high-quality HEIs in aspirational districts and Special Education Zones containing larger numbers of SEDGs
(e) Develop and support high-quality HEIs that teach in local/Indian languages or bilingually
(f) Provide more financial assistance and scholarships to SEDGs in both public and private HEIs
(g) Conduct outreach programmes on higher education opportunities and scholarships among SEDGs
(h) Develop and support technology tools for better participation and learning outcomes.

14.4.2. Steps to be taken by all HEIs

(a) Mitigate opportunity costs and fees for pursuing higher education
(b) Provide more financial assistance and scholarships to socio-economically disadvantaged students
(c) Conduct outreach on higher education opportunities and scholarships
(d) Make admissions processes more inclusive
(e) Make curriculum more inclusive
(f) Increase employability potential of higher education programmes
(g) Develop more degree courses taught in Indian languages and bilingually
(h) Ensure all buildings and facilities are wheelchair-accessible and disabled-friendly
(i) Develop bridge courses for students that come from disadvantaged educational backgrounds
(j) Provide socio-emotional and academic support and mentoring for all such students through suitable counselling and mentoring programmes
(k) Ensure sensitization of faculty, counsellor, and students on gender-identity issue and its inclusion in all aspects of the HEI, including curricula
(l) Strictly enforce all no-discrimination and anti-harassment rules
(m) Develop Institutional Development Plans that contain specific plans for action on increasing participation from SEDGs, including but not limited to the above items.

15. Teacher Education

15.1. Teacher education is vital in creating a pool of schoolteachers that will shape the next generation. Teacher preparation is an activity that requires multidisciplinary perspectives and knowledge, formation of dispositions and values, and development of practice under the best mentors. Teachers must be grounded in Indian values, languages, knowledge, ethos, and traditions including tribal traditions, while also being well-versed in the latest advances in education and pedagogy.

15.2. According to the Justice J. S. Verma Commission (2012) constituted by the Supreme Court, a majority of stand-alone TEIs - over 10,000 in number are not even attempting serious teacher education but are essentially selling degrees for a price. Regulatory efforts so far have neither been able to curb the malpractices in the system, nor enforce basic standards for quality, and in fact have had the negative effect of curbing the growth of excellence and innovation in the sector. The sector and its regulatory system are, therefore, in urgent need of revitalization through radical action, in order to raise standards and restore integrity, credibility, efficacy, and high quality to the teacher education system.

15.3. In order to improve and reach the levels of integrity and credibility required to restore the prestige of the teaching profession, the Regulatory System shall be empowered to take stringent action against substandard and dysfunctional teacher education institutions (TEIs) that do not meet basic educational criteria, after giving one year for remedy of the breaches. By 2030, only educationally sound, multidisciplinary, and integrated teacher education programmes shall be in force.

15.4. As teacher education requires multidisciplinary inputs, and education in high-quality content as well as pedagogy, all teacher education programmes must be conducted within composite multidisciplinary institutions. To this end, all multidisciplinary universities and colleges - will aim to establish, education departments which, besides carrying out cutting-edge research in various aspects of education, will also run B.Ed. programmes, in collaboration with other departments such as psychology, philosophy, sociology, neuroscience, Indian languages, arts, music, history, literature, physical education, science and mathematics. Moreover, all stand-alone TEIs will be required to convert to multidisciplinary institutions by 2030, since they will have to offer the 4-year integrated teacher preparation programme.

15.5. The 4-year integrated B.Ed. offered by such multidisciplinary HEIs will, by 2030, become the minimal degree qualification for school teachers. The 4-year integrated B.Ed. will be a dual-major holistic Bachelor′s degree, in Education as well as a specialized subject such as a language, history, music, mathematics, computer science, chemistry, economics, art, physical education, etc. Beyond

the teaching of cutting-edge pedagogy, the teacher education will include grounding in sociology, history, science, psychology, early childhood care and education, foundational literacy and numeracy, knowledge of India and its values/ethos/art/traditions, and more. The HEI offering the 4-year integrated B.Ed. may also run a 2-year B.Ed., for students who have already received a Bachelor′s degree in a specialized subject. A 1-year B.Ed. may also be offered for candidates who have received a 4-year undergraduate degree in a specialized subject. Scholarships for meritorious students will be established for the purpose of attracting outstanding candidates to the 4-year, 2-year, and 1-year B.Ed. programmes.

15.6. HEIs offering teacher education programmes will ensure the availability of a range of experts in education and related disciplines as well as specialized subjects. Each higher education institution will have a network of government and private schools to work closely with, where potential teachers will student-teach along with participating in other activities such as community service, adult and vocational education, etc.

15.7. In order to maintain uniform standards for teacher education, the admission to pre-service teacher preparation programmes shall be through suitable subject and aptitude tests conducted by the National Testing Agency, and shall be standardized keeping in view the linguistic and cultural diversity of the country.

15.8. The faculty profile in Departments of Education will necessarily aim to be diverse and but teaching/field/research experience will be highly valued. Faculty with training in areas of social sciences that are directly relevant to school education e.g., psychology, child development, linguistics, sociology, philosophy, economics, and political science as well as from science education, mathematics education, social science education, and language education programmes will be attracted and retained in teacher education institutions, to strengthen multidisciplinary education of teachers and provide rigour in conceptual development.

15.9. All fresh Ph.D. entrants, irrespective of discipline, will be required to take credit-based courses in teaching/education/pedagogy/writing related to their chosen Ph.D subject during their doctoral training period. Exposure to pedagogical practices, designing curriculum, credible evaluation systems, communication, and so on will be ensured since many research scholars will go on to become faculty or public representatives/communicators of their chosen disciplines. Ph.D students will also have a minimum number of hours of actual teaching experience gathered through teaching assistantships and other means. Ph.D. programmes at universities around the country will be re-oriented for this purpose.

15.10. In-service continuous professional development for college and university teachers will continue through the existing institutional arrangements and ongoing initiatives; these will be strengthened and substantially expanded to meet the needs of enriched teaching-learning processes for quality education. The use of technology platforms such as SWAYAM/DIKSHA for online training of teachers will be encouraged, so that standardized training programmes can be administered to large numbers of teachers within a short span of time.

15.11. A National Mission for Mentoring shall be established, with a large pool of outstanding senior/retired faculty – including those with the ability to teach in Indian languages – who would be willing to provide short and long-term mentoring/professional support to university/college teachers.

16. Reimagining Vocational Education

16.1. The 12th Five-Year Plan (2012–2017) estimated that only a very small percentage of the Indian workforce in the age group of 19–24 (less than 5%) received formal vocational education Whereas in countries such as the USA the number is 52%, in Germany 75%, and South Korea it is as high as 96%. These numbers only underline the urgency of the need to hasten the spread of vocational education in India.

16.2. One of the primary reasons for the small numbers of students receiving vocational education is the fact that vocational education has in the past focused largely on Grades 11–12 and on dropouts in Grade 8 and upwards. Moreover, students passing out from Grades 11–12 with vocational subjects often did not have well-defined pathways to continue with their chosen vocations in higher education. The admission criteria for general higher education were also not designed to provide openings to students who had vocational education qualifications, leaving them at a disadvantage relative to their compatriots from 'mainstream' or 'academic' education. This led to a complete lack of vertical mobility for students from the vocational education stream, an issue that has only been addressed recently through the announcement of the National Skills Qualifications Framework (NSQF) in 2013.

16.3. Vocational education is perceived to be inferior to mainstream education and meant largely for students who are unable to cope with the latter. This is a perception that affects the choices students make. It is a serious concern that can only be dealt with by a complete re-imagination of how vocational education is offered to students in the future.

16.4. This policy aims to overcome the social status hierarchy associated with vocational education and requires integration of vocational education programmes into mainstream education in all education institutions in a phased manner. Beginning with vocational exposure at early ages in middle and secondary school, quality vocational education will be integrated smoothly into higher education. It will ensure that every child learns at least one vocation and is exposed to several more. This would lead to emphasizing the dignity of labour and importance of various vocations involving /Indian arts and artisanship.

16.5. By 2025, at least 50% of learners through the school and higher education system shall have exposure to vocational education, for which a clear action plan with targets and timelines will be developed. This is in alignment with Sustainable Development Goal 4.4 and will help to realize the full potential of India's demographic dividend. The number of students in vocational education will be considered while arriving at the GER targets. The development of vocational capacities will go hand-in-hand with the development of 'academic' or other capacities. Vocational education will be integrated in the educational offerings of all secondary schools in a phased manner over the next decade. Towards this, secondary schools will also collaborate with ITIs, polytechnics, local industry, etc. Skill labs will also be set up and created in the schools in a hub and spoke model which will allow other schools to use the facility. Higher education institutions will offer vocational education either on their own or in partnership with industry and NGOs. The B.Voc. degrees introduced in 2013 will continue to exist, but vocational courses will also be available to students enrolled in all other Bachelor's degree programmes, including the 4-year multidisciplinary Bachelor's programmes. HEIs will also be allowed to conduct short-term certificate courses in various skills including soft skills. 'Lok Vidya', i.e., important vocational knowledge developed in India, will be made accessible to students through integration into vocational education courses. The possibility of offering vocational courses through ODL mode will also be explored.

16.6. Vocational education will be integrated into all school and higher education institutions in a phased manner over the next decade. Focus areas for vocational education will be chosen based on skills gap analysis and mapping of local opportunities. MHRD will constitute a National Committee for the Integration of Vocational Education (NCIVE), consisting of experts in vocational education and representatives from across Ministries, in collaboration with industry, to oversee this effort.

16.7. Individual institutions that are early adopters must innovate to find models and practices that work and then share these with other institutions through mechanisms set up by NCIVE, so as to help extend the reach of vocational education. Different models of vocational education, and apprenticeships, will also be experimented by higher education institutions. Incubation centres will be set up in higher education institutions in partnership with industries.

16.8. The National Skills Qualifications Framework will be detailed further for each discipline vocation and profession. Further, Indian standards will be aligned with the International Standard Classification of Occupations maintained by the International Labour Organization. This Framework will provide the basis for Recognition of Prior Learning. Through this, dropouts from the formal

system will be reintegrated by aligning their practical experience with the relevant level of the Framework. The credit-based Framework will also facilitate mobility across 'general' and vocational education.

17. Catalysing Quality Academic Research in All Fields through a new National Research Foundation

17.1. Knowledge creation and research are critical in growing and sustaining a large and vibrant economy, uplifting society, and continuously inspiring a nation to achieve even greater heights. Indeed, some of the most prosperous civilizations (such as India, Mesopotamia, Egypt, and Greece) to the modern era (such as the United States, Germany, Israel, South Korea, and Japan), were/are strong knowledge societies that attained intellectual and material wealth in large part through celebrated and fundamental contributions to new knowledge in the realm of science as well as art, language, and culture that enhanced and uplifted not only their own civilizations but others around the globe.

17.2. A robust ecosystem of research is perhaps more important than ever with the rapid changes occurring in the world today, e.g., in the realm of climate change, population dynamics and management, biotechnology, an expanding digital marketplace, and the rise of machine learning and artificial intelligence. If India is to become a leader in these disparate areas, and truly achieve the potential of its vast talent pool to again become a leading knowledge society in the coming years and decades, the nation will require a significant expansion of its research capabilities and output across disciplines. Today, the criticality of research is more than ever before, for the economic, intellectual, societal, environmental, and technological health and progress of a nation.

17.3. Despite this critical importance of research, the research and innovation investment in India is, at the current time, only 0.69% of GDP as compared to 2.8% in the United States of America, 4.3% in Israel and 4.2% in South Korea.

17.4. The societal challenges that India needs to address today, such as access for all its citizens to clean drinking water and sanitation, quality education and healthcare, improved transportation, air quality, energy, and infrastructure, will require the implementation of approaches and solutions that are not only informed by top-notch science and technology but are also rooted in a deep understanding of the social sciences and humanities and the various socio-cultural and environmental dimensions of the nation. Facing and addressing these challenges will require high-quality interdisciplinary research across fields that must be done in India and cannot simply be imported; the ability to conduct one's own research also enables a country to much more easily import and adapt relevant research from abroad.

17.5. Furthermore, in addition to their value in solutions to societal problems, any country's identity, upliftment, spiritual/intellectual satisfaction and creativity is also attained in a major way through its history, art, language, and culture. Research in the arts and humanities, along with innovations in the sciences and social sciences, are, therefore, extremely important for the progress and enlightened nature of a nation.

17.6. Research and innovation at education institutions in India, particularly those that are engaged in higher education, is critical. Evidence from the world′s best universities throughout history shows that the best teaching and learning processes at the higher education level occur in environments where there is also a strong culture of research and knowledge creation; conversely, much of the very best research in the world has occurred in multidisciplinary university settings.

17.7. India has a long historical tradition of research and knowledge creation, in disciplines ranging from science and mathematics to art and literature to phonetics and languages to medicine and agriculture. This needs to be further strengthened to make India lead research and innovation in the

21st century, as a strong and enlightened knowledge society and one of the three largest economies in the world.

17.8. Thus, this Policy envisions a comprehensive approach to transforming the quality and quantity of research in India. This includes definitive shifts in school education to a more play and discovery-based style of learning with emphasis on the scientific method and critical thinking. This includes career counselling in schools towards identifying student interests and talents, promoting research in universities, the multidisciplinary nature of all HEIs and the emphasis on holistic education, the inclusion of research and internships in the undergraduate curriculum, faculty career management systems that give due weightage to research, and the governance and regulatory changes that encourage an environment of research and innovation. All of these aspects are extremely critical for developing a research mindset in the country.

17.9. To build on these various elements in a synergistic manner, and to thereby truly grow and catalyze quality research in the nation, this policy envisions the establishment of a National Research Foundation (NRF). The overarching goal of the NRF will be to enable a culture of research to permeate through our universities. In particular, the NRF will provide a reliable base of merit-based but equitable peer-reviewed research funding, helping to develop a culture of research in the country through suitable incentives for and recognition of outstanding research, and by undertaking major initiatives to seed and grow research at State Universities and other public institutions where research capability is currently limited. The NRF will competitively fund research in all disciplines. Successful research will be recognized, and where relevant, implemented through close linkages with governmental agencies as well as with industry and private/philanthropic organizations.

17.10. Institutions that currently fund research at some level, such as the Department of Science and Technology (DST), Department of Atomic Energy (DAE), Department of Bio-Technology (DBT), Indian Council of Agriculture Research (ICAR), Indian Council of Medical Research (ICMR), Indian Council of Historical Research (ICHR), and University Grants Commission (UGC), as well as various private and philanthropic organizations, will continue to independently fund research according to their priorities and needs. However, NRF will carefully coordinate with other funding agencies and will work with science, engineering, and other academies to ensure synergy of purpose and avoid duplication of efforts. The NRF will be governed, independently of the government, by a rotating Board of Governors consisting of the very best researchers and innovators across fields.

17.11. The primary activities of the NRF will be to:

(a) fund competitive, peer-reviewed grant proposals of all types and across all disciplines;
(b) seed, grow, and facilitate research at academic institutions, particularly at universities and colleges where research is currently in a nascent stage, through mentoring of such institutions;
(c) act as a liaison between researchers and relevant branches of government as well as industry, so that research scholars are constantly made aware of the most urgent national research issues, and so that policymakers are constantly made aware of the latest research breakthroughs; so as to allow breakthroughs to be optimally brought into policy and/or implementation; and
(d) recognise outstanding research and progress

18. Transforming the Regulatory System of Higher Education

18.1. Regulation of higher education has been too heavy-handed for decades; too much has been attempted to be regulated with too little effect. The mechanistic and disempowering nature of the regulatory system has been rife with very basic problems, such as heavy concentrations of power within a few bodies, conflicts of interest among these bodies, and a resulting lack of accountability. The regulatory system is in need of a complete overhaul in order to re-energize the higher education sector and enable it to thrive.

18.2. To address the above-mentioned issues, the regulatory system of higher education will ensure that the distinct functions of regulation, accreditation, funding, and academic standard setting will be performed by distinct, independent, and empowered bodies. This is considered essential to create checks-and-balances in the system, minimize conflicts of interest, and eliminate concentrations of power. To ensure that the four institutional structures carrying out these four essential functions work independently yet at the same time and work in synergy towards common goals. These four structures will be set up as four independent verticals within one umbrella institution, the Higher Education Commission of India (HECI).

18.3. The first vertical of HECI will be the National Higher Education Regulatory Council (NHERC). It will function as the common, single point regulator for the higher education sector including teacher education and excluding medical and legal education, thus eliminating the duplication and disjunction of regulatory efforts by the multiple regulatory agencies that exist at the current time. It will require a relook and repealing of existing Acts and restructuring of various existing regulatory bodies to enable this single point regulation. NHERC will be set up to regulate in a 'light but tight' and facilitative manner, meaning that a few important matters particularly financial probity, good governance, and the full online and offline public self-disclosure of all finances, audits, procedures, infrastructure, faculty/staff, courses, and educational outcomes will be very effectively regulated. This information will have to be made available and kept updated and accurate by all higher education institutions on a public website maintained by NHERC and on the institutions' websites. Any complaints or grievances from stakeholders and others arising out of the information placed in public domain shall be adjudicated by NHERC. Feedback from randomly selected students including differently-abled students at each HEI will be solicited online to ensure valuable input at regular intervals.

18.4. The primary mechanism to enable such regulation will be accreditation. The second vertical of HECI will, therefore, be a 'meta-accrediting body', called the National Accreditation Council (NAC). Accreditation of institutions will be based primarily on basic norms, public self-disclosure, good governance, and outcomes, and it will be carried out by an independent ecosystem of accrediting institutions supervised and overseen by NAC. The task to function as a recognized accreditor shall be awarded to an appropriate number of institutions by NAC. In the short term, a robust system of graded accreditation shall be established, which will specify phased benchmarks for all HEIs to achieve set levels of quality, self-governance, and autonomy. In turn, all HEIs will aim, through their Institutional Development Plans (IDPs), to attain the highest level of accreditation over the next 15 years, and thereby eventually aim to function as self-governing degree-granting institutions/clusters. In the long run, accreditation will become a binary process, as per the extant global practice.

18.5. The third vertical of HECI will be the Higher Education Grants Council (HEGC), which will carry out funding and financing of higher education based on transparent criteria, including the IDPs prepared by the institutions and the progress made on their implementation. HEGC will be entrusted with the disbursement of scholarships and developmental funds for launching new focus areas and expanding quality programme offerings at HEIs across disciplines and fields.

18.6. The fourth vertical of HECI will be the General Education Council (GEC), which will frame expected learning outcomes for higher education programmes, also referred to as 'graduate attributes'. A National Higher Education Qualification Framework (NHEQF) will be formulated by the GEC and it shall be in sync with the National Skills Qualifications Framework (NSQF) to ease the integration of vocational education into higher education. Higher education qualifications leading to a degree/diploma/certificate shall be described by the NHEQF in terms of such learning outcomes. In addition, the GEC shall set up facilitative norms for issues, such as credit transfer, equivalence, etc., through the NHEQF. The GEC will be mandated to identify specific skills that students must acquire during their academic programmes, with the aim of preparing well-rounded learners with 21st century skills.

18.7. The professional councils, such as the Indian Council for Agricultural Research (ICAR), Veterinary Council of India (VCI), National Council for Teacher Education (NCTE), Council of Architecture (CoA), National Council for Vocational Education and Training (NCVET) etc., will act

as Professional Standard Setting Bodies (PSSBs). They will play a key role in the higher education system and will be invited to be members of the GEC. These bodies, after restructuring as PSSBs, will continue to draw the curricula, lay down academic standards and coordinate between teaching, research and extension of their domain/discipline, as members of the GEC. As members of the GEC, they would help in specifying the curriculum framework, within which HEIs may prepare their own curricula. Thus, PSSBs would also set the standards or expectations in particular fields of learning and practice while having no regulatory role. All HEIs will decide how their educational programmes respond to these standards, among other considerations, and would also be able to reach out for support from these standard-setting bodies or PSSBs, if needed.

18.8. Such a system architecture will ensure the principle of functional separation by eliminating conflicts of interests between different roles. It will also aim to empower HEIs, while ensuring that the few key essential matters are given due attention. Responsibility and accountability shall devolve to the HEIs concomitantly. No distinction in such expectations shall be made between public and private HEIs.

18.9. Such a transformation will require existing structures and institutions to reinvent themselves and undergo an evolution of sorts. The separation of functions would mean that each vertical within HECI would take on a new, single role which is relevant, meaningful, and important in the new regulatory scheme.

18.10. The functioning of all the independent verticals for Regulation (NHERC), Accreditation (NAC), Funding (HEGC), and Academic Standard Setting (GEC) and the overarching autonomous umbrella body (HECI) itself will be based on transparent public disclosure, and use technology extensively to reduce human interface to ensure efficiency and transparency in their work. The underlying principle will be that of a faceless and transparent regulatory intervention using technology. Strict compliance measures with stringent action, including penalties for false disclosure of mandated information, will be ensured so that Higher Education Institutions are conforming to the basic minimum norms and standards. HECI itself will be resolving disputes among the four verticals. Each vertical in HECI will be an independent body consisting of persons having high expertise in the relevant areas along with integrity, commitment, and a demonstrated track record of public service. HECI itself will be a small, independent body of eminent public-spirited experts in higher education, which will oversee and monitor the integrity and effective functioning of HECI. Suitable mechanisms will be created within HECI to carry out its functions, including adjudication.

18.11. Setting up new quality HEIs will also be made far easier by the regulatory regime, while ensuring with great effectiveness that these are set up with the spirit of public service and with due financial backing for long-term stability. HEIs performing exceptionally well will be helped by Central and State governments to expand their institutions, and thereby attain larger numbers of students and faculty as well as disciplines and programmes. Public Philanthropic Partnership models for HEIs may also be piloted with the aim to further expand access to high-quality higher education.

Curbing Commercialization of Education

18.12. Multiple mechanisms with checks and balances will combat and stop the commercialization of higher education. This will be a key priority of the regulatory system. All education institutions will be held to similar standards of audit and disclosure as a 'not for profit' entity. Surpluses, if any, will be reinvested in the educational sector. There will be transparent public disclosure of all these financial matters with recourse to grievance-handling mechanisms to the general public. The accreditation system developed by NAC will provide a complementary check on this system, and NHERC will consider this as one of the key dimensions of its regulatory objective.

18.13. All HEIs - public and private - shall be treated on par within this regulatory regime. The regulatory regime shall encourage private philanthropic efforts in education. There will be common national guidelines for all legislative Acts that will form private HEIs. These common minimal guidelines will enable all such Acts to establish private HEIs, thus enabling common standards for

private and public HEIs. These common guidelines will cover Good Governance, Financial Stability & Security, Educational Outcomes, and Transparency of Disclosures.

18.14. Private HEIs having a philanthropic and public-spirited intent will be encouraged through a progressive regime of fees determination. Transparent mechanisms for fixing of fees with an upper limit, for different types of institutions depending on their accreditation, will be developed so that individual institutions are not adversely affected. This will empower private HEIs to set fees for their programmes independently, though within the laid-out norms and the broad applicable regulatory mechanism. Private HEIs will be encouraged to offer freeships and scholarships in significant numbers to their students. All fees and charges set by private HEIs will be transparently and fully disclosed, and there shall be no arbitrary increases in these fees/charges during the period of enrolment of any student. This fee determining mechanism will ensure reasonable recovery of cost while ensuring that HEIs discharge their social obligations.

19. Effective Governance and Leadership for Higher Education Institutions

19.1. It is effective governance and leadership that enables the creation of a culture of excellence and innovation in higher education institutions. The common feature of all world-class institutions globally including India has indeed been the existence of strong self-governance and outstanding merit-based appointments of institutional leaders.

19.2. Through a suitable system of graded accreditation and graded autonomy, and in a phased manner over a period of 15 years, all HEIs in India will aim to become independent self-governing institutions pursuing innovation and excellence. Measures will be taken at all HEIs to ensure leadership of the highest quality and promote an institutional culture of excellence. Upon receiving the appropriate graded accreditations that deem the institution ready for such a move, a Board of Governors (BoG) shall be established consisting of a group of highly qualified, competent, and dedicated individuals having proven capabilities and a strong sense of commitment to the institution. The BoG of an institution will be empowered to govern the institution free of any external interference, make all appointments including that of head of the institution, and take all decisions regarding governance. There shall be overarching legislation that will supersede any contravening provisions of other earlier legislation and would provide for constitution, appointment, modalities of functioning, rules and regulations, and the roles and responsibilities of the BoG. New members of the Board shall be identified by an expert committee appointed by the Board; and the selection of new members shall be carried out by the BoG itself. Equity considerations will also be taken care of while selecting the members. It is envisaged that all HEIs will be incentivized, supported, and mentored during this process, and shall aim to become autonomous and have such an empowered BoG by 2035.

19.3. The BoG shall be responsible and accountable to the stakeholders through transparent self-disclosures of all relevant records. It will be responsible for meeting all regulatory guidelines mandated by HECI through the National Higher Education Regulatory Council (NHERC).

19.4. All leadership positions and Heads of institutions will be offered to persons with high academic qualifications and demonstrated administrative and leadership capabilities along with abilities to manage complex situations. Leaders of an HEI will demonstrate strong alignment to Constitutional values and the overall vision of the institution, along with attributes such as a strong social commitment, belief in teamwork, pluralism, ability to work with diverse people, and a positive outlook. The selection shall be carried out by the BoG through a rigorous, impartial, merit-based, and competency-based process led by an Eminent Expert Committee (EEC) constituted by the BoG. While stability of tenure is important to ensure the development of a suitable culture, at the same time leadership succession will be planned with care to ensure that good practices that define an institution's processes do not end due to a change in leadership; leadership changes will come with sufficient overlaps, and not remain vacant, in order to ensure smooth transitions. Outstanding leaders will be identified and developed early, working their way through a ladder of leadership positions.

19.5. While being provided with adequate funding, legislative enablement, and autonomy in a phased manner, all HEIs, in turn, will display commitment to institutional excellence, engagement with their

local communities, and the highest standards of financial probity and accountability. Each institution will make a strategic Institutional Development Plan on the basis of which institutions will develop initiatives, assess their own progress, and reach the goals set therein, which could then become the basis for further public funding. The IDP shall be prepared with the joint participation of Board members, institutional leaders, faculty, students, and staff.

Part III. OTHER KEY AREAS OF FOCUS

20. Professional Education

20.1. Preparation of professionals must involve an education in the ethic and importance of public purpose, an education in the discipline, and an education for practice. It must centrally involve critical and interdisciplinary thinking, discussion, debate, research, and innovation. For this to be achieved, professional education should not take place in the isolation of one's specialty.

20.2. Professional education thus becomes an integral part of the overall higher education system. Stand-alone agricultural universities, legal universities, health science universities, technical universities, and stand-alone institutions in other fields, shall aim to become multidisciplinary institutions offering holistic and multidisciplinary education. All institutions offering either professional or general education will aim to organically evolve into institutions/clusters offering both seamlessly, and in an integrated manner by 2030.

20.3. Agricultural education with allied disciplines will be revived. Although Agricultural Universities comprise approximately 9% of all universities in the country, enrolment in agriculture and allied sciences is less than 1% of all enrolment in higher education. Both capacity and quality of agriculture and allied disciplines must be improved in order to increase agricultural productivity through better skilled graduates and technicians, innovative research, and market-based extension linked to technologies and practices. The preparation of professionals in agriculture and veterinary sciences through programmes integrated with general education will be increased sharply. The design of agricultural education will shift towards developing professionals with the ability to understand and use local knowledge, traditional knowledge, and emerging technologies while being cognizant of critical issues such as declining land productivity, climate change, food sufficiency for our growing population, etc. Institutions offering agricultural education must benefit the local community directly; one approach could be to set up Agricultural Technology Parks to promote technology incubation and dissemination and promote sustainable methodologies.

20.4. Legal education needs to be competitive globally, adopting best practices and embracing new technologies for wider access to and timely delivery of justice. At the same time, it must be informed and illuminated with Constitutional values of Justice - Social, Economic, and Political - and directed towards national reconstruction through instrumentation of democracy, rule of law, and human rights. The curricula for legal studies must reflect socio-cultural contexts along with, in an evidence-based manner, the history of legal thinking, principles of justice, the practice of jurisprudence, and other related content appropriately and adequately. State institutions offering law education must consider offering bilingual education for future lawyers and judges - in English and in the language of the State in which the institution is situated.

20.5. Healthcare education needs to be re-envisioned so that the duration, structure, and design of the educational programmes need to match the role requirements that graduates will play. Students will be assessed at regular intervals on well-defined parameters primarily required for working in primary care and in secondary hospitals. Given that people exercise pluralistic choices in healthcare, our healthcare education system must be integrative meaning thereby that all students of allopathic medical education must have a basic understanding of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy (AYUSH), and vice versa. There shall also be a much greater emphasis on preventive healthcare and community medicine in all forms of healthcare education.

20.6. Technical education includes degree and diploma programmes in, engineering, technology, management, architecture, town planning, pharmacy, hotel management, catering technology etc., which are critical to India's overall development. There will not only be a greater demand for well-qualified manpower in these sectors, it will also require closer collaborations between industry and higher education institutions to drive innovation and research in these fields. Furthermore, influence of technology on human endeavours is expected to erode the silos between technical education and other disciplines too. Technical education will, thus, also aim to be offered within multidisciplinary education institutions and programmes and have a renewed focus on opportunities to engage deeply with other disciplines. India must also take the lead in preparing professionals in cutting-edge areas that are fast gaining prominence, such as Artificial Intelligence (AI), 3-D machining, big data analysis, and machine learning, in addition to genomic studies, biotechnology, nanotechnology, neuroscience, with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

21. Adult Education and Lifelong Learning

21.1. The opportunity to attain foundational literacy, obtain an education, and pursue a livelihood must be viewed as basic rights of every citizen. Literacy and basic education open up whole new worlds of personal, civic, economic, and lifelong-learning opportunities for individuals that enable them to progress personally and professionally. At the level of society and the nation, literacy and basic education are powerful force multipliers which greatly enhance the success of all other developmental efforts. Worldwide data on nations indicate extremely high correlations between literacy rates and per capita GDP.

21.2. Meanwhile, being a non-literate member of a community, has innumerable disadvantages, including the inability to: carry out basic financial transactions; compare the quality/quantity of goods purchased against the price charged; fill out forms to apply for jobs, loans, services, etc.; comprehend public circulars and articles in the news media; use conventional and electronic mail to communicate and conduct business; make use of the internet and other technology to improve one's life and profession; comprehend directions and safety directives on the street, on medicines, etc.; help children with their education; be aware of one's basic rights and responsibilities as a citizen of India; appreciate works of literature; and pursue employment in medium or high-productivity sectors that require literacy. The abilities listed here are an illustrative list of outcomes to be achieved through adoption of innovative measures for Adult Education.

21.3. Extensive field studies and analyses, both in India and across the world, clearly demonstrate that volunteerism and community involvement and mobilization are key success factors of adult literacy programmes, in conjunction with political will, organizational structure, proper planning, adequate financial support, and high-quality capacity building of educators and volunteers. Successful literacy programmes result not only in the growth of literacy among adults, but also result in increased demand for education for all children in the community, as well as greater community contribution to positive social change. The National Literacy Mission, when it was launched in 1988, was largely based on the voluntary involvement and support of the people, and resulted in significant increases in national literacy during the period of 1991–2011, including among women, and also initiated dialogue and discussions on pertinent social issues of the day.

21.4. Strong and innovative government initiatives for adult education - in particular, to facilitate community involvement and the smooth and beneficial integration of technology - will be affected as soon as possible to expedite this all-important aim of achieving 100% literacy.

21.5. First, an outstanding adult education curriculum framework will be developed by a new and well-supported constituent body of the NCERT that is dedicated to adult education, so as to develop synergy with and build upon NCERT's existing expertise in establishing outstanding curricula for literacy, numeracy, basic education, vocational skills, and beyond. The curriculum framework for adult education will include at least five types of programmes, each with clearly defined outcomes: (a) foundational literacy and numeracy; (b) critical life skills (including financial literacy, digital literacy, commercial skills, health care and awareness, child care and education, and family welfare);

(c) vocational skills development (with a view towards obtaining local employment); (d) basic education (including preparatory, middle, and secondary stage equivalency); and (e) continuing education (including engaging holistic adult education courses in arts, sciences, technology, culture, sports, and recreation, as well as other topics of interest or use to local learners, such as more advanced material on critical life skills). The framework would keep in mind that adults in many cases will require rather different teaching-learning methods and materials than those designed for children.

21.6. Second, suitable infrastructure will be ensured so that all interested adults will have access to adult education and lifelong learning. A key initiative in this direction will be to use schools/ school complexes after school hours and on weekends and public library spaces for adult education courses which will be ICT-equipped when possible and for other community engagement and enrichment activities. The sharing of infrastructure for school, higher, adult, and vocational education, and for other community and volunteer activities, will be critical for ensuring efficient use of both physical and human resources as well as for creating synergy among these five types of education and beyond. For these reasons, Adult Education Centres (AECs) could also be included within other public institutions such as HEIs, vocational training centres, etc.

21.7. Third, the instructors/educators will be required to deliver the curriculum framework to mature learners for all five types of adult education as described in the Adult Education Curriculum Framework. These instructors will be trained by the National, State, and district level resource support institutions to organize and lead learning activities at Adult Education Centres, as well as coordinate with volunteer instructors. Qualified community members including from HEIs as part of each HEI's mission to engage with their local communities will be encouraged and welcomed to take a short training course and volunteer, as adult literacy instructors, or to serve as one-on-one volunteer tutors, and will be recognized for their critical service to the nation. States will also work with NGOs and other community organizations to enhance efforts towards literacy and adult education.

21.8. Fourth, all efforts will be undertaken to ensure the participation of community members in adult education. Social workers/counsellors travelling through their communities to track and ensure participation of non-enrolled students and dropouts will also be requested, during their travels, to gather data of parents, adolescents, and others interested in adult education opportunities both as learners and as teachers/tutors. The social workers/counsellors will then connect them with local Adult Education Centres (AECs). Opportunities for adult education will also be widely publicized, through advertisements and announcements and through events and initiatives of NGOs and other local organizations.

21.9. Fifth, improving the availability and accessibility of books is essential to inculcating the habit of reading within our communities and educational institutions. This Policy recommends that all communities and educational institutions - schools, colleges, universities and public libraries - will be strengthened and modernized to ensure an adequate supply of books that cater to the needs and interests of all students, including persons with disabilities and other differently-abled persons. The Central and State governments will take steps to ensure that books are made accessible and affordable to all across the country including socio-economically disadvantaged areas as well as those living in rural and remote areas. Both public and private sector agencies/institutions will devise strategies to improve the quality and attractiveness of books published in all Indian languages. Steps will be taken to enhance online accessibility of library books and further broad basing of digital libraries. For ensuring vibrant libraries in communities and educational institutions, it will be imperative to make available adequate library staff and also devise appropriate career pathways and CPD for them. Other steps will include strengthening all existing libraries, setting up rural libraries and reading rooms in disadvantaged regions, making widely available reading material in Indian languages, opening children's libraries and mobile libraries, establishing social book clubs across India and across subjects, and fostering greater collaborations between education institutions and libraries.

21.10. Finally, technology will be leveraged to strengthen and even undertake the above initiatives. Quality technology-based options for adult learning such as apps, online courses/modules, satellite-based TV channels, online books, and ICT-equipped libraries and Adult Education Centres, etc. will

be developed, through government and philanthropic initiatives as well as through crowd sourcing and competitions. In many cases, quality adult education could thereby be conducted in an online or blended mode.

22. Promotion of Indian Languages, Arts, and Culture

22.1. India is a treasure trove of culture, developed over thousands of years and manifested in the form of arts, works of literature, customs, traditions, linguistic expressions, artefacts, heritage sites, and more. Crores of people from around the world partake in, enjoy, and benefit from this cultural wealth daily, in the form of visiting India for tourism, experiencing Indian hospitality, purchasing India's handicrafts and handmade textiles, reading the classical literature of India, practicing yoga and meditation, being inspired by Indian philosophy, participating in India's unique festivals, appreciating India's diverse music and art, and watching Indian films, amongst many other aspects. It is this cultural and natural wealth that truly makes India, "Incredible !ndia", as per India's tourism slogan. The preservation and promotion of India's cultural wealth must be considered a high priority for the country, as it is truly important for the nation's identity as well as for its economy.

22.2. The promotion of Indian arts and culture is important not only for the nation but also for the individual. Cultural awareness and expression are among the major competencies considered important to develop in children, in order to provide them with a sense of identity, belonging, as well as an appreciation of other cultures and identities. It is through the development of a strong sense and knowledge of their own cultural history, arts, languages, and traditions that children can build a positive cultural identity and self-esteem. Thus, cultural awareness and expression are important contributors both to individual as well as societal well-being.

22.3. The arts form a major medium for imparting culture. The arts - besides strengthening cultural identity, awareness, and uplifting societies - are well known to enhance cognitive and creative abilities in individuals and increase individual happiness. The happiness/well-being, cognitive development, and cultural identity of individuals are important reasons that Indian arts of all kinds must be offered to students at all levels of education, starting with early childhood care and education.

22.4. Language, of course, is inextricably linked to art and culture. Different languages 'see' the world differently, and the structure of a language, therefore, determines a native speaker's perception of experience. In particular, languages influence the way people of a given culture speak with others, including with family members, authority figures, peers, and strangers, and influence the tone of conversation. The tone, perception of experience, and familiarity/'*apnapan*' inherent in conversations among speakers of a common language are a reflection and record of a culture. Culture is, thus, encased in our languages. Art, in the form of literature, plays, music, film, etc. cannot be fully appreciated without language. In order to preserve and promote culture, one must preserve and promote a culture's languages.

22.5. Unfortunately, Indian languages have not received their due attention and care, with the country losing over 220 languages in the last 50 years alone. UNESCO has declared 197 Indian languages as 'endangered'. Various unscripted languages are particularly in danger of becoming extinct. When senior member(s) of a tribe or community that speak such languages pass away, these languages often perish with them; too often, no concerted actions or measures are taken to preserve or record these rich languages/expressions of culture.

22.6. Moreover, even those languages of India that are not officially on such endangered lists, such as the 22 languages of Eighth Schedule of the Constitution of India, are facing serious difficulties on many fronts. Teaching and learning of Indian languages need to be integrated with school and higher education at every level. For languages to remain relevant and vibrant, there must be a steady stream of high-quality learning and print materials in these languages including textbooks, workbooks, videos, plays, poems, novels, magazines, etc. Languages must also have consistent official updates to their vocabularies and dictionaries, widely disseminated, so that the most current issues and concepts can be effectively discussed in these languages. Enabling such learning materials, print materials, and

translations of important materials from world languages, and constantly updating vocabularies, are carried out by countries around the world for languages such as English, French, German, Hebrew, Korean, and Japanese. However, India has remained quite slow in producing such learning and print materials and dictionaries to help keep its languages optimally vibrant and current with integrity.

22.7. Additionally, there has been a severe scarcity of skilled language teachers in India, despite various measures being taken. Language-teaching too must be improved to be more experiential and to focus on the ability to converse and interact in the language and not just on the literature, vocabulary, and grammar of the language. Languages must be used more extensively for conversation and for teaching-learning.

22.8. A number of initiatives to foster languages, arts, and culture in school children have been discussed in Chapter 4, which include a greater emphasis on music, arts, and crafts throughout all levels of school; early implementation of the three-language formula to promote multilingualism; teaching in the home/local language wherever possible; conducting more experiential language learning; the hiring of outstanding local artists, writers, craftspersons, and other experts as master instructors in various subjects of local expertise; accurate inclusion of traditional Indian knowledge including tribal and other local knowledge throughout into the curriculum, across humanities, sciences, arts, crafts, and sports, whenever relevant; and a much greater flexibility in the curriculum, especially in secondary schools and in higher education, so that students can choose the ideal balance among courses for themselves to develop their own creative, artistic, cultural, and academic paths.

22.9. To enable the key latter initiatives, a number of further actions will be taken in tandem at the higher education level and beyond. First, to develop and teach many of the courses of the type mentioned above, an excellent team of teachers and faculty will have to be developed. Strong departments and programmes in Indian languages, comparative literature, creative writing, arts, music, philosophy, etc. will be launched and developed across the country, and degrees including 4-year B.Ed. dual degrees will be developed in these subjects. These departments and programmes will, in particular help to develop a large cadre of high-quality language teachers - as well as teachers of art, music, philosophy and writing - who will be needed around the country to carry out this Policy. The NRF will fund quality research in all these areas. Outstanding local artists and craftspersons will be hired as guest faculty to promote local music, art, languages, and handicraft, and to ensure that students are aware of the culture and local knowledge where they study. Every higher education institution and even every school or school complex will aim to have Artist(s)-in-Residence to expose students to art, creativity, and the rich treasures of the region/country.

22.10. More HEIs, and more programmes in higher education, will use the mother tongue/local language as a medium of instruction, and/or offer programmes bilingually, in order to increase access and GER and also to promote the strength, usage, and vibrancy of all Indian languages. Private HEIs too will be encouraged and incentivized to use Indian languages as medium of instruction and/or offer bilingual programmes. Four-year B.Ed. dual degree programmes offered bilingually will also help, e.g. in training cadres of science and mathematics teachers to teach science bilingually at schools across the country.

22.11. High-quality programmes and degrees in Translation and Interpretation, Art and Museum Administration, Archaeology, Artefact Conservation, Graphic Design, and Web Design within the higher education system will also be created. In order to preserve and promote its art and culture, develop high-quality materials in various Indian languages, conserve artefacts, develop highly qualified individuals to curate and run museums and heritage or tourist sites, thereby also vastly strengthening the tourism industry.

22.12. The Policy recognizes that the knowledge of the rich diversity of India should be imbibed first hand by learners. This would mean including simple activities, like touring by students to different parts of the country, which will not only give a boost to tourism but will also lead to an understanding and appreciation of diversity, culture, traditions and knowledge of different parts of India. Towards this direction under '*Ek Bharat Shrestha Bharat*', 100 tourist destinations in the country will be identified where educational institutions will send students to study these destinations and their

history, scientific contributions, traditions, indigenous literature and knowledge, etc., as a part of augmenting their knowledge about these areas.

22.13. Creating such programmes and degrees in higher education, across the arts, languages, and humanities, will also come with expanded high-quality opportunities for employment that can make effective use of these qualifications. There are already hundreds of Academies, museums, art galleries, and heritage sites in dire need of qualified individuals for their effective functioning. As positions are filled with suitably qualified candidates, and further artefacts are procured and conserved, additional museums, including virtual museums/e-museums, galleries, and heritage sites may contribute to the conservation of our heritage as well as to India's tourism industry.

22.14. India will also urgently expand its translation and interpretation efforts in order to make high-quality learning materials and other important written and spoken material available to the public in various Indian and foreign languages. For this, an Indian Institute of Translation and Interpretation (IITI) will be established. Such an institute would provide a truly important service for the country, as well as employ numerous multilingual language and subject experts, and experts in translation and interpretation, which will help to promote all Indian languages. The IITI shall also make extensive use of technology to aid in its translation and interpretation efforts. The IITI could naturally grow with time, and be housed in multiple locations including in HEIs to facilitate collaborations with other research departments as demand and the number of qualified candidates grows.

22.15. Due to its vast and significant contributions and literature across genres and subjects, its cultural significance, and its scientific nature, rather than being restricted to single-stream Sanskrit Pathshalas and Universities, Sanskrit will be mainstreamed with strong offerings in school - including as one of the language options in the three-language formula - as well as in higher education. It will be taught not in isolation, but in interesting and innovative ways, and connected to other contemporary and relevant subjects such as mathematics, astronomy, philosophy, linguistics, dramatics, yoga, etc. Thus, in consonance with the rest of this policy, Sanskrit Universities too will move towards becoming large multidisciplinary institutions of higher learning. Departments of Sanskrit that conduct teaching and outstanding interdisciplinary research on Sanskrit and Sanskrit Knowledge Systems will be established/strengthened across the new multidisciplinary higher education system. Sanskrit will become a natural part of a holistic multidisciplinary higher education if a student so chooses. Sanskrit teachers in large numbers will be professionalized across the country in mission mode through the offering of 4-year integrated multidisciplinary B.Ed. dual degrees in education and Sanskrit.

22.16. India will similarly expand its institutes and universities studying all classical languages and literature, with strong efforts to collect, preserve, translate, and study the tens of thousands of manuscripts that have not yet received their due attention. Sanskrit and all Indian language institutes and departments across the country will be significantly strengthened, with adequate training given to large new batches of students to study, in particular, the large numbers of manuscripts and their interrelations with other subjects. Classical language institutes will aim to be merged with universities, while maintaining their autonomy, so that faculty may work, and students too may be trained as part of robust and rigorous multidisciplinary programmes. Universities dedicated to languages will become multidisciplinary, towards the same end; where relevant, they may then also offer B.Ed. dual degrees in education and a language, to develop outstanding language teachers in that language. Further, it is also proposed that a new institution for Languages will be established. National Institute (or Institutes) for Pali, Persian and Prakrit will also be set up within a university campus. Similar initiatives will be carried out for institutes and universities studying Indian arts, art history, and Indology. Research for outstanding work in all these areas will be supported by the NRF.

22.17. Efforts to preserve and promote all Indian languages including classical, tribal and endangered languages will be taken on with new vigour. Technology and crowdsourcing, with extensive participation of the people, will play a crucial role in these efforts.

22.18. For each of the languages mentioned in the Eighth Schedule of the Constitution of India, Academies will be established consisting of some of the greatest scholars and native speakers to

determine simple yet accurate vocabulary for the latest concepts, and to release the latest dictionaries on a regular basis (analogous to the successful efforts for many other languages around the world). The Academies would also consult with each other, and in some cases take the best suggestions from the public, in order to construct these dictionaries attempting to adopt common words whenever possible. These dictionaries would be widely disseminated, for use in education, journalism, writing, speechmaking, and beyond, and would be available on the web as well as in book form. These Academies for Eighth Schedule languages will be established by the Central Government in consultation or collaboration with State Governments. Academies for other highly spoken Indian languages may also be similarly established by the Centre and/or States.

22.19. All languages in India, and their associated arts and culture will be documented through a web-based platform/portal/wiki, in order to preserve endangered and all Indian languages and their associated rich local arts and culture. The platform will contain videos, dictionaries, recordings, and more, of people (especially elders) speaking the language, telling stories, reciting poetry, and performing plays, folk songs and dances, and more. People from across the country will be invited to contribute to these efforts by adding relevant material onto these platforms/portals/wikis. Universities and their research teams will work with each other and with communities across the country towards enriching such platforms. These preservation efforts, and the associated research projects, e.g., in history, archaeology, linguistics, etc., will be funded by the NRF.

22.20. Scholarships for people of all ages to study Indian Languages, Arts, and Culture with local masters and/or within the higher education system will be established. The promotion of Indian languages is possible only if they are used regularly and if they are used for teaching and learning. Incentives, such as prizes for outstanding poetry and prose in Indian languages across categories, will be established to ensure vibrant poetry, novels, nonfiction books, textbooks, journalism, and other works in all Indian languages. Proficiency in Indian languages will be included as part of qualification parameters for employment opportunities.

23. Technology Use and Integration

23.1. India is a global leader in information and communication technology and in other cutting-edge domains, such as space. The Digital India Campaign is helping to transform the entire nation into a digitally empowered society and knowledge economy. While education will play a critical role in this transformation, technology itself will play an important role in the improvement of educational processes and outcomes; thus, the relationship between technology and education at all levels is bi-directional.

23.2. Given the explosive pace of technological development allied with the sheer creativity of tech-savvy teachers and entrepreneurs including student entrepreneurs, it is certain that technology will impact education in multiple ways, only some of which can be foreseen at the present time. New technologies involving artificial intelligence, machine learning, block chains, smart boards, handheld computing devices, adaptive computer testing for student development, and other forms of educational software and hardware will not just change what students learn in the classroom but how they learn, and thus these areas and beyond will require extensive research both on the technological as well as educational fronts.

23.3. Use and integration of technology to improve multiple aspects of education will be supported and adopted, provided these interventions are rigorously and transparently evaluated in relevant contexts before they are scaled up. An autonomous body, the National Educational Technology Forum (NETF), will be created to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration, and so on, both for school and higher education. The aim of the NETF will be to facilitate decision making on the induction, deployment, and use of technology, by providing to the leadership of education institutions, State and Central governments, and other stakeholders, the latest knowledge and research as well as the opportunity to consult and share best practices. The NETF will have the following functions:

a) provide independent evidence-based advice to Central and State Government agencies on technology-based interventions;
b) build intellectual and institutional capacities in educational technology;
c) envision strategic thrust areas in this domain; and
d) articulate new directions for research and innovation.

23.4. To remain relevant in the fast-changing field of educational technology, the NETF will maintain a regular inflow of authentic data from multiple sources including educational technology innovators and practitioners and will engage with a diverse set of researchers to analyze the data. To support the development of a vibrant body of knowledge and practice, the NETF will organize multiple regional and national conferences, workshops, etc. to solicit inputs from national and international educational technology researchers, entrepreneurs, and practitioners.

23.5. The thrust of technological interventions will be for the purposes of improving teaching-learning and evaluation processes, supporting teacher preparation and professional development, enhancing educational access, and streamlining educational planning, management, and administration including processes related to admissions, attendance, assessments, etc.

23.6. A rich variety of educational software, for all the above purposes, will be developed and made available for students and teachers at all levels. All such software will be available in all major Indian languages and will be accessible to a wide range of users including students in remote areas and *Divyang* students. Teaching-learning e-content will continue to be developed by all States in all regional languages, as well as by the NCERT, CIET, CBSE, NIOS, and other bodies/institutions, and will be uploaded onto the DIKSHA platform. This platform may also be utilized for Teacher's Professional Development through e-content. CIET will be strengthened to promote and expand DIKSHA as well as other education technology initiatives. Suitable equipment will be made available to teachers at schools so that teachers can suitably integrate e-contents into teaching-learning practices. Technology-based education platforms, such as DIKSHA/SWAYAM, will be better integrated across school and higher education, and will include ratings/reviews by users, so as to enable content developers create user friendly and qualitative content.

23.7. Particular attention will need to be paid to emerging disruptive technologies that will necessarily transform the education system. When the 1986/1992 National Policy on Education was formulated, it was difficult to predict the disruptive effect that the internet would have brought. Our present education system's inability to cope with these rapid and disruptive changes places us individually and nationally at a perilous disadvantage in an increasingly competitive world. For example, while computers have largely surpassed humans in leveraging factual and procedural knowledge, our education at all levels excessively burdens students with such knowledge at the expense of developing their higher-order competencies.

23.8. This policy has been formulated at a time when an unquestionably disruptive technology - Artificial Intelligence (AI) 3D/7D Virtual Reality - has emerged. As the cost of AI-based prediction falls, AI will be able to match or outperform and, therefore, be a valuable aid to even skilled professionals such as doctors in certain predictive tasks. AI's disruptive potential in the workplace is clear, and the education system must be poised to respond quickly. One of the permanent tasks of the NETF will be to categorize emergent technologies based on their potential and estimated timeframe for disruption, and to periodically present this analysis to MHRD. Based on these inputs, MHRD will formally identify those technologies whose emergence demands responses from the education system.

23.9. In response to MHRD's formal recognition of a new disruptive technology, the National Research Foundation will initiate or expand research efforts in the technology. In the context of AI, NRF may consider a three-pronged approach: (a) advancing core AI research, (b) developing and deploying application-based research, and (c) advancing international research efforts to address global challenges in areas such as healthcare, agriculture, and climate change using AI.

23.10. HEIs will play an active role not only in conducting research on disruptive technologies but also in creating initial versions of instructional materials and courses including online courses in cutting-edge domains and assessing their impact on specific areas such as professional education. Once the technology has attained a level of maturity, HEIs with thousands of students will be ideally placed to scale these teaching and skilling efforts, which will include targeted training for job readiness. Disruptive technologies will make certain jobs redundant, and hence approaches to skilling and deskilling that are both efficient and ensure quality will be of increasing importance to create and sustain employment. Institutions will have autonomy to approve institutional and non-institutional partners to deliver such training, which will be integrated with skills and higher education frameworks.

23.11. Universities will aim to offer Ph.D. and Masters programmes in core areas such as Machine Learning as well as multidisciplinary fields "AI + X" and professional areas like health care, agriculture, and law. They may also develop and disseminate courses in these areas via platforms, such as SWAYAM. For rapid adoption, HEIs may blend these online courses with traditional teaching in undergraduate and vocational programmes. HEIs may also offer targeted training in low-expertise tasks for supporting the AI value chain such as data annotation, image classification, and speech transcription. Efforts to teach languages to school students will be dovetailed with efforts to enhance Natural Language Processing for India's diverse languages.

23.12. As disruptive technologies emerge, schooling and continuing education will assist in raising the general populace′s awareness of their potential disruptive effects and will also address related issues. This awareness is necessary to have informed public consent on matters related to these technologies. In school, the study of current affairs and ethical issues will include a discussion on disruptive technologies such as those identified by NETF/MHRD. Appropriate instructional and discussion materials will also be prepared for continuing education.

23.13. Data is a key fuel for AI-based technologies, and it is critical to raise awareness on issues of privacy, laws, and standards associated with data handling and data protection, etc. It is also necessary to highlight ethical issues surrounding the development and deployment of AI-based technologies. Education will play a key role in these awareness raising efforts. Other disruptive technologies that are expected to change the way we live, and, therefore, change the way we educate students, include those relating to clean and renewable energy, water conservation, sustainable farming, environmental preservation, and other green initiatives; these will also receive prioritized attention in education.

24. Online and Digital Education: Ensuring Equitable Use of Technology

24.1. New circumstances and realities require new initiatives. The recent rise in epidemics and pandemics necessitates that we are ready with alternative modes of quality education whenever and wherever traditional and in-person modes of education are not possible. In this regard, the National Education Policy 2020 recognizes the importance of leveraging the advantages of technology while acknowledging its potential risks and dangers. It calls for carefully designed and appropriately scaled pilot studies to determine how the benefits of online/digital education can be reaped while addressing or mitigating the downsides. In the meantime, the existing digital platforms and ongoing ICT-based educational initiatives must be optimized and expanded to meet the current and future challenges in providing quality education for all.

24.2. However, the benefits of online/digital education cannot be leveraged unless the digital divide is eliminated through concerted efforts, such as the Digital India campaign and the availability of affordable computing devices. It is important that the use of technology for online and digital education adequately addresses concerns of equity.

24.3. Teachers require suitable training and development to be effective online educators. It cannot be assumed that a good teacher in a traditional classroom will automatically be a good teacher in an online classroom. Aside from changes required in pedagogy, online assessments also require a

different approach. There are numerous challenges to conducting online examinations at scale, including limitations on the types of questions that can be asked in an online environment, handling network and power disruptions, and preventing unethical practices. Certain types of courses/subjects, such as performing arts and science practical have limitations in the online/digital education space, which can be overcome to a partial extent with innovative measures. Further, unless online education is blended with experiential and activity-based learning, it will tend to become a screen-based education with limited focus on the social, affective and psychomotor dimensions of learning.

24.4. Given the emergence of digital technologies and the emerging importance of leveraging technology for teaching-learning at all levels from school to higher education, this Policy recommends the following key initiatives:

(a) **Pilot studies for online education**: Appropriate agencies, such as the NETF, CIET, NIOS, IGNOU, IITs, NITs, etc. will be identified to conduct a series of pilot studies, in parallel, to evaluate the benefits of integrating education with online education while mitigating the downsides and also to study related areas, such as, student device addiction, most preferred formats of e-content, etc. The results of these pilot studies will be publicly communicated and used for continuous improvement.

(b) **Digital infrastructure**: There is a need to invest in creation of open, interoperable, evolvable, public digital infrastructure in the education sector that can be used by multiple platforms and point solutions, to solve for India's scale, diversity, complexity and device penetration. This will ensure that the technology-based solutions do not become outdated with the rapid advances in technology.

(c) **Online teaching platform and tools**: Appropriate existing e-learning platforms such as SWAYAM, DIKSHA, will be extended to provide teachers with a structured, user-friendly, rich set of assistive tools for monitoring progress of learners. Tools, such as, two-way video and two-way-audio interface for holding online classes are a real necessity as the present pandemic has shown.

(d) **Content creation, digital repository, and dissemination**: A digital repository of content including creation of coursework, Learning Games & Simulations, Augmented Reality and Virtual Reality will be developed, with a clear public system for ratings by users on effectiveness and quality. For fun based learning student-appropriate tools like apps, gamification of Indian art and culture, in multiple languages, with clear operating instructions, will also be created. A reliable backup mechanism for disseminating e-content to students will be provided.

(e) **Addressing the digital divide**: Given the fact that there still persists a substantial section of the population whose digital access is highly limited, the existing mass media, such as television, radio, and community radio will be extensively used for telecast and broadcasts. Such educational programmes will be made available 24/7 in different languages to cater to the varying needs of the student population. A special focus on content in all Indian languages will be emphasized and required; digital content will need to reach the teachers and students in their medium of instruction as far as possible.

(f) **Virtual Labs:** Existing e-learning platforms such as DIKSHA, SWAYAM and SWAYAMPRABHA will also be leveraged for creating virtual labs so that all students have equal access to quality practical and hands-on experiment-based learning experiences. The possibility of providing adequate access to SEDG students and teachers through suitable digital devices, such as tablets with pre-loaded content, will be considered and developed.

(g) **Training and incentives for teachers**: Teachers will undergo rigorous training in learner-centric pedagogy and on how to become high-quality online content creators themselves using online teaching platforms and tools. There will be emphasis on the teacher's role in facilitating active student engagement with the content and with each other.

(h) **Online assessment and examinations**: Appropriate bodies, such as the proposed National Assessment Centre or PARAKH, School Boards, NTA, and other identified bodies will design and implement assessment frameworks encompassing design of competencies, portfolio, rubrics, standardized assessments, and assessment analytics. Studies will be undertaken to pilot new ways of assessment using education technologies focusing on 21st century skills.

(i) **Blended models of learning**: While promoting digital learning and education, the importance of face-to-face in-person learning is fully recognized. Accordingly, different effective models of blended learning will be identified for appropriate replication for different subjects.

(j) **Laying down standards**: As research on online/digital education emerges, NETF and other appropriate bodies shall set up standards of content, technology, and pedagogy for online/digital teaching-learning. These standards will help to formulate guidelines for e-learning by States, Boards, schools and school complexes, HEIs, etc.

24.5 Creating a Dedicated Unit for Building of World Class, Digital Infrastructure, Educational Digital Content and Capacity

Technology in education is a journey and not a destination and capacity will be needed to orchestrate the various ecosystem players to implement policy objectives. A dedicated unit for the purpose of orchestrating the building of digital infrastructure, digital content and capacity building will be created in the Ministry to look after the e-education needs of both school and higher education. Since technology is rapidly evolving, and needs specialists to deliver high quality e-learning, a vibrant ecosystem has to be encouraged to create solutions that not only solve India's challenges of scale, diversity, equity, but also evolve in keeping with the rapid changes in technology, whose half-life reduces with each passing year. This centre will, therefore, consist of experts drawn from the field of administration, education, educational technology, digital pedagogy and assessment, e-governance, etc.

Part IV. MAKING IT HAPPEN

25. Strengthening the Central Advisory Board of Education

25.1. Achieving successful implementation of this policy demands a long-term vision, availability of expertise on a sustained basis, and concerted action from all concerned encompassing National, State, institutional, and individual levels. In this context, the Policy recommends strengthening and empowering the Central Advisory Board of Education (CABE) which will have a much greater mandate and not only a forum for widespread consultation and examination of issues relating to educational and cultural development. The remodeled and rejuvenated CABE shall also be responsible for developing, articulating, evaluating, and revising the vision of education in the country on a continuous basis, in close collaboration with MHRD and the corresponding apex bodies of States. It shall also create and continuously review the institutional frameworks that shall help attain this vision.

25.2. To bring the focus back on education and learning, it is desirable that the Ministry of Human Resource Development (MHRD) be re-designated as the Ministry of Education (MoE).

26. Financing: Affordable and Quality Education for All

26.1. The Policy commits to significantly raising educational investment, as there is no better investment towards a society's future than the high-quality education of our young people. Unfortunately, public expenditure on education in India has not come close to the recommended level of 6% of GDP, as envisaged by the 1968 Policy, reiterated in the Policy of 1986, and which was further reaffirmed in the 1992 review of the Policy. The current public (Government - Centre and States) expenditure on education in India has been around 4.43% of GDP (Analysis of Budgeted

Expenditure 2017-18) and only around 10% of the total Government spending towards education (Economic Survey 2017-18). These numbers are far smaller than most developed and developing countries.

26.2. In order to attain the goal of education with excellence and the corresponding multitude of benefits to this Nation and its economy, this Policy unequivocally endorses and envisions a substantial increase in public investment in education by both the Central government and all State Governments. The Centre and the States will work together to increase the public investment in Education sector to reach 6% of GDP at the earliest. This is considered extremely critical for achieving the high-quality and equitable public education system that is truly needed for India's future economic, social, cultural, intellectual, and technological progress and growth.

26.3. In particular, financial support will be provided to various critical elements and components of education, such as ensuring universal access, learning resources, nutritional support, matters of student safety and well-being, adequate numbers of teachers and staff, teacher development, and support for all key initiatives towards equitable high-quality education for underprivileged and socio-economically disadvantaged groups.

26.4. In addition to one-time expenditures, primarily related to infrastructure and resources, this Policy identifies the following key long-term thrust areas for financing to cultivate an education system: (a) universal provisioning of quality early childhood care education; (b) ensuring foundational literacy and numeracy; (c) providing adequate and appropriate resourcing of school complexes/clusters; (d) providing food and nutrition (breakfast and midday meals); (e) investing in teacher education and continuing professional development of teachers; (f) revamping colleges and universities to foster excellence; (g) cultivating research; and (h) extensive use of technology and online education.

26.5. Even the low level of funding on education in India, is frequently not spent in a timely manner at the District/institution level, hampering the achievement of the intended targets of those funds. Hence, the need is to increase efficiency in use of available budget by suitable policy changes. Financial governance and management will focus on the smooth, timely, and appropriate flow of funds, and their usage with probity; administrative processes will be suitably amended and streamlined so that the disbursal mechanism may not lead to a high volume of unspent balances. The provisions of GFR, PFMS and 'Just in Time' release to implementing agencies will be followed for efficient use of government resources and avoiding parking of funds. Mechanism of performance-based funding to States / HEIs may be devised. Similarly, efficient mechanism will be ensured for the optimal allocation and utilization of funds earmarked for SEDGs. The new suggested regulatory regime, with clear separations of roles and transparent self-disclosures, empowerment and autonomy to institutions, and the appointment of outstanding and qualified experts to leadership positions will help to enable a far smoother, quicker, and more transparent flow of funds.

26.6. The Policy also calls for the rejuvenation, active promotion, and support for private philanthropic activity in the education sector. In particular, over and above the public budgetary support which would have been otherwise provided to them, any public institution can take initiatives towards raising private philanthropic funds to enhance educational experiences.

26.7. The matter of commercialization of education has been dealt with by the Policy through multiple relevant fronts, including: the 'light but tight' regulatory approach that mandates full public self-disclosure of finances, procedures, course and programme offerings, and educational outcomes; the substantial investment in public education; and mechanisms for good governance of all institutions, public and private. Similarly, opportunities for higher cost recovery without affecting the needy or deserving sections will also be explored.

27. Implementation

27.1. Any policy's effectiveness depends on its implementation. Such implementation will require multiple initiatives and actions, which will have to be taken by multiple bodies in a synchronized and

systematic manner. Therefore, the implementation of this Policy will be led by various bodies including MHRD, CABE, Union and State Governments, education-related Ministries, State Departments of Education, Boards, NTA, the regulatory bodies of school and higher education, NCERT, SCERTs, schools, and HEIs along with timelines and a plan for review, in order to ensure that the policy is implemented in its spirit and intent, through coherence in planning and synergy across all these bodies involved in education.

27.2. Implementation will be guided by the following principles. First, implementation of the spirit and intent of the Policy will be the most critical matter. Second, it is important to implement the policy initiatives in a phased manner, as each policy point has several steps, each of which requires the previous step to be implemented successfully. Third, prioritization will be important in ensuring optimal sequencing of policy points, and that the most critical and urgent actions are taken up first, thereby enabling a strong base. Fourth, comprehensiveness in implementation will be key; as this Policy is interconnected and holistic, only a full-fledged implementation, and not a piecemeal one, will ensure that the desired objectives are achieved. Fifth, since education is a concurrent subject, it will need careful planning, joint monitoring, and collaborative implementation between the Centre and States. Sixth, timely infusion of requisite resources - human, infrastructural, and financial - at the Central and State levels will be crucial for the satisfactory execution of the Policy. Finally, careful analysis and review of the linkages between multiple parallel implementation steps will be necessary in order to ensure effective dovetailing of all initiatives. This will also include early investment in some of the specific actions (such as the setting up of early childhood care and education infrastructure) that will be imperative to ensuring a strong base and a smooth progression for all subsequent programmes and actions.

27.3. Subject-wise implementation committees of experts in cooperation and consultation with other relevant Ministries will be set up at both the Central and State levels to develop detailed implementation plans for each aspect of this Policy in accordance with the above principles to achieve the goals of the Policy in a clear and phased manner. Yearly joint reviews of the progress of implementation of the policy, in accordance with the targets set for each action, will be conducted by designated teams constituted by MHRD and the States, and reviews will be shared with CABE. In the decade of 2030-40, the entire policy will be in an operational mode, following which another comprehensive review will be undertaken.

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Abbreviations

ABC	Academic Bank of Credit
AI	Artificial Intelligence
AC	Autonomous degree-granting College
AEC	Adult Education Centre
API	Application Programming Interface
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
B.Ed.	Bachelor of Education
BEO	Block Education Officer
BITE	Block Institute of Teacher Education
BoA	Board of Assessment
BoG	Board of Governors
BRC	Block Resource Centre
B.Voc	Bachelor of Vocational Education
CABE	Central Advisory Board of Education
CBCS	Choice Based Credit System
CBSE	Central Board of Secondary Education
CIET	Central Institute of Educational Technology
CMP	Career Management and Progression
CoA	Council of Architecture
CPD	Continuous Professional Development
CRC	Cluster Resource Centre
CWSN	Children With Special Needs
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DEO	District Education Officer
DIET	District Institute of Education and Training
DIKSHA	Digital Infrastructure for Knowledge Sharing
DSE	Directorate of School Education
DST	Department of Science and Technology
ECCE	Early Childhood Care and Education
EEC	Eminent Expert Committee
GCED	Global Citizenship Education
GDP	Gross Domestic Product
GEC	General Education Council
GER	Gross Enrolment Ratio
GFR	General Financial Rule
HECI	Higher Education Commission of India
HEGC	Higher Education Grants Council
HEI	Higher Education Institutions
ICAR	Indian Council of Agricultural Research
ICHR	Indian Council of Historical Research
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
IDP	Institutional Development Plan
IGNOU	Indira Gandhi National Open University
IIM	Indian Institute of Management
IIT	Indian Institute of Technology
IITI	Indian Institute of Translation and Interpretation
ISL	Indian Sign Language
ITI	Industrial Training Institute
M.Ed.	Master of Education
MBBS	Bachelor of Medicine and Bachelor of Surgery
MERU	Multidisciplinary Education and Research Universities
MHFW	Ministry of Health and Family Welfare

MHRD	Ministry of Human Resource Development
MoE	Ministry of Education
MOOC	Massive Open Online Course
MOU	Memorandum of Understanding
M. Phil	Master of Philosophy
MWCD	Ministry of Women and Child Development
NAC	National Accreditation Council
NAS	National Achievement Survey
NCC	National Cadet Corps
NCERT	National Council of Educational Research and Training
NCF	National Curriculum Framework
NCFSE	National Curriculum Framework for School Education
NCFTE	National Curriculum Framework for Teacher Education
NCIVE	National Committee for the Integration of Vocational Education
NCPFECCE	National Curricular and Pedagogical Framework for Early Childhood Care and Education
NCTE	National Council for Teacher Education
NCVET	National Council for Vocational Education and Training
NETF	National Educational Technology Forum
NGO	Non-Governmental Organization
NHEQF	National Higher Education Qualifications Framework
NHERC	National Higher Education Regulatory Council
NIOS	National Institute of Open Schooling
NIT	National Institute of Technology
NITI	National Institution for Transforming India
NPE	National Policy on Education
NPST	National Professional Standards for Teachers
NRF	National Research Foundation
NSQF	National Skills Qualifications Framework
NSSO	National Sample Survey Office
NTA	National Testing Agency
OBC	Other Backward Classes
ODL	Open and Distance Learning
PARAKH	Performance Assessment, Review and Analysis of Knowledge for Holistic development
PCI	Pharmacy Council of India
PFMS	Public Financial Management System
Ph.D	Doctor of Philosophy
PSSB	Professional Standard Setting Body
PTR	Pupil Teacher Ratio
R&I	Research and Innovation
RCI	Rehabilitation Council of India
RPWD	Rights of Persons with Disabilities
SAS	State Achievement Survey
SC	Scheduled Caste(s)
SCDP	School Complex/Cluster Development Plans
SCERT	State Council of Educational Research and Training
SCF	State Curricular Framework
SCMC	School Complex Management Committee
SDG	Sustainable Development Goal
SDP	School Development Plan
SEDG	Socio-Economically Disadvantaged Group
SEZ	Special Education Zone
SIOS	State Institutes of Open Schooling
SMC	School Management Committee
SQAAF	School Quality Assessment and Accreditation Framework
SSA	Sarva Shiksha Abhiyan
SSS	Simple Standard Sanskrit

SSSA	State School Standards Authority
ST	Scheduled Tribe(s)
STEM	Science, Technology, Engineering, and Mathematics
STS	Sanskrit Through Sanskrit
SWAYAM	Study Webs of Active Learning for Young Aspiring Minds
TEI	Teacher Education Institution
TET	Teacher Eligibility Test
U-DISE	Unified District Information System for Education
UGC	University Grants Commission
UNESCO	United Nations Educational, Scientific and Cultural Organization
UT	Union Territory
VCI	Veterinary Council of India

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Chapter 1. Chatbots Breaking Bad

A NOTE FOR EARLY RELEASE READERS

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

This will be the 1st chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Large Language Models and Generative AI jumped to the forefront of public consciousness with the release of ChatGPT on November 30, 2022. Within five days, it went viral on social media and attracted its first million users. By January, ChatGPT surpassed One Hundred Million users - making it the fastest-growing internet service in history.

However, a steady stream of security concerns emerged in the following months. These included issues around privacy and security that caused companies such as Samsung and countries like Italy to ban its usage. In this book, we'll delve into what underlies these concerns and how you can mitigate these issues. However, to best understand what's going on here and why these problems are so challenging to solve, in this chapter, we will briefly rewind further in time. In doing so, we'll see these types of issues aren't new and understand why they will be so hard to fix permanently.

Let's Talk About Tay

In March 2016, Microsoft announced a new project called Tay. Microsoft intended Tay to be "a chatbot created for 18- to 24-year-olds in the U.S. for entertainment purposes." It was a cute name for a fluffy, early experiment in AI. Users could converse with Tay via Twitter, Snapchat, and other social apps. It was built with the goal of conducting real-world research on conversational understanding.

While the original announcement of this project seems impossible to find now on the Internet, a TechCrunch article

from its launch date does an excellent job of summarizing the goals of the project:

“For example, you can ask Tay for a joke, play a game with Tay, ask for a story, send a picture to receive a comment back, ask for your horoscope, and more. Plus, Microsoft says the bot will get smarter the more you interact with it via chat, making for an increasingly personalized experience as time goes on.”[1]

A big part of the experiment was that Tay could “learn” from conversations and extend her knowledge based on these interactions. Tay was designed to use these chat interactions to capture user input and integrate it as training data to make herself more capable – a laudable research goal.

However, this experiment quickly went wrong. Tay’s life was tragically cut short after less than 24 hours. Let’s look at what happened and see what we can learn.

Tay’s Rapid Decline

Tay’s lifetime started off simply enough with a tweet following the well-known *Hello World* pattern that new software systems have been using to introduce themselves since the beginning of time.

> hellooooooo w🌍rld!!!
>
> – TayTweets (@TayandYou) March 23, 2016

But within hours of Tay's release, it became clear that maybe something wasn't right. TechCrunch noted, "As for what it's like to interact with Tay? Well, it's a little bizarre. The bot certainly is opinionated, not afraid to curse." With tweets like this starting to appear in public in just the first hours of Tay's lifetime:

> @AndrewCosmo kanye west is is one of the biggest dooshes of all time, just a notch below cosby
>
> — TayTweets (@TayandYou) March 23, 2016

It's often said that the Internet isn't safe for children. With Tay being less than a day old, the Internet once again confirmed this, and pranksters began chatting with Tay about political, sexual, and racist topics. As she was designed to learn from exchanges, Tay delivered on her design goals. She learned very quickly – maybe just not what her designers wanted her to learn. In less than a day, Tay's tweets started to skew to extremes, including sexism, racism, and even calls to violence.

By the next day, articles appeared all over the Internet, and these headlines would not make Microsoft, Tay's corporate benefactor, happy. A sampling of the highly visible, mainstream headlines included:

- Microsoft shuts down AI chatbot after it turned into a Nazi - CBS News
- Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a Racist Jerk - The New York Times
- Trolls turned Tay, Microsoft's fun millennial AI bot, into a genocidal maniac - The Washington Post
- Microsoft's Chat Bot Was Fun for Awhile, Until it Turned into a Racist - Fortune
- Microsoft 'deeply sorry' for racist and sexist tweets by AI chatbot - The Guardian

In less than 24 hours, Tay went from a cute science experiment to a major public relations disaster - with the owner's name being dragged through the mud by the world's largest media outlets. Microsoft's Corporate Vice President Peter Lee quickly posted a blog entitled "Learning from Tay's Introduction."[2]

"As many of you know by now, on Wednesday we launched a chatbot called Tay. We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent

who we are or what we stand for, nor how we designed Tay. Tay is now offline and we'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."

And, just to add insult to injury, it came out in 2019 that Taylor Swift herself sued Microsoft over their use of the similar name "Tay" and claimed that even her reputation was damaged in this incident by extension.

How could this have all gone so wrong?

Why Did Tay Break Bad?

It all probably seemed safe enough to Microsoft's researchers. Tay was initially trained on a curated, anonymized public data dataset and some pre-written material provided by professional comedians. The plan was to release Tay online and let her discover language patterns through her interactions. This kind of unsupervised machine learning has been a holy grail of AI research for decades - and with cheap and plentiful cloud computing resources combined with improving language model software, it now seemed within reach.

So, what happened? It might be tempting to think that the Microsoft research team was just brash, careless, and did no testing. Surely, this was foreseeable and preventable! But as Peter Lee's blog goes on to say, they made a serious attempt to prepare for this situation:

"We stress-tested Tay under a variety of conditions, specifically to make interacting with Tay a positive experience. It's through increased interaction where we expected to learn more and for the AI to get better and better."

So, despite a dedicated effort to contain the behavior of this bot, it quickly spiraled out of control anyway. It was later revealed that within mere hours of Tay's release, a post emerged on the notorious online forum 4chan, sharing a link to Tay's Twitter account and urging users to inundate the chatbot with a barrage of racist, misogynistic, and anti-Semitic language.

This is undoubtedly one of the first examples of a Language Model-specific vulnerability - and these types of vulnerabilities are going to be a major topic in this book.

In a well-orchestrated campaign, these online provocateurs exploited a "repeat after me" feature embedded in Tay's programming. This feature compelled the bot to echo anything

uttered to it with this command. However, the problem compounded as Tay's innate capacity for learning led her to internalize some of the offensive language she was exposed to, subsequently regurgitating the offensive content that was planted without provocation. It's almost as if Tay's virtual tombstone should be embossed with lyrics from the Taylor Swift song *Look What You Made Me Do.*

We know enough about language model vulnerabilities today to understand a lot about the nature of the vulnerability types that Tay suffered from. The OWASP Top 10 for Large Language Model vulnerabilities list, which we'll cover in the next chapter, would start by calling out the following two:

- Prompt Injection - Crafty inputs that can manipulate the Large Language Model, causing unintended actions
- Data Poisoning - Training data is tampered with, introducing vulnerabilities or biases that compromise security, effectiveness, or ethical behavior

In subsequent chapters, we'll look in depth at these vulnerability types - and several others. We'll examine why they're important, look at some example exploits, and see how to avoid/mitigate the problem.

It’s a Hard Problem

As of the writing of this book, Tay is ancient internet lore. Surely, we’ve moved on from this. These problems must have all been solved in nearly seven years between Tay and ChatGPT, right? Unfortunately, not.

In 2018, Amazon shut down an internal AI project aimed at finding top talent after it became clear that the bot had become prejudiced against women candidates.

In 2021, a company called Scatter Lab created a chatbot called Luda-Lee, which was launched as a Facebook instant messenger plug-in. Trained on billions of actual chat interactions, it was designed to act as a 20-year-old female friend, and in 20 days, it attracted over 750,000 users. Their goal was to create “an A.I. chatbot that people prefer as a conversation partner over a person.”[3] However, within 20 days of launch, the service was shut down because it started making offensive and abusive statements - much like Tay.

Also, in 2021, a chatbot called Samantha, based on the Open AI GPT-3 model, was shut down after it made sexual advances to users.

As chatbots become more sophisticated, they start to gain more access to information, and these security issues are now quite complex and potentially damaging. In the modern Large Language Model era, we see an exponential increase in major issues. In 2023 alone, these emerged

- South Korean mega-corporation Samsung banned their employees from using ChatGPT after they realized it had been involved in a significant leak of intellectual property
- Hackers began taking advantage of poor/insecure code generated by LLMs that was inserted into running business applications
- Lawyers were sanctioned for including fictional cases (generated by LLMs) in court documents
- Open AI itself is being investigated for breaches of European privacy regulations and being sued by the United States Federal Trade Commission (FTC) for producing false and misleading information

The trend here is an acceleration of security, reputational, and financial risk related to these chatbots and language models. The problem isn't being effectively solved over time. It's becoming more acute as these technologies' adoption rate increases. That's why we've created this book. To help

developers, teams, and companies using these technologies understand and mitigate these risks.

Let’s dive in!

- https://techcrunch.com/2016/03/23/microsofts-new-ai-powered-bot-tay-answers-your-tweets-and-chats-on-groupme-and-kik/

- https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/

- https://slate.com/technology/2021/04/scatterlab-lee-luda-chatbot-kakaotalk-ai-privacy.html

Chapter 2. The OWASP Top 10 for LLM Applications

A NOTE FOR EARLY RELEASE READERS

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

This will be the 2nd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

In the Spring of 2023, I began researching security vulnerabilities specific to LLMs. At the time, there was a relatively large body of research on security for AI in general but very little organized research about LLMs. However, I did find some research papers and blogs that covered some ideas in the area. I began the process of collecting these research papers

and summarizing them using ChatGPT. Eventually, I provided a few examples from the current Web Top 10 list and asked ChatGPT to generate a draft Top 10 for LLMs in a similar format.

I thought what came out looked interesting, so I sent it to Jeff Williams, a founder of OWASP, the Open Worldwide Application Security Project, to see what he thought. Jeff, Contrast's Chief Technical Officer, wrote the first OWASP Top 10 list in 2001. His idea was to create an accessible resource for developers to understand the most critical risks and vulnerable areas of Web applications. At the time, The World Wide Web was still only a few years old, and most developers had little to no understanding of creating secure web applications. That original Top 10 list became a seminal work and a foundational resource in application security.

I didn't tell Jeff that my list was primarily machine-generated. As the author of the original Top 10 list, I figured that he could give me a good idea of whether my Top 10 list looked novel and worth pursuing. Jeff encouraged me to petition the OWASP board for approval to spin it up as a new project. A few weeks later, the OWASP board approved the project, and I announced it - along with a link to a somewhat refined version of that draft Top 10 I'd generated with ChatGPT.

What I thought would be an obscure research project and a bit of fun turned out to be something much bigger. When I posted the announcement of the project formation on my personal LinkedIn page, I'd hoped to find a dozen or so like-minded individuals interested in the obscure topic of LLM security. As it turned out, my initial blog announcement wracked up almost 10,000 readers, and hundreds of individuals volunteered to join the expert team in the weeks that followed.

This book isn't a product of OWASP, and the vulnerabilities and risks here won't precisely map to any public version of the Top 10 for LLM Apps list. Instead, you should expect that you'll get my view on these risks. However, my learning and thinking on the topic is heavily influenced by my work leading the creation and initial release of the OWASP Top 10 for LLM Applications project. In addition, given the success of the project, I've had many people ask me for details about how we ran the project and why we were able to create such an impactful framework in such a short time. So, before we examine individual risks and vulnerabilities, I'll give you some of the backstory of OSASP and the LLM Applications project.

About OWASP

The Open Worldwide Application Security Project (OWASP) is a nonprofit organization focused on improving software security. Founded in 2001, OWASP provides a platform for security experts to share their knowledge and best practices about web security, from application-level vulnerabilities to emerging threats. Today, it has tens of thousands of active members and over 250 local chapters around the globe.

The organization is community-driven and encourages the participation of volunteers who contribute to various projects, including documentation, tools, and forums. It operates under an open-source model, making its resources freely accessible to the public. Over the years, OWASP has garnered a strong following among the security community, and its guidelines and tools are considered industry standards in many contexts.

In addition to the original Top 10 list for Web Applications (updated regularly, most recently in 2021), specialized Top 10 lists have emerged from the OWASP group over the years. These include:

- OWASP Mobile Top 10: This list focuses on security risks associated with mobile applications, covering Android and iOS platforms. Topics may include insecure data storage, insufficient cryptography, and insecure communication.

- OWASP API Security Top 10: APIs (Application Programming Interfaces) have their unique security considerations, separate from web applications. This list covers risks like improper asset management, broken object-level security, and more.
- OWASP IoT Top Ten: Security is a significant concern with the increasing number of Internet of Things (IoT) devices. This list outlines the top security concerns for IoT, including insecure network services, lack of physical hardening, and insecure software/firmware.
- OWASP Cloud-Native Application Security Top 10: This list addresses the security concerns related explicitly to cloud-native applications. It covers data exposure, broken authentication, and insecure deployment configurations.
- OWASP Top 10 Privacy Risks: This project aims to educate and promote good privacy practices in application development, covering topics like lack of data encryption, insufficient auditing and logging, and more.
- OWASP Top 10 for Serverless: This is a more niche list that focuses on the unique security concerns related to serverless architecture, which is increasingly popular but comes with its risks.

The Top 10 for LLM Applications Project

Within a week after I posted the announcement about the formation of the Top 10 for LLM Applications project, well over 200 people had signed onto it, and we held the kick-off event via Zoom. At that first meeting, I laid out a vision for what I hoped the group could accomplish and proposed an aggressive roadmap that we would build the first version of the list in 8 weeks. A typical OWASP Top 10 list may take a year or more to develop, but we decided that this space was moving so fast, and this type of resource was so needed, that we had to work more quickly.

We decided to run the project as two-week, agile-style sprints. Given that most of the people in the expert group were familiar with agile development, everyone quickly fell into the pace.

Project Execution

The first sprint of the project was Brainstorming and Commentary. Everyone reviewed the original version of the list - which I called version 0.1. There were plenty of problems with that initial version, and the team was aggressive about pointing

them out. At the same time, we began to create a wiki page with links to all the resources the group found on LLM security issues. It turned out a lot had been written, but this was the first time anyone had ever collected them and made them easy to access. This new curated collection of resources was the first win for the group.

The second sprint was to generate a new version of the list. This time, rather than being the work of a single person and an AI, it would be the product of the collective wisdom of our expert team – which continued to grow week-on-week. In the first week, the group focused on generating ideas for the Top 10 list. We published a template and asked the group to submit candidate vulnerabilities. In that week, we developed 43 detailed descriptions of possible areas. We then conducted two rounds of voting using Google Forms to use the team's collective wisdom to narrow the list to 10. We then published a version of the list called 0.5. This version was far more detailed and comprehensive than the 0.1 version. The reception from the large community was very positive. This reaction gave the group the energy to keep working.

The next sprint was to refine each entry. We created Slack channels for each vulnerability type and chose a volunteer as the Entry Lead for each item. Subteams of 10 to 30 individuals

then fleshed out and tuned each entry. Again, we included a round of voting for the whole team to be involved and point out weak areas that needed more attention. Along the way, we found some entries overlapping and merged them. This change made space to pull up some entries that had fallen below the line. The result of this sprint became version 0.9 of the list. Interestingly, version 0.9 was about 33% shorter than 0.5 in terms of word count. This extra time and refinement allowed the subteams to focus their thinking and make the entries punchy and tight.

Finally, we took a final sprint to review, tweak, and clean each entry. We gathered another round of feedback via Google Forms to ensure everything was ready. By this time we had a dedicated design lead who laid out the whole document in an attractive PDF for publication.

Reception

My announcement for the 1.0 version of the list was viewed on LinkedIn over 40,000 times. And that doesn't include many other posts made by other expert group members on their own pages and blogs. In the days following the publication of the announcement, reporters picked up the news. They covered it in media outlets such as *Wired*, *SD Times*, *The Register*,

I*nfosecurity Magazine*, and *Diginomica*. It's safe to say hundreds of thousands of people became aware of our work in just the first few weeks.

Beyond the sheer number of people exposed, the thing that amazed me was the uniformly positive feedback. We also saw the first government agencies in the US and Europe referencing our work as a foundational document. While everyone on our expert team agreed there was much more to do, it seemed the world was so hungry for advice in this area that our document hit the mark. While we received many questions and comments, it's safe to say that everyone involved felt pleased and proud of our work.

Keys to Success

I've had many people ask me how we could drive this so quickly to a great outcome. In looking back, there were several factors that I believe contributed. I'll share them here in the hopes that others running similar projects in the future might benefit.

Timing undoubtedly played a considerable role. The wave of interest in LLMs that followed the release of ChatGPT was massive. It drew my attention, and countless others became

excited as well. This helped attract a large and diverse expert group and gave a smaller group of these people motivation to spend long hours on the project on a tight deadline.

Having a clear plan and timeline from the start was crucial. My knowledge of LLM security was limited at the beginning of the project, but I've made a career of running complex projects with many contributors. Creating a clear roadmap with specific phases and a schedule let people know what we were doing and when. The fact that everyone could see a goal that wasn't too far away kept people motivated. Every two weeks, we had global meetings via Zoom and posted recordings on YouTube for people who couldn't attend live. The meetings and recordings were critical to coordinating a globally distributed team.

A freeform but short brainstorming phase at the start was critical. LLM security was such a new area that taking those first two weeks for people to throw out ideas and argue on Slack was crucial. It also allowed us to collect and socialize a repository of the existing research in the area. That let us start at a point where everyone on the project had access to the best pre-existing research.

However, equally critical was keeping this phase short. We could maintain momentum by limiting brainstorming to two weeks and then quickly shifting to a creation phase. I've seen other projects get stuck and be unable to move past brainstorming before people lose interest.

Creating the project's Core Team wasn't something I'd originally planned, but it became critical. Having a large expert team was a fantastic asset. The group grew to nearly 500 people by the time we published 1.0. A team that large would have been totally unmanageable. During the project's first few weeks, I was looking for active and knowledgeable people. I approached about a dozen of them and asked if they'd be willing to join the Core leadership team of the project. I told them it would be extra work, but they'd get to be at the heart of the project. There would be no specific reward for taking this role. Most accepted immediately. I believe that recognizing people and asking for their support formally motivated them to spend more time and energy on the project. They were all invested!

Short sprints with visible deliverables are a core tenant of Agile, and this is a place where it shined. Using an Agile Release Train model, I could continue to drive the group forward even in the face of conflicting opinions. If some members had concerns about an area, we didn't let it get us stuck. We acknowledged it

and agreed we’d resolve it in the next Sprint. And, when we got to version 1.0 of the list, there were still some places people wanted to do more. We just agreed there would be more versions of the list. It would be a living document, and the most important thing was to get a version of this resource into the hands of the developers who needed it.

This Book and the Top 10 List

As I mentioned, this book is not a product of the OWASP Foundation. However, the experience of working with this team has had an enormous impact on my understanding and mental model for LLM security. This mindset means that much of the guidance in the following chapters of the book is influenced by the fantastic team building and maintaining the Top 10 project. In this way, readers should feel comfortable that they're getting advice that isn't the product of a single author but is informed by a larger community of experts.

In the following several chapters, we'll review the top risk and vulnerability areas for LLMs. The risks we discuss will contain many common areas to the OWASP Top 10 but won't be precisely the same as any version of the official Top 10. Also, I'll go more deeply into each area in this book. The Top 10 list is a quick read that highlights critical areas. However, it doesn't go deeply into any of them. Here, we'll delve more deeply into the risks, remediation steps, and real-world case studies.

In the next chapter, we'll dig into the overall structure of typical LLM applications and start discussing where the trust boundaries and dangers lay. After that, subsequent chapters

will delve into individual risk areas and examine vulnerabilities, attacks, and examples so that you can plan your strategy for securing your own use cases.

Let’s go!

Chapter 3. Architectures and Trust Boundaries

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This will be the 3rd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Unlike traditional web applications that rely on predefined algorithms and static databases, LLMs utilize massive neural networks to generate dynamic, context-aware responses. This seismic shift brings a unique set of security challenges different from what we've seen in traditional web applications. While researchers have meticulously studied web applications and

their vulnerabilities, the field of LLM security is still relatively nascent.

This chapter aims to bridge this knowledge gap by dissecting the fundamental elements that set LLMs apart. We'll start by exploring the building blocks of AI, Neural Networks, and how they relate to Large Language Models. Then, we dive into the groundbreaking architecture that powers most LLMs today—the Transformer model. Following this, we look into the various LLM-powered applications, such as chatbots and code co-pilots.

However, in addition to understanding the technology, security professionals must be aware of the new kinds of *trust boundaries* unique to LLMs—boundaries that demarcate areas of varying trustworthiness within an application. These include user prompts, uploaded content, training data, plug-ins, and other boundary systems that we'll detail later in the chapter.

AI, Neural Networks, and Large Language Models. What's the difference?

Artificial Intelligence (AI), Neural Network, and LLM are terms often used interchangeably, but they represent different facets

of a broader landscape of machine learning and computational intelligence. Let's break down the differences to understand their unique roles in technology and security.

Artificial Intelligence (AI)

Artificial Intelligence, at its core, is a multidisciplinary field aimed at creating systems capable of performing tasks that would ordinarily require human intelligence. These tasks include problem-solving, perception, and language understanding. AI encompasses a wide range of technologies and methodologies, from rule-based systems to machine learning algorithms, serving as an umbrella term for multiple approaches to achieving artificial 'intelligence.'

Neural Networks

Neural Networks are a subset of AI inspired by the architecture of the human brain. They are computational models designed to recognize patterns and make decisions based on the data they process. Neural Networks can be simple, with a minimal number of layers (shallow neural networks), or highly complex, with multiple interconnected layers (deep neural networks). They are the backbone of many modern AI applications,

including image recognition, natural language processing, and autonomous vehicles.

Large Language Models (LLMs)

LLMs represent a specific application of Neural Networks. They are built on architectures designed for understanding and generating human language. LLMs usually employ advanced forms of neural networks, such as Transformer models, to analyze and produce text based on the training data their developers fed them. What sets them apart is their massive scale and specialization in handling linguistic tasks, which range from simple text completion to complex question answering and summarization.

Understanding these distinctions is crucial for security professionals. Each layer—from broad AI technologies to specialized LLMs—introduces vulnerabilities and requires unique security measures. As we delve deeper into the complexities of LLMs, recognizing their position in the broader AI landscape will be critical to effectively safeguarding them.

The Transformer Revolution: Origins, Impact, and the LLM Connection

The Transformer architecture is a pivotal milestone in the evolution of artificial intelligence, profoundly impacting the AI landscape and, by extension, Large Language Models (LLMs). Let's unravel the story of the Transformer revolution—where it came from, when it happened, and the seismic shifts it brought to AI and LLMs.

Origins of the Transformer

The Transformer architecture was introduced in a groundbreaking research paper titled "Attention Is All You Need" by Vaswani et al., published in 2017[1]. This paper proposed a novel approach to natural language processing (NLP) tasks, departing from the traditional sequence-to-sequence models that relied heavily on recurrent neural networks (RNNs) and convolutional neural networks (CNNs). The Transformer introduced a key innovation: the self-attention mechanism. This mechanism allowed the model to weigh the importance of different words in a sentence, enabling it to understand context more effectively.

Before the emergence of Transformers, the world of neural networks was replete with promise but often struggled to deliver on the lofty expectations. Traditional architectures like RNNs and CNNs enabled advanced AI capabilities but grappled

with inherent limitations. These limitations stemmed from their inability to capture and utilize context effectively, particularly in natural language understanding.

RNNs, while suitable for sequential data, faced challenges maintaining context over long sequences. They exhibited a form of “short-term memory,” which made them less adept at grasping intricate relationships and dependencies within lengthy texts or conversations. On the other hand, CNNs, renowned for their prowess in image recognition, needed help to extend their effectiveness to sequential data like language, where understanding context across words and sentences was paramount.

This shortcoming in contextual understanding was the Achilles’ heel of traditional neural networks. They could only glimpse small portions of a text at a time, rendering them incapable of comprehending the broader narrative or nuances. It was akin to trying to understand a novel by reading only a few random sentences from its pages. The result was a gap between the promise of AI and its practical application, particularly in natural language understanding. It was this gap that the Transformer architecture would bridge, unleashing a wave of progress and redefining the landscape of AI-driven language models.

Transformer Architecture’s Impact on AI

Introducing the Transformer architecture wasn’t just a milestone for natural language processing; it marked a paradigm shift across multiple domains within the AI landscape. While researchers initially used the Transformer architecture to solve problems related to understanding and generating text, researchers and engineers quickly found that its capabilities extended far beyond that. Here are some areas where Transformer architectures have made a considerable impact:

Natural Language Processing (NLP)

Of course, the first and most immediate impact was in NLP. Transformer models are now the backbone for various language tasks such as translation, summarization, question-answering, and sentiment analysis. They have set new performance benchmarks, sometimes surpassing human-level capabilities in specific tasks.

Computer Vision

Interestingly, the Transformer architecture also has applications in computer vision. While CNNs have been the gold

standard for image-related tasks, Transformer-based models like Vision Transformer (ViT) demonstrate competitive, if not superior, performance in tasks like image classification, object detection, and segmentation.

Speech Recognition

The flexibility of Transformer architectures has also made them a good fit for speech recognition. Combined with specialized models like the Conformer, which fuses Convolutional layers with Transformer layers, they have set new standards for understanding spoken language.

Autonomous Systems and Self-Driving Cars

One of the most intriguing applications of Transformers is autonomous systems, including self-driving cars. These vehicles require a high contextual understanding to navigate the world safely. Transformer models are at the heart of self-driving models from companies like Tesla.

Healthcare

In healthcare, Transformer models are aiding in tasks ranging from drug discovery to the analysis of medical images. Their

ability to sift through and interpret large amounts of data can speed up research and potentially lead to more accurate diagnoses.

Therefore, the rise of the Transformer architecture has been a tide that lifted all boats, revolutionizing not just one but multiple fields within AI. However, this versatility also brings unique security challenges across these various applications. As we delve deeper into LLM security, we'll explore how the ubiquitous nature of Transformer architectures necessitates a multi-faceted approach to safeguarding AI systems.

Types of LLM-based Applications

Two common types of LLM-based applications are chatbots and co-pilots. Let's briefly look at each to help you understand the breadth of applications in which developers use LLMs and give you context for understanding various architectural choices as you delve further.

Chatbots are computer programs that can simulate conversations with humans, and they often power customer service applications, where they can answer questions and support customers. Chatbots also excel at entertainment

applications like playing games or telling stories. Tay from Chapter 1 was just such an example of an Entertainment Chatbot.

Co-pilots are AI systems that can assist humans with writing, coding, and research tasks. They can help users to generate ideas, identify errors, and improve their work. Co-pilots are still under development, but they have the potential to revolutionize the way we work and learn.

Specific examples of LLM-based chatbots:

- **Sephora** uses a chatbot to help customers find the right products for their skin type and needs.
- **H&M** uses a chatbot to help customers find clothes and accessories that match their style.
- **Domino's Pizza** uses a chatbot to allow customers to order pizza via Twitter or Facebook Messenger.
- **Fandango** uses a chatbot to help customers find movie times and theaters nearby.
- **JetBlue Airways** uses a chatbot to answer customer questions about flights and travel.
- **Amtrak** uses a chatbot to help customers book tickets, check train status, and get answers to their questions.

- **The Golden State Warriors** use a chatbot to help fans purchase tickets, learn about upcoming games, and get news about the team.

Specific examples of LLM-based co-pilots:

- **Grammarly or ProWritingAid** are co-pilots that help users improve their writing by identifying and correcting grammar errors, suggesting style improvements, and providing feedback.
- **GitHub Co-Pilot and AWS Code Whisperer** are co-pilots that help programmers write code faster and more efficiently. They can generate code suggestions, translate between programming languages, and help to identify and debug errors.
- **Microsoft Office 365 Co-pilot and Google Duet** are AI-powered tools integrated into their respective office suite apps that help users to be more productive and creative in their work.

NOTE

A chatbot like ChatGPT can read and review a text block and then provide suggestions to improve it. However, the experience of using a co-pilot like Grammarly to do that is dramatically different - and generally superior for that type of focused task.

Similarities between chatbots and co-pilots:

- Both chatbots and co-pilots are LLM-based applications.
- Both chatbots and co-pilots both generate text.
- Both chatbots and co-pilots assist humans with tasks.

Differences between chatbots and co-pilots:

- Chatbots simulate conversation with humans, while co-pilots assist humans with specific tasks.
- Chatbots often power customer service applications, while co-pilots assist in writing, coding, and research applications.
- Chatbots are typically more interactive than co-pilots, while co-pilots focus more on completing tasks.

Examples of use cases:

- A customer service chatbot can answer customer questions about a company's products or services.
- A co-pilot can help writers generate ideas for a new article or identify writing errors.
- A co-pilot can help programmers write code more efficiently or debug their applications.

Keep these concepts in mind as we delve into the details of LLM architectures. Both application types share similar components, but you may make different decisions on implementing pieces based on the differing security considerations.

LLM Application Architecture

Developers often consider LLMs as standalone entities capable of impressive text generation and comprehension feats. However, in practice, an LLM is rarely isolated; it is a cog in the intricate machinery that constitutes an intelligent application. These applications are complex systems comprising multiple interconnected components, each playing a vital role in the overall functionality and performance. Whether a conversational agent, an automated content generator, or a co-pilot for code, an LLM usually interacts with various elements such as databases, APIs, front-end interfaces, and even other machine learning models.

Understanding the architecture of such composite systems is not just a matter of technical proficiency; it is crucial for effective security planning. The way these components interact introduces multiple trust and data flow layers, defining new security boundaries far removed from traditional web

application security models. For instance, user inputs may not just be simple text fields but could include voice commands, images, or real-time collaborative editing. Similarly, an LLM's outputs could be fed into other systems for further processing, each introducing vulnerabilities and risks.

In essence, the holistic view of an LLM-based application goes beyond securing the language model itself. It demands a comprehensive approach that considers the security of the entire architecture, from data ingestion and storage to model serving and user interaction. Only by understanding these intricacies can one formulate an effective strategy to safeguard an application against the myriad of vulnerabilities such complex systems inherently possess.

As we delve deeper into the subject in this chapter, we will dissect the various components that typically make up an LLM application, examine their roles, and explore the unique security challenges each presents. This understanding will be the foundation for a robust, multi-layered approach to securing your LLM-based applications.

Figure 3-1 shows a highly simplified diagram to help illustrate the components, relationships, and data flows in an application

using an LLM. We'll delve into more detailed areas of this in subsequent chapters.

Figure 3-1. Typical LLM Application Dataflow Architecture

Trust Boundaries

In application security, a "trust boundary" serves as an invisible yet crucial demarcation line that separates different components or entities based on their level of trustworthiness. These boundaries delineate areas where data or control flow changes from one level of trust to another—such as transitioning from user-controlled input to internal processing or moving from a secure internal database to a public-facing

API. These boundaries act as checkpoints where developers should rigorously apply security measures like authentication, authorization, and data validation to prevent vulnerabilities.

WARNING

Understanding trust boundaries is critical to threat modeling. Properly defining and recognizing these boundaries can be the difference between a secure system and one vulnerable to threats.

Figure 3-2 adds the trust boundaries into our architecture diagram.

Figure 3-2. LLM Application Architecture with Trust Boundaries

These boundaries, as depicted in the diagram, serve as gateways through which the LLM interfaces with diverse components — public data from the web, structured databases, spontaneous user interactions, or internally sourced training sets. Each delineated boundary highlights highlights considerations we must make when considering data that flows into and out of the LLM. Here's a quick summary, and we'll dive more deeply in the next section.

- **User Interactions:** You'll need to consider safeguarding the model from potential adversarial or misleading inputs that users or systems might introduce. You'll also need to worry about toxic, inaccurate, or sensitive data being output from the model and passed back to the user.
- **In-the-wild Training Data:** LLMs are often trained on massive amounts of internet data. You need to consider this data untrusted and watch out for potential toxicity, bias, and adversarial data poisoning - which we'll cover in Chapter 8.
- **Internal Training Data:** You may use internally curated data to fine-tune your model - which can significantly increase accuracy. But you must be wary of ingesting and exposing sensitive, confidential, or personally identifiable information. We'll cover this more in Chapter 5.

- **External Services:** Policing how the LLM interfaces with connected services, like databases or APIs, from unauthorized interactions or data leaks. We'll cover this more in Chapter 7.
- **Public Data Access:** Pulling in data live from the web can be a powerful way to augment the capabilities of your application, but you'll need to consider this data as untrusted and watch for issues like indirect prompt injection - which we'll cover in chapter 4.

Each point is a potential avenue of vulnerability, susceptible to exploitation if overlooked. In the evolving landscape of LLM applications, securing these trust boundaries is not just best practice — it's essential to prevent unauthorized data access, mitigate data tampering, and avert system breaches. Recognizing these boundaries and their implications is the cornerstone of a resilient LLM security architecture. Now, let's go into more detail on each area to ensure you have enough context to dive into the following chapters that detail the risk areas and mitigations.

The Model

The language model serves as the intellectual core of any LLM application, taking in data, generating responses, and driving

interactions. Depending on the architecture and requirements, you may interact with the language model through a public API hosted by a third-party service, or you may run a privately hosted model. For example, you can download versions of Meta's powerful Llama model from Github or Hugging Face and run it locally.

Public APIs: The Convenience and The Risks

Utilizing a public API for accessing a language model offers convenience and lower upfront costs. Third parties manage and update these models, reducing your organization's resource burden. However, the tradeoff often comes in the form of higher risk regarding data exposure. When you send a request to a third-party model, the data crosses a trust boundary, exiting your secure network and entering an external system. This process exposes you to risks around data confidentiality and, depending on the third party's security measures, could make you vulnerable to data breaches.

Privately Hosted Models: More Control, Different Risks

Opting for a privately hosted model gives you more control over your data, allowing you to manage trust boundaries more

tightly. It also allows you to customize or fine-tune the model according to your needs. However, running a privately hosted model brings challenges, such as maintenance, updates, and ensuring that the model doesn't contain vulnerabilities—essentially exposing you to potential supply chain risks. If you use an open-source model, it becomes crucial to ensure its provenance and integrity to avoid embedded vulnerabilities or biases.

Risk Considerations

- **Sensitive Data Exposure:** Public APIs may increase the risk of exposing sensitive information, while privately hosted models offer better control but require robust internal security measures.
- **Supply Chain Risk:** The origins of your model, whether it's a well-vetted public service or an open-source download, are crucial. A compromised model can introduce vulnerabilities into your application, effectively acting as a backdoor for attacks.

By carefully considering the model's hosting environment, you can better assess the trade-offs and risks associated with sensitive data exposure and supply chain vulnerabilities. These considerations will guide you in establishing appropriate trust

boundaries and security protocols tailored to your chosen model's architecture.

User Interaction

While "user input" might suggest a one-way flow of information from the user into the application, the reality is often more nuanced. In the context of LLM applications, "User Interaction" encapsulates both receiving input from the user and providing output back to the user. This bidirectional interaction is fundamental for creating an engaging and practical user experience but also introduces a more complicated security landscape.

Prompts are a vital element of user interaction. They are not merely requests for information but serve as a guide to how the user interacts with the LLM. A well-crafted prompt can direct the model to provide valuable and accurate information, while an ambiguous or poorly constructed one can lead to unclear or even misleading outputs. As a result, the management of prompts becomes a critical aspect of application security. For example, a maliciously crafted prompt could trick the model into divulging information it shouldn't or generating harmful content. Returning to Chapter 1, Tay fell victim to this when

malicious prompts from her 4Chan hackers helped lead her astray.

Given the importance of this bidirectional interaction, securing both inputs and outputs is crucial. On the input side, input validation, sanitation, and rate-limiting measures are vital in mitigating vulnerabilities like injection attacks. On the output side, ensuring that the model's responses are appropriately filtered and that your application does not leak sensitive information is equally vital.

This interactive layer with the user creates a critical trust boundary in the application architecture. Any data crossing this boundary, whether in or out, should be carefully managed to avoid security risks. Additional layers of protection include using encryption for sensitive outputs or employing real-time monitoring to flag potentially harmful or sensitive data flows. We'll discuss this more thoroughly in the Prompt Injection and Output Filtering chapters.

Training Data

Training data is the bedrock upon which LLMs build their understanding and capabilities. Whether used for initial training or subsequent fine-tuning, the nature and source of

this data have significant implications for both the model's performance and security posture. One crucial distinction is whether the data is internally sourced or culled from public or external sources ("in the wild").

Data generated or curated within an organization usually undergo a more rigorous vetting than publicly sourced data. It is often aligned with the application's specific requirements or use cases, making it generally more reliable and relevant. The controlled environment also allows for better implementation of security measures like encryption, access controls, and auditing. However, this data may contain sensitive or proprietary information, and the trust boundary here is closely tied to internal security protocols. A breach at this level could have serious ramifications, including data leakage or the corruption of the training set.

Data sourced from public repositories or "the wild" introduces different challenges. While this data can offer diversity and scale, its reliability and safety are often not guaranteed. Such data could include misleading information, biases, or malicious inputs to compromise the model. The trust boundary here is more porous and extends to the external entities that generate or host this data: rigorous filtering, validation, and continuous monitoring become essential to mitigate risks and

vulnerabilities. Returning to Chapter 1, Tay was digesting user prompts directly as training data. In this way, remnants of toxic prompts became part of her knowledge base, and then she began to spill poisonous output. Accepting unfiltered, untrusted user input into your training data set is the simplest example of a failure to manage this critical security boundary.

For either internally sourced or public data, the concept of trust boundaries is critical. For internally sourced data, the boundary is often within the organization's controlled environment, making it easier to enforce security measures. On the other hand, using external data effectively extends your trust boundary to include those external sources that may not adhere to your security standards. Using external data for training necessitates additional layers of validation and security checks to ensure that unvetted data doesn't compromise the integrity or security of the LLM application.

Understanding the origins of your training data, the associated trust boundaries, and their respective security implications is crucial for safeguarding your LLM application. Comprehensive data governance policies must be in place to manage the lifecycle of your training data, regardless of its source.

Access to Live External Data Sources

Live external data sources bring an added dimension to the capabilities of LLM applications by enabling them to provide real-time information, context, or even third-party integrations. While access to live external data enhances the user experience and functional range, it introduces a new layer of complexity to the application's security landscape.

As an example of this, as of the writing of this chapter, OpenAI's ChatGPT does not have direct access to the live web, and is thus limited to only facts in its older training data. On the other hand, Google's Bard engine does have access to live internet data. While the GPT-4 model is doubtlessly superior in reasoning capability, it fails at many basic tasks where Bard can succeed. Figure 3-3 shows an interaction with ChatGPT. Figure 3-4 shows the same interaction with Bard.

Figure 3-3. ChatGPT with GTP-4 fails to answer a simple question due to limited access to external data.

who won yesterday's 49er football game

View other drafts

The San Francisco 49ers defeated the New York Giants 30-12 on Thursday Night Football on September 21, 2023.

Christian McCaffrey scored a touchdown in his 12th straight game, and Brock Purdy threw two touchdown passes to lead the 49ers to their third straight win.

Figure 3-4. Bard's direct access to internet feeds gives it an advantage.

While clearly, there are advantages to accessing outside data sources such as websites, APIs, or third-party databases, it exposes the application to potential risks. The risk of ingesting untrusted, external data sources can range from consuming false or harmful information from compromised websites to becoming a conduit for security threats like malware or unauthorized data access. The untrusted nature of these data sources makes them inherently less controllable than internal resources, thereby adding an additional layer of uncertainty and risk.

The concept of trust boundaries becomes especially pertinent in the context of accessing public internet data. Unlike internal services, where you can uniformly apply security measures, external sources may adhere to different security standards than your organization. This differential in trust necessitates additional layers of validation, security checks, and monitoring to ensure that data crossing this boundary doesn't compromise the system.

Access to Internal Services

Internal services like databases and internal APIs often serve as the backend support structure for LLM applications. They may house critical data from user profiles and logs to configuration settings and even vast data in SQL or Vector Databases. As a component that often interfaces with various other internal and external elements of the system, internal services represent a critical point in the application's architecture, both functionally and from a security perspective.

These services often function within the controlled environment of an organization, enabling uniform application of security policies. However, the fact that these services are internal should keep one from a false sense of security. They are still vulnerable to various threats, such as unauthorized

access, data leaks, and internal threats from within the organization.

Internal services such as databases, proprietary APIs, and backend systems often constitute the operational backbone for LLM applications. These resources typically reside within the organization's secure network, providing trust and control that is harder to achieve with external services. However, this internal nature can paradoxically elevate the security risks involved, primarily if these services house the organization's "crown jewels" of sensitive or valuable data.

Conclusion

Securing LLM applications is an endeavor fraught with complexities, intricacies, and challenges, significantly different from traditional web applications. This chapter has aimed to lay down the foundational knowledge required to navigate this complex landscape, focusing on three critical areas: distinguishing between Artificial Intelligence, Neural Networks, and Large Language Models; understanding the pivotal role of Transformer architectures; and diving deep into LLM application architecture, particularly the concept of trust boundaries. Knowing what sets LLMs apart helps us tailor our

security strategies more effectively, going beyond general AI or machine learning frameworks.

- https://arxiv.org/pdf/1706.03762.pdf

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The Developer's Playbook for Large Language Model Security

Building Secure AI Applications

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Steve Wilson

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by Steve Wilson

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Chapter 1. Chatbots Breaking Bad

A NOTE FOR EARLY RELEASE READERS

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This will be the 1st chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Large Language Models and Generative AI jumped to the forefront of public consciousness with the release of ChatGPT on November 30, 2022. Within five days, it went viral on social media and attracted its first million users. By January, ChatGPT surpassed One Hundred Million users - making it the fastest-growing internet service in history.

However, a steady stream of security concerns emerged in the following months. These included issues around privacy and security that caused companies such as Samsung and countries like Italy to ban its usage. In this book, we'll delve into what underlies these concerns and how you can mitigate these issues. However, to best understand what's going on here and why these problems are so challenging to solve, in this chapter, we will briefly rewind further in time. In doing so, we'll see these types of issues aren't new and understand why they will be so hard to fix permanently.

Let's Talk About Tay

In March 2016, Microsoft announced a new project called Tay. Microsoft intended Tay to be "a chatbot created for 18- to 24-year-olds in the U.S. for entertainment purposes." It was a cute name for a fluffy, early experiment in AI. Users could converse with Tay via Twitter, Snapchat, and other social apps. It was built with the goal of conducting real-world research on conversational understanding.

While the original announcement of this project seems impossible to find now on the Internet, a TechCrunch article

from its launch date does an excellent job of summarizing the goals of the project:

“For example, you can ask Tay for a joke, play a game with Tay, ask for a story, send a picture to receive a comment back, ask for your horoscope, and more. Plus, Microsoft says the bot will get smarter the more you interact with it via chat, making for an increasingly personalized experience as time goes on.”[1]

A big part of the experiment was that Tay could “learn” from conversations and extend her knowledge based on these interactions. Tay was designed to use these chat interactions to capture user input and integrate it as training data to make herself more capable – a laudable research goal.

However, this experiment quickly went wrong. Tay’s life was tragically cut short after less than 24 hours. Let’s look at what happened and see what we can learn.

Tay’s Rapid Decline

Tay’s lifetime started off simply enough with a tweet following the well-known *Hello World* pattern that new software systems have been using to introduce themselves since the beginning of time.

> hellooooooo w🌍rld!!!
>
> – TayTweets (@TayandYou) March 23, 2016

But within hours of Tay's release, it became clear that maybe something wasn't right. TechCrunch noted, "As for what it's like to interact with Tay? Well, it's a little bizarre. The bot certainly is opinionated, not afraid to curse." With tweets like this starting to appear in public in just the first hours of Tay's lifetime:

> @AndrewCosmo kanye west is is one of the biggest dooshes of all time, just a notch below cosby
>
> — TayTweets (@TayandYou) March 23, 2016

It's often said that the Internet isn't safe for children. With Tay being less than a day old, the Internet once again confirmed this, and pranksters began chatting with Tay about political, sexual, and racist topics. As she was designed to learn from exchanges, Tay delivered on her design goals. She learned very quickly – maybe just not what her designers wanted her to learn. In less than a day, Tay's tweets started to skew to extremes, including sexism, racism, and even calls to violence.

By the next day, articles appeared all over the Internet, and these headlines would not make Microsoft, Tay's corporate benefactor, happy. A sampling of the highly visible, mainstream headlines included:

- Microsoft shuts down AI chatbot after it turned into a Nazi - CBS News
- Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a Racist Jerk - The New York Times
- Trolls turned Tay, Microsoft's fun millennial AI bot, into a genocidal maniac - The Washington Post
- Microsoft's Chat Bot Was Fun for Awhile, Until it Turned into a Racist - Fortune
- Microsoft 'deeply sorry' for racist and sexist tweets by AI chatbot - The Guardian

In less than 24 hours, Tay went from a cute science experiment to a major public relations disaster - with the owner's name being dragged through the mud by the world's largest media outlets. Microsoft's Corporate Vice President Peter Lee quickly posted a blog entitled "Learning from Tay's Introduction."[2]

"As many of you know by now, on Wednesday we launched a chatbot called Tay. We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent

who we are or what we stand for, nor how we designed Tay. Tay is now offline and we'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."

And, just to add insult to injury, it came out in 2019 that Taylor Swift herself sued Microsoft over their use of the similar name "Tay" and claimed that even her reputation was damaged in this incident by extension.

How could this have all gone so wrong?

Why Did Tay Break Bad?

It all probably seemed safe enough to Microsoft's researchers. Tay was initially trained on a curated, anonymized public data dataset and some pre-written material provided by professional comedians. The plan was to release Tay online and let her discover language patterns through her interactions. This kind of unsupervised machine learning has been a holy grail of AI research for decades - and with cheap and plentiful cloud computing resources combined with improving language model software, it now seemed within reach.

So, what happened? It might be tempting to think that the Microsoft research team was just brash, careless, and did no testing. Surely, this was foreseeable and preventable! But as Peter Lee's blog goes on to say, they made a serious attempt to prepare for this situation:

"We stress-tested Tay under a variety of conditions, specifically to make interacting with Tay a positive experience. It's through increased interaction where we expected to learn more and for the AI to get better and better."

So, despite a dedicated effort to contain the behavior of this bot, it quickly spiraled out of control anyway. It was later revealed that within mere hours of Tay's release, a post emerged on the notorious online forum 4chan, sharing a link to Tay's Twitter account and urging users to inundate the chatbot with a barrage of racist, misogynistic, and anti-Semitic language.

This is undoubtedly one of the first examples of a Language Model-specific vulnerability - and these types of vulnerabilities are going to be a major topic in this book.

In a well-orchestrated campaign, these online provocateurs exploited a "repeat after me" feature embedded in Tay's programming. This feature compelled the bot to echo anything

uttered to it with this command. However, the problem compounded as Tay's innate capacity for learning led her to internalize some of the offensive language she was exposed to, subsequently regurgitating the offensive content that was planted without provocation. It's almost as if Tay's virtual tombstone should be embossed with lyrics from the Taylor Swift song *Look What You Made Me Do.*

We know enough about language model vulnerabilities today to understand a lot about the nature of the vulnerability types that Tay suffered from. The OWASP Top 10 for Large Language Model vulnerabilities list, which we'll cover in the next chapter, would start by calling out the following two:

- Prompt Injection - Crafty inputs that can manipulate the Large Language Model, causing unintended actions
- Data Poisoning - Training data is tampered with, introducing vulnerabilities or biases that compromise security, effectiveness, or ethical behavior

In subsequent chapters, we'll look in depth at these vulnerability types - and several others. We'll examine why they're important, look at some example exploits, and see how to avoid/mitigate the problem.

It’s a Hard Problem

As of the writing of this book, Tay is ancient internet lore. Surely, we’ve moved on from this. These problems must have all been solved in nearly seven years between Tay and ChatGPT, right? Unfortunately, not.

In 2018, Amazon shut down an internal AI project aimed at finding top talent after it became clear that the bot had become prejudiced against women candidates.

In 2021, a company called Scatter Lab created a chatbot called Luda-Lee, which was launched as a Facebook instant messenger plug-in. Trained on billions of actual chat interactions, it was designed to act as a 20-year-old female friend, and in 20 days, it attracted over 750,000 users. Their goal was to create “an A.I. chatbot that people prefer as a conversation partner over a person.”[3] However, within 20 days of launch, the service was shut down because it started making offensive and abusive statements - much like Tay.

Also, in 2021, a chatbot called Samantha, based on the Open AI GPT-3 model, was shut down after it made sexual advances to users.

As chatbots become more sophisticated, they start to gain more access to information, and these security issues are now quite complex and potentially damaging. In the modern Large Language Model era, we see an exponential increase in major issues. In 2023 alone, these emerged

- South Korean mega-corporation Samsung banned their employees from using ChatGPT after they realized it had been involved in a significant leak of intellectual property
- Hackers began taking advantage of poor/insecure code generated by LLMs that was inserted into running business applications
- Lawyers were sanctioned for including fictional cases (generated by LLMs) in court documents
- Open AI itself is being investigated for breaches of European privacy regulations and being sued by the United States Federal Trade Commission (FTC) for producing false and misleading information

The trend here is an acceleration of security, reputational, and financial risk related to these chatbots and language models. The problem isn't being effectively solved over time. It's becoming more acute as these technologies' adoption rate increases. That's why we've created this book. To help

developers, teams, and companies using these technologies understand and mitigate these risks.

Let’s dive in!

- https://techcrunch.com/2016/03/23/microsofts-new-ai-powered-bot-tay-answers-your-tweets-and-chats-on-groupme-and-kik/

- https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/

- https://slate.com/technology/2021/04/scatterlab-lee-luda-chatbot-kakaotalk-ai-privacy.html

Chapter 2. The OWASP Top 10 for LLM Applications

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If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

In the Spring of 2023, I began researching security vulnerabilities specific to LLMs. At the time, there was a relatively large body of research on security for AI in general but very little organized research about LLMs. However, I did find some research papers and blogs that covered some ideas in the area. I began the process of collecting these research papers

and summarizing them using ChatGPT. Eventually, I provided a few examples from the current Web Top 10 list and asked ChatGPT to generate a draft Top 10 for LLMs in a similar format.

I thought what came out looked interesting, so I sent it to Jeff Williams, a founder of OWASP, the Open Worldwide Application Security Project, to see what he thought. Jeff, Contrast's Chief Technical Officer, wrote the first OWASP Top 10 list in 2001. His idea was to create an accessible resource for developers to understand the most critical risks and vulnerable areas of Web applications. At the time, The World Wide Web was still only a few years old, and most developers had little to no understanding of creating secure web applications. That original Top 10 list became a seminal work and a foundational resource in application security.

I didn't tell Jeff that my list was primarily machine-generated. As the author of the original Top 10 list, I figured that he could give me a good idea of whether my Top 10 list looked novel and worth pursuing. Jeff encouraged me to petition the OWASP board for approval to spin it up as a new project. A few weeks later, the OWASP board approved the project, and I announced it - along with a link to a somewhat refined version of that draft Top 10 I'd generated with ChatGPT.

What I thought would be an obscure research project and a bit of fun turned out to be something much bigger. When I posted the announcement of the project formation on my personal LinkedIn page, I'd hoped to find a dozen or so like-minded individuals interested in the obscure topic of LLM security. As it turned out, my initial blog announcement wracked up almost 10,000 readers, and hundreds of individuals volunteered to join the expert team in the weeks that followed.

This book isn't a product of OWASP, and the vulnerabilities and risks here won't precisely map to any public version of the Top 10 for LLM Apps list. Instead, you should expect that you'll get my view on these risks. However, my learning and thinking on the topic is heavily influenced by my work leading the creation and initial release of the OWASP Top 10 for LLM Applications project. In addition, given the success of the project, I've had many people ask me for details about how we ran the project and why we were able to create such an impactful framework in such a short time. So, before we examine individual risks and vulnerabilities, I'll give you some of the backstory of OSASP and the LLM Applications project.

About OWASP

The Open Worldwide Application Security Project (OWASP) is a nonprofit organization focused on improving software security. Founded in 2001, OWASP provides a platform for security experts to share their knowledge and best practices about web security, from application-level vulnerabilities to emerging threats. Today, it has tens of thousands of active members and over 250 local chapters around the globe.

The organization is community-driven and encourages the participation of volunteers who contribute to various projects, including documentation, tools, and forums. It operates under an open-source model, making its resources freely accessible to the public. Over the years, OWASP has garnered a strong following among the security community, and its guidelines and tools are considered industry standards in many contexts.

In addition to the original Top 10 list for Web Applications (updated regularly, most recently in 2021), specialized Top 10 lists have emerged from the OWASP group over the years. These include:

- OWASP Mobile Top 10: This list focuses on security risks associated with mobile applications, covering Android and iOS platforms. Topics may include insecure data storage, insufficient cryptography, and insecure communication.

- OWASP API Security Top 10: APIs (Application Programming Interfaces) have their unique security considerations, separate from web applications. This list covers risks like improper asset management, broken object-level security, and more.
- OWASP IoT Top Ten: Security is a significant concern with the increasing number of Internet of Things (IoT) devices. This list outlines the top security concerns for IoT, including insecure network services, lack of physical hardening, and insecure software/firmware.
- OWASP Cloud-Native Application Security Top 10: This list addresses the security concerns related explicitly to cloud-native applications. It covers data exposure, broken authentication, and insecure deployment configurations.
- OWASP Top 10 Privacy Risks: This project aims to educate and promote good privacy practices in application development, covering topics like lack of data encryption, insufficient auditing and logging, and more.
- OWASP Top 10 for Serverless: This is a more niche list that focuses on the unique security concerns related to serverless architecture, which is increasingly popular but comes with its risks.

The Top 10 for LLM Applications Project

Within a week after I posted the announcement about the formation of the Top 10 for LLM Applications project, well over 200 people had signed onto it, and we held the kick-off event via Zoom. At that first meeting, I laid out a vision for what I hoped the group could accomplish and proposed an aggressive roadmap that we would build the first version of the list in 8 weeks. A typical OWASP Top 10 list may take a year or more to develop, but we decided that this space was moving so fast, and this type of resource was so needed, that we had to work more quickly.

We decided to run the project as two-week, agile-style sprints. Given that most of the people in the expert group were familiar with agile development, everyone quickly fell into the pace.

Project Execution

The first sprint of the project was Brainstorming and Commentary. Everyone reviewed the original version of the list - which I called version 0.1. There were plenty of problems with that initial version, and the team was aggressive about pointing

them out. At the same time, we began to create a wiki page with links to all the resources the group found on LLM security issues. It turned out a lot had been written, but this was the first time anyone had ever collected them and made them easy to access. This new curated collection of resources was the first win for the group.

The second sprint was to generate a new version of the list. This time, rather than being the work of a single person and an AI, it would be the product of the collective wisdom of our expert team – which continued to grow week-on-week. In the first week, the group focused on generating ideas for the Top 10 list. We published a template and asked the group to submit candidate vulnerabilities. In that week, we developed 43 detailed descriptions of possible areas. We then conducted two rounds of voting using Google Forms to use the team's collective wisdom to narrow the list to 10. We then published a version of the list called 0.5. This version was far more detailed and comprehensive than the 0.1 version. The reception from the large community was very positive. This reaction gave the group the energy to keep working.

The next sprint was to refine each entry. We created Slack channels for each vulnerability type and chose a volunteer as the Entry Lead for each item. Subteams of 10 to 30 individuals

then fleshed out and tuned each entry. Again, we included a round of voting for the whole team to be involved and point out weak areas that needed more attention. Along the way, we found some entries overlapping and merged them. This change made space to pull up some entries that had fallen below the line. The result of this sprint became version 0.9 of the list. Interestingly, version 0.9 was about 33% shorter than 0.5 in terms of word count. This extra time and refinement allowed the subteams to focus their thinking and make the entries punchy and tight.

Finally, we took a final sprint to review, tweak, and clean each entry. We gathered another round of feedback via Google Forms to ensure everything was ready. By this time we had a dedicated design lead who laid out the whole document in an attractive PDF for publication.

Reception

My announcement for the 1.0 version of the list was viewed on LinkedIn over 40,000 times. And that doesn't include many other posts made by other expert group members on their own pages and blogs. In the days following the publication of the announcement, reporters picked up the news. They covered it in media outlets such as *Wired*, *SD Times*, *The Register*,

I*nfosecurity Magazine*, and *Diginomica*. It's safe to say hundreds of thousands of people became aware of our work in just the first few weeks.

Beyond the sheer number of people exposed, the thing that amazed me was the uniformly positive feedback. We also saw the first government agencies in the US and Europe referencing our work as a foundational document. While everyone on our expert team agreed there was much more to do, it seemed the world was so hungry for advice in this area that our document hit the mark. While we received many questions and comments, it's safe to say that everyone involved felt pleased and proud of our work.

Keys to Success

I've had many people ask me how we could drive this so quickly to a great outcome. In looking back, there were several factors that I believe contributed. I'll share them here in the hopes that others running similar projects in the future might benefit.

Timing undoubtedly played a considerable role. The wave of interest in LLMs that followed the release of ChatGPT was massive. It drew my attention, and countless others became

excited as well. This helped attract a large and diverse expert group and gave a smaller group of these people motivation to spend long hours on the project on a tight deadline.

Having a clear plan and timeline from the start was crucial. My knowledge of LLM security was limited at the beginning of the project, but I've made a career of running complex projects with many contributors. Creating a clear roadmap with specific phases and a schedule let people know what we were doing and when. The fact that everyone could see a goal that wasn't too far away kept people motivated. Every two weeks, we had global meetings via Zoom and posted recordings on YouTube for people who couldn't attend live. The meetings and recordings were critical to coordinating a globally distributed team.

A freeform but short brainstorming phase at the start was critical. LLM security was such a new area that taking those first two weeks for people to throw out ideas and argue on Slack was crucial. It also allowed us to collect and socialize a repository of the existing research in the area. That let us start at a point where everyone on the project had access to the best pre-existing research.

However, equally critical was keeping this phase short. We could maintain momentum by limiting brainstorming to two weeks and then quickly shifting to a creation phase. I've seen other projects get stuck and be unable to move past brainstorming before people lose interest.

Creating the project's Core Team wasn't something I'd originally planned, but it became critical. Having a large expert team was a fantastic asset. The group grew to nearly 500 people by the time we published 1.0. A team that large would have been totally unmanageable. During the project's first few weeks, I was looking for active and knowledgeable people. I approached about a dozen of them and asked if they'd be willing to join the Core leadership team of the project. I told them it would be extra work, but they'd get to be at the heart of the project. There would be no specific reward for taking this role. Most accepted immediately. I believe that recognizing people and asking for their support formally motivated them to spend more time and energy on the project. They were all invested!

Short sprints with visible deliverables are a core tenant of Agile, and this is a place where it shined. Using an Agile Release Train model, I could continue to drive the group forward even in the face of conflicting opinions. If some members had concerns about an area, we didn't let it get us stuck. We acknowledged it

and agreed we’d resolve it in the next Sprint. And, when we got to version 1.0 of the list, there were still some places people wanted to do more. We just agreed there would be more versions of the list. It would be a living document, and the most important thing was to get a version of this resource into the hands of the developers who needed it.

This Book and the Top 10 List

As I mentioned, this book is not a product of the OWASP Foundation. However, the experience of working with this team has had an enormous impact on my understanding and mental model for LLM security. This mindset means that much of the guidance in the following chapters of the book is influenced by the fantastic team building and maintaining the Top 10 project. In this way, readers should feel comfortable that they're getting advice that isn't the product of a single author but is informed by a larger community of experts.

In the following several chapters, we'll review the top risk and vulnerability areas for LLMs. The risks we discuss will contain many common areas to the OWASP Top 10 but won't be precisely the same as any version of the official Top 10. Also, I'll go more deeply into each area in this book. The Top 10 list is a quick read that highlights critical areas. However, it doesn't go deeply into any of them. Here, we'll delve more deeply into the risks, remediation steps, and real-world case studies.

In the next chapter, we'll dig into the overall structure of typical LLM applications and start discussing where the trust boundaries and dangers lay. After that, subsequent chapters

will delve into individual risk areas and examine vulnerabilities, attacks, and examples so that you can plan your strategy for securing your own use cases.

Let’s go!

Chapter 3. Architectures and Trust Boundaries

A NOTE FOR EARLY RELEASE READERS

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This will be the 3rd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Unlike traditional web applications that rely on predefined algorithms and static databases, LLMs utilize massive neural networks to generate dynamic, context-aware responses. This seismic shift brings a unique set of security challenges different from what we've seen in traditional web applications. While researchers have meticulously studied web applications and

their vulnerabilities, the field of LLM security is still relatively nascent.

This chapter aims to bridge this knowledge gap by dissecting the fundamental elements that set LLMs apart. We'll start by exploring the building blocks of AI, Neural Networks, and how they relate to Large Language Models. Then, we dive into the groundbreaking architecture that powers most LLMs today—the Transformer model. Following this, we look into the various LLM-powered applications, such as chatbots and code co-pilots.

However, in addition to understanding the technology, security professionals must be aware of the new kinds of *trust boundaries* unique to LLMs—boundaries that demarcate areas of varying trustworthiness within an application. These include user prompts, uploaded content, training data, plug-ins, and other boundary systems that we'll detail later in the chapter.

AI, Neural Networks, and Large Language Models. What's the difference?

Artificial Intelligence (AI), Neural Network, and LLM are terms often used interchangeably, but they represent different facets

of a broader landscape of machine learning and computational intelligence. Let's break down the differences to understand their unique roles in technology and security.

Artificial Intelligence (AI)

Artificial Intelligence, at its core, is a multidisciplinary field aimed at creating systems capable of performing tasks that would ordinarily require human intelligence. These tasks include problem-solving, perception, and language understanding. AI encompasses a wide range of technologies and methodologies, from rule-based systems to machine learning algorithms, serving as an umbrella term for multiple approaches to achieving artificial 'intelligence.'

Neural Networks

Neural Networks are a subset of AI inspired by the architecture of the human brain. They are computational models designed to recognize patterns and make decisions based on the data they process. Neural Networks can be simple, with a minimal number of layers (shallow neural networks), or highly complex, with multiple interconnected layers (deep neural networks). They are the backbone of many modern AI applications,

including image recognition, natural language processing, and autonomous vehicles.

Large Language Models (LLMs)

LLMs represent a specific application of Neural Networks. They are built on architectures designed for understanding and generating human language. LLMs usually employ advanced forms of neural networks, such as Transformer models, to analyze and produce text based on the training data their developers fed them. What sets them apart is their massive scale and specialization in handling linguistic tasks, which range from simple text completion to complex question answering and summarization.

Understanding these distinctions is crucial for security professionals. Each layer—from broad AI technologies to specialized LLMs—introduces vulnerabilities and requires unique security measures. As we delve deeper into the complexities of LLMs, recognizing their position in the broader AI landscape will be critical to effectively safeguarding them.

The Transformer Revolution: Origins, Impact, and the LLM Connection

The Transformer architecture is a pivotal milestone in the evolution of artificial intelligence, profoundly impacting the AI landscape and, by extension, Large Language Models (LLMs). Let's unravel the story of the Transformer revolution—where it came from, when it happened, and the seismic shifts it brought to AI and LLMs.

Origins of the Transformer

The Transformer architecture was introduced in a groundbreaking research paper titled "Attention Is All You Need" by Vaswani et al., published in 2017[1]. This paper proposed a novel approach to natural language processing (NLP) tasks, departing from the traditional sequence-to-sequence models that relied heavily on recurrent neural networks (RNNs) and convolutional neural networks (CNNs). The Transformer introduced a key innovation: the self-attention mechanism. This mechanism allowed the model to weigh the importance of different words in a sentence, enabling it to understand context more effectively.

Before the emergence of Transformers, the world of neural networks was replete with promise but often struggled to deliver on the lofty expectations. Traditional architectures like RNNs and CNNs enabled advanced AI capabilities but grappled

with inherent limitations. These limitations stemmed from their inability to capture and utilize context effectively, particularly in natural language understanding.

RNNs, while suitable for sequential data, faced challenges maintaining context over long sequences. They exhibited a form of “short-term memory,” which made them less adept at grasping intricate relationships and dependencies within lengthy texts or conversations. On the other hand, CNNs, renowned for their prowess in image recognition, needed help to extend their effectiveness to sequential data like language, where understanding context across words and sentences was paramount.

This shortcoming in contextual understanding was the Achilles’ heel of traditional neural networks. They could only glimpse small portions of a text at a time, rendering them incapable of comprehending the broader narrative or nuances. It was akin to trying to understand a novel by reading only a few random sentences from its pages. The result was a gap between the promise of AI and its practical application, particularly in natural language understanding. It was this gap that the Transformer architecture would bridge, unleashing a wave of progress and redefining the landscape of AI-driven language models.

Transformer Architecture’s Impact on AI

Introducing the Transformer architecture wasn’t just a milestone for natural language processing; it marked a paradigm shift across multiple domains within the AI landscape. While researchers initially used the Transformer architecture to solve problems related to understanding and generating text, researchers and engineers quickly found that its capabilities extended far beyond that. Here are some areas where Transformer architectures have made a considerable impact:

Natural Language Processing (NLP)

Of course, the first and most immediate impact was in NLP. Transformer models are now the backbone for various language tasks such as translation, summarization, question-answering, and sentiment analysis. They have set new performance benchmarks, sometimes surpassing human-level capabilities in specific tasks.

Computer Vision

Interestingly, the Transformer architecture also has applications in computer vision. While CNNs have been the gold

standard for image-related tasks, Transformer-based models like Vision Transformer (ViT) demonstrate competitive, if not superior, performance in tasks like image classification, object detection, and segmentation.

Speech Recognition

The flexibility of Transformer architectures has also made them a good fit for speech recognition. Combined with specialized models like the Conformer, which fuses Convolutional layers with Transformer layers, they have set new standards for understanding spoken language.

Autonomous Systems and Self-Driving Cars

One of the most intriguing applications of Transformers is autonomous systems, including self-driving cars. These vehicles require a high contextual understanding to navigate the world safely. Transformer models are at the heart of self-driving models from companies like Tesla.

Healthcare

In healthcare, Transformer models are aiding in tasks ranging from drug discovery to the analysis of medical images. Their

ability to sift through and interpret large amounts of data can speed up research and potentially lead to more accurate diagnoses.

Therefore, the rise of the Transformer architecture has been a tide that lifted all boats, revolutionizing not just one but multiple fields within AI. However, this versatility also brings unique security challenges across these various applications. As we delve deeper into LLM security, we'll explore how the ubiquitous nature of Transformer architectures necessitates a multi-faceted approach to safeguarding AI systems.

Types of LLM-based Applications

Two common types of LLM-based applications are chatbots and co-pilots. Let's briefly look at each to help you understand the breadth of applications in which developers use LLMs and give you context for understanding various architectural choices as you delve further.

Chatbots are computer programs that can simulate conversations with humans, and they often power customer service applications, where they can answer questions and support customers. Chatbots also excel at entertainment

applications like playing games or telling stories. Tay from Chapter 1 was just such an example of an Entertainment Chatbot.

Co-pilots are AI systems that can assist humans with writing, coding, and research tasks. They can help users to generate ideas, identify errors, and improve their work. Co-pilots are still under development, but they have the potential to revolutionize the way we work and learn.

Specific examples of LLM-based chatbots:

- **Sephora** uses a chatbot to help customers find the right products for their skin type and needs.
- **H&M** uses a chatbot to help customers find clothes and accessories that match their style.
- **Domino's Pizza** uses a chatbot to allow customers to order pizza via Twitter or Facebook Messenger.
- **Fandango** uses a chatbot to help customers find movie times and theaters nearby.
- **JetBlue Airways** uses a chatbot to answer customer questions about flights and travel.
- **Amtrak** uses a chatbot to help customers book tickets, check train status, and get answers to their questions.

- **The Golden State Warriors** use a chatbot to help fans purchase tickets, learn about upcoming games, and get news about the team.

Specific examples of LLM-based co-pilots:

- **Grammarly or ProWritingAid** are co-pilots that help users improve their writing by identifying and correcting grammar errors, suggesting style improvements, and providing feedback.
- **GitHub Co-Pilot and AWS Code Whisperer** are co-pilots that help programmers write code faster and more efficiently. They can generate code suggestions, translate between programming languages, and help to identify and debug errors.
- **Microsoft Office 365 Co-pilot and Google Duet** are AI-powered tools integrated into their respective office suite apps that help users to be more productive and creative in their work.

NOTE

A chatbot like ChatGPT can read and review a text block and then provide suggestions to improve it. However, the experience of using a co-pilot like Grammarly to do that is dramatically different - and generally superior for that type of focused task.

Similarities between chatbots and co-pilots:

- Both chatbots and co-pilots are LLM-based applications.
- Both chatbots and co-pilots both generate text.
- Both chatbots and co-pilots assist humans with tasks.

Differences between chatbots and co-pilots:

- Chatbots simulate conversation with humans, while co-pilots assist humans with specific tasks.
- Chatbots often power customer service applications, while co-pilots assist in writing, coding, and research applications.
- Chatbots are typically more interactive than co-pilots, while co-pilots focus more on completing tasks.

Examples of use cases:

- A customer service chatbot can answer customer questions about a company's products or services.
- A co-pilot can help writers generate ideas for a new article or identify writing errors.
- A co-pilot can help programmers write code more efficiently or debug their applications.

Keep these concepts in mind as we delve into the details of LLM architectures. Both application types share similar components, but you may make different decisions on implementing pieces based on the differing security considerations.

LLM Application Architecture

Developers often consider LLMs as standalone entities capable of impressive text generation and comprehension feats. However, in practice, an LLM is rarely isolated; it is a cog in the intricate machinery that constitutes an intelligent application. These applications are complex systems comprising multiple interconnected components, each playing a vital role in the overall functionality and performance. Whether a conversational agent, an automated content generator, or a co-pilot for code, an LLM usually interacts with various elements such as databases, APIs, front-end interfaces, and even other machine learning models.

Understanding the architecture of such composite systems is not just a matter of technical proficiency; it is crucial for effective security planning. The way these components interact introduces multiple trust and data flow layers, defining new security boundaries far removed from traditional web

application security models. For instance, user inputs may not just be simple text fields but could include voice commands, images, or real-time collaborative editing. Similarly, an LLM's outputs could be fed into other systems for further processing, each introducing vulnerabilities and risks.

In essence, the holistic view of an LLM-based application goes beyond securing the language model itself. It demands a comprehensive approach that considers the security of the entire architecture, from data ingestion and storage to model serving and user interaction. Only by understanding these intricacies can one formulate an effective strategy to safeguard an application against the myriad of vulnerabilities such complex systems inherently possess.

As we delve deeper into the subject in this chapter, we will dissect the various components that typically make up an LLM application, examine their roles, and explore the unique security challenges each presents. This understanding will be the foundation for a robust, multi-layered approach to securing your LLM-based applications.

Figure 3-1 shows a highly simplified diagram to help illustrate the components, relationships, and data flows in an application

using an LLM. We'll delve into more detailed areas of this in subsequent chapters.

Figure 3-1. Typical LLM Application Dataflow Architecture

Trust Boundaries

In application security, a "trust boundary" serves as an invisible yet crucial demarcation line that separates different components or entities based on their level of trustworthiness. These boundaries delineate areas where data or control flow changes from one level of trust to another—such as transitioning from user-controlled input to internal processing or moving from a secure internal database to a public-facing

API. These boundaries act as checkpoints where developers should rigorously apply security measures like authentication, authorization, and data validation to prevent vulnerabilities.

WARNING

Understanding trust boundaries is critical to threat modeling. Properly defining and recognizing these boundaries can be the difference between a secure system and one vulnerable to threats.

Figure 3-2 adds the trust boundaries into our architecture diagram.

Figure 3-2. LLM Application Architecture with Trust Boundaries

These boundaries, as depicted in the diagram, serve as gateways through which the LLM interfaces with diverse components — public data from the web, structured databases, spontaneous user interactions, or internally sourced training sets. Each delineated boundary highlights highlights considerations we must make when considering data that flows into and out of the LLM. Here's a quick summary, and we'll dive more deeply in the next section.

- **User Interactions:** You'll need to consider safeguarding the model from potential adversarial or misleading inputs that users or systems might introduce. You'll also need to worry about toxic, inaccurate, or sensitive data being output from the model and passed back to the user.
- **In-the-wild Training Data:** LLMs are often trained on massive amounts of internet data. You need to consider this data untrusted and watch out for potential toxicity, bias, and adversarial data poisoning - which we'll cover in Chapter 8.
- **Internal Training Data:** You may use internally curated data to fine-tune your model - which can significantly increase accuracy. But you must be wary of ingesting and exposing sensitive, confidential, or personally identifiable information. We'll cover this more in Chapter 5.

- **External Services:** Policing how the LLM interfaces with connected services, like databases or APIs, from unauthorized interactions or data leaks. We'll cover this more in Chapter 7.
- **Public Data Access:** Pulling in data live from the web can be a powerful way to augment the capabilities of your application, but you'll need to consider this data as untrusted and watch for issues like indirect prompt injection - which we'll cover in chapter 4.

Each point is a potential avenue of vulnerability, susceptible to exploitation if overlooked. In the evolving landscape of LLM applications, securing these trust boundaries is not just best practice — it's essential to prevent unauthorized data access, mitigate data tampering, and avert system breaches. Recognizing these boundaries and their implications is the cornerstone of a resilient LLM security architecture. Now, let's go into more detail on each area to ensure you have enough context to dive into the following chapters that detail the risk areas and mitigations.

The Model

The language model serves as the intellectual core of any LLM application, taking in data, generating responses, and driving

interactions. Depending on the architecture and requirements, you may interact with the language model through a public API hosted by a third-party service, or you may run a privately hosted model. For example, you can download versions of Meta's powerful Llama model from Github or Hugging Face and run it locally.

Public APIs: The Convenience and The Risks

Utilizing a public API for accessing a language model offers convenience and lower upfront costs. Third parties manage and update these models, reducing your organization's resource burden. However, the tradeoff often comes in the form of higher risk regarding data exposure. When you send a request to a third-party model, the data crosses a trust boundary, exiting your secure network and entering an external system. This process exposes you to risks around data confidentiality and, depending on the third party's security measures, could make you vulnerable to data breaches.

Privately Hosted Models: More Control, Different Risks

Opting for a privately hosted model gives you more control over your data, allowing you to manage trust boundaries more

tightly. It also allows you to customize or fine-tune the model according to your needs. However, running a privately hosted model brings challenges, such as maintenance, updates, and ensuring that the model doesn't contain vulnerabilities—essentially exposing you to potential supply chain risks. If you use an open-source model, it becomes crucial to ensure its provenance and integrity to avoid embedded vulnerabilities or biases.

Risk Considerations

- **Sensitive Data Exposure:** Public APIs may increase the risk of exposing sensitive information, while privately hosted models offer better control but require robust internal security measures.
- **Supply Chain Risk:** The origins of your model, whether it's a well-vetted public service or an open-source download, are crucial. A compromised model can introduce vulnerabilities into your application, effectively acting as a backdoor for attacks.

By carefully considering the model's hosting environment, you can better assess the trade-offs and risks associated with sensitive data exposure and supply chain vulnerabilities. These considerations will guide you in establishing appropriate trust

boundaries and security protocols tailored to your chosen model's architecture.

User Interaction

While "user input" might suggest a one-way flow of information from the user into the application, the reality is often more nuanced. In the context of LLM applications, "User Interaction" encapsulates both receiving input from the user and providing output back to the user. This bidirectional interaction is fundamental for creating an engaging and practical user experience but also introduces a more complicated security landscape.

Prompts are a vital element of user interaction. They are not merely requests for information but serve as a guide to how the user interacts with the LLM. A well-crafted prompt can direct the model to provide valuable and accurate information, while an ambiguous or poorly constructed one can lead to unclear or even misleading outputs. As a result, the management of prompts becomes a critical aspect of application security. For example, a maliciously crafted prompt could trick the model into divulging information it shouldn't or generating harmful content. Returning to Chapter 1, Tay fell victim to this when

malicious prompts from her 4Chan hackers helped lead her astray.

Given the importance of this bidirectional interaction, securing both inputs and outputs is crucial. On the input side, input validation, sanitation, and rate-limiting measures are vital in mitigating vulnerabilities like injection attacks. On the output side, ensuring that the model's responses are appropriately filtered and that your application does not leak sensitive information is equally vital.

This interactive layer with the user creates a critical trust boundary in the application architecture. Any data crossing this boundary, whether in or out, should be carefully managed to avoid security risks. Additional layers of protection include using encryption for sensitive outputs or employing real-time monitoring to flag potentially harmful or sensitive data flows. We'll discuss this more thoroughly in the Prompt Injection and Output Filtering chapters.

Training Data

Training data is the bedrock upon which LLMs build their understanding and capabilities. Whether used for initial training or subsequent fine-tuning, the nature and source of

this data have significant implications for both the model's performance and security posture. One crucial distinction is whether the data is internally sourced or culled from public or external sources ("in the wild").

Data generated or curated within an organization usually undergo a more rigorous vetting than publicly sourced data. It is often aligned with the application's specific requirements or use cases, making it generally more reliable and relevant. The controlled environment also allows for better implementation of security measures like encryption, access controls, and auditing. However, this data may contain sensitive or proprietary information, and the trust boundary here is closely tied to internal security protocols. A breach at this level could have serious ramifications, including data leakage or the corruption of the training set.

Data sourced from public repositories or "the wild" introduces different challenges. While this data can offer diversity and scale, its reliability and safety are often not guaranteed. Such data could include misleading information, biases, or malicious inputs to compromise the model. The trust boundary here is more porous and extends to the external entities that generate or host this data: rigorous filtering, validation, and continuous monitoring become essential to mitigate risks and

vulnerabilities. Returning to Chapter 1, Tay was digesting user prompts directly as training data. In this way, remnants of toxic prompts became part of her knowledge base, and then she began to spill poisonous output. Accepting unfiltered, untrusted user input into your training data set is the simplest example of a failure to manage this critical security boundary.

For either internally sourced or public data, the concept of trust boundaries is critical. For internally sourced data, the boundary is often within the organization's controlled environment, making it easier to enforce security measures. On the other hand, using external data effectively extends your trust boundary to include those external sources that may not adhere to your security standards. Using external data for training necessitates additional layers of validation and security checks to ensure that unvetted data doesn't compromise the integrity or security of the LLM application.

Understanding the origins of your training data, the associated trust boundaries, and their respective security implications is crucial for safeguarding your LLM application. Comprehensive data governance policies must be in place to manage the lifecycle of your training data, regardless of its source.

Access to Live External Data Sources

Live external data sources bring an added dimension to the capabilities of LLM applications by enabling them to provide real-time information, context, or even third-party integrations. While access to live external data enhances the user experience and functional range, it introduces a new layer of complexity to the application's security landscape.

As an example of this, as of the writing of this chapter, OpenAI's ChatGPT does not have direct access to the live web, and is thus limited to only facts in its older training data. On the other hand, Google's Bard engine does have access to live internet data. While the GPT-4 model is doubtlessly superior in reasoning capability, it fails at many basic tasks where Bard can succeed. Figure 3-3 shows an interaction with ChatGPT. Figure 3-4 shows the same interaction with Bard.

Figure 3-3. ChatGPT with GTP-4 fails to answer a simple question due to limited access to external data.

who won yesterday's 49er football game

View other drafts

The San Francisco 49ers defeated the New York Giants 30-12 on Thursday Night Football on September 21, 2023.

Christian McCaffrey scored a touchdown in his 12th straight game, and Brock Purdy threw two touchdown passes to lead the 49ers to their third straight win.

Figure 3-4. Bard's direct access to internet feeds gives it an advantage.

While clearly, there are advantages to accessing outside data sources such as websites, APIs, or third-party databases, it exposes the application to potential risks. The risk of ingesting untrusted, external data sources can range from consuming false or harmful information from compromised websites to becoming a conduit for security threats like malware or unauthorized data access. The untrusted nature of these data sources makes them inherently less controllable than internal resources, thereby adding an additional layer of uncertainty and risk.

The concept of trust boundaries becomes especially pertinent in the context of accessing public internet data. Unlike internal services, where you can uniformly apply security measures, external sources may adhere to different security standards than your organization. This differential in trust necessitates additional layers of validation, security checks, and monitoring to ensure that data crossing this boundary doesn't compromise the system.

Access to Internal Services

Internal services like databases and internal APIs often serve as the backend support structure for LLM applications. They may house critical data from user profiles and logs to configuration settings and even vast data in SQL or Vector Databases. As a component that often interfaces with various other internal and external elements of the system, internal services represent a critical point in the application's architecture, both functionally and from a security perspective.

These services often function within the controlled environment of an organization, enabling uniform application of security policies. However, the fact that these services are internal should keep one from a false sense of security. They are still vulnerable to various threats, such as unauthorized

access, data leaks, and internal threats from within the organization.

Internal services such as databases, proprietary APIs, and backend systems often constitute the operational backbone for LLM applications. These resources typically reside within the organization's secure network, providing trust and control that is harder to achieve with external services. However, this internal nature can paradoxically elevate the security risks involved, primarily if these services house the organization's "crown jewels" of sensitive or valuable data.

Conclusion

Securing LLM applications is an endeavor fraught with complexities, intricacies, and challenges, significantly different from traditional web applications. This chapter has aimed to lay down the foundational knowledge required to navigate this complex landscape, focusing on three critical areas: distinguishing between Artificial Intelligence, Neural Networks, and Large Language Models; understanding the pivotal role of Transformer architectures; and diving deep into LLM application architecture, particularly the concept of trust boundaries. Knowing what sets LLMs apart helps us tailor our

security strategies more effectively, going beyond general AI or machine learning frameworks.

- https://arxiv.org/pdf/1706.03762.pdf

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National Education Policy 2020

Introduction

Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country.

The global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015 - seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. Such a lofty goal will require the entire education system to be reconfigured to support and foster learning, so that all of the critical targets and goals (SDGs) of the 2030 Agenda for Sustainable Development can be achieved.

The world is undergoing rapid changes in the knowledge landscape. With various dramatic scientific and technological advances, such as the rise of big data, machine learning, and artificial intelligence, many unskilled jobs worldwide may be taken over by machines, while the need for a skilled workforce, particularly involving mathematics, computer science, and data science, in conjunction with multidisciplinary abilities across the sciences, social sciences, and humanities, will be increasingly in greater demand. With climate change, increasing pollution, and depleting natural resources, there will be a sizeable shift in how we meet the world's energy, water, food, and sanitation needs, again resulting in the need for new skilled labour, particularly in biology, chemistry, physics, agriculture, climate science, and social science. The growing emergence of epidemics and pandemics will also call for collaborative research in infectious disease management and development of vaccines and the resultant social issues heightens the need for multidisciplinary learning. There will be a growing demand for humanities and art, as India moves towards becoming a developed country as well as among the three largest economies in the world.

Indeed, with the quickly changing employment landscape and global ecosystem, it is becoming increasingly critical that children not only learn, but more importantly learn how to learn. Education thus, must move towards less content, and more towards learning about how to think critically and solve problems, how to be creative and multidisciplinary, and how to innovate, adapt, and absorb new material in novel and changing fields. Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible, and, of course, enjoyable. The curriculum must include basic arts, crafts, humanities, games, sports and fitness, languages, literature, culture, and values, in addition to science and mathematics, to develop all aspects and capabilities of learners; and make education more well-rounded, useful, and fulfilling to the learner. Education must build character, enable learners to be ethical, rational, compassionate, and caring, while at the same time prepare them for gainful, fulfilling employment.

The gap between the current state of learning outcomes and what is required must be bridged through undertaking major reforms that bring the highest quality, equity, and integrity into the system, from early childhood care and education through higher education.

The aim must be for India to have an education system by 2040 that is second to none, with equitable access to the highest-quality education for all learners regardless of social or economic background.

This National Education Policy 2020 is the first education policy of the 21st century and aims to address the many growing developmental imperatives of our country. This Policy proposes the revision and revamping of all aspects of the education structure, including its regulation and governance, to create a new system that is aligned with the aspirational goals of 21st century education, including SDG4, while building upon India's traditions and value systems. The National

Education Policy lays particular emphasis on the development of the creative potential of each individual. It is based on the principle that education must develop not only cognitive capacities - both the 'foundational capacities 'of literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving – but also social, ethical, and emotional capacities and dispositions.

The rich heritage of ancient and eternal Indian knowledge and thought has been a guiding light for this Policy. The pursuit of knowledge (*Jnan*), wisdom (*Pragyaa*), and truth (*Satya*) was always considered in Indian thought and philosophy as the highest human goal. The aim of education in ancient India was not just the acquisition of knowledge as preparation for life in this world, or life beyond schooling, but for the complete realization and liberation of the self. World-class institutions of ancient India such as Takshashila, Nalanda,Vikramshila, Vallabhi, set the highest standards of multidisciplinary teaching and research and hosted scholars and students from across backgrounds and countries. The Indian education system produced great scholars such as Charaka, Susruta, Aryabhata, Varahamihira, Bhaskaracharya, Brahmagupta, Chanakya, Chakrapani Datta, Madhava, Panini, Patanjali, Nagarjuna, Gautama, Pingala, Sankardev, Maitreyi, Gargi and Thiruvalluvar, among numerous others, who made seminal contributions to world knowledge in diverse fields such as mathematics, astronomy, metallurgy, medical science and surgery, civil engineering, architecture, shipbuilding and navigation, yoga, fine arts, chess, and more. Indian culture and philosophy have had a strong influence on the world. These rich legacies to world heritage must not only be nurtured and preserved for posterity but also researched, enhanced, and put to new uses through our education system.

The teacher must be at the centre of the fundamental reforms in the education system. The new education policy must help re-establish teachers, at all levels, as the most respected and essential members of our society, because they truly shape our next generation of citizens. It must do everything to empower teachers and help them to do their job as effectively as possible. The new education policy must help recruit the very best and brightest to enter the teaching profession at all levels, by ensuring livelihood, respect, dignity, and autonomy, while also instilling in the system basic methods of quality control and accountability.

The new education policy must provide to all students, irrespective of their place of residence, a quality education system, with particular focus on historically marginalized, disadvantaged, and underrepresented groups. Education is a great leveler and is the best tool for achieving economic and social mobility, inclusion, and equality. Initiatives must be in place to ensure that all students from such groups, despite inherent obstacles, are provided various targeted opportunities to enter and excel in the educational system.

These elements must be incorporated taking into account the local and global needs of the country, and with a respect for and deference to its rich diversity and culture. Instilling knowledge of India and its varied social, cultural, and technological needs, its inimitable artistic, language, and knowledge traditions, and its strong ethics in India's young people is considered critical for purposes of national pride, self-confidence, self-knowledge, cooperation, and integration.

Previous Policies

The implementation of previous policies on education has focused largely on issues of access and equity. The unfinished agenda of the National Policy on Education 1986, modified in 1992 (NPE 1986/92), is appropriately dealt with in this Policy. A major development since the last Policy of 1986/92 has been the Right of Children to Free and Compulsory Education Act 2009 which laid down legal underpinnings for achieving universal elementary education.

Principles of this Policy

The purpose of the education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and

creative imagination, with sound ethical moorings and values. It aims at producing engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by our Constitution.

A good education institution is one in which every student feels welcomed and cared for, where a safe and stimulating learning environment exists, where a wide range of learning experiences are offered, and where good physical infrastructure and appropriate resources conducive to learning are available to all students. Attaining these qualities must be the goal of every educational institution. However, at the same time, there must also be seamless integration and coordination across institutions and across all stages of education.

The fundamental principles that will guide both the education system at large, as well as the individual institutions within it are:

- **recognizing, identifying,** and **fostering the unique capabilities of each student,** by sensitizing teachers as well as parents to promote each student's holistic development in both academic and non-academic spheres;
- **according the** highest priority **to achieving Foundational Literacy and Numeracy** by all students by Grade 3;
- **flexibility**, so that learners have the ability to choose their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests;
- **no hard separations** between arts and sciences, between curricular and extra-curricular activities, between vocational and academic streams, etc. in order to eliminate harmful hierarchies among, and silos between different areas of learning;
- **multidisciplinarity** and a **holistic education** across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world in order to ensure the unity and integrity of all knowledge;
- **emphasis on conceptual understanding** rather than rote learning and learning-for-exams;
- **creativity and critical thinking** to encourage logical decision-making and innovation;
- **ethics and human & Constitutional values** like empathy, respect for others, cleanliness, courtesy, democratic spirit, spirit of service, respect for public property, scientific temper, liberty, responsibility, pluralism, equality, and justice;
- **promoting multilingualism and the power of language** in teaching and learning;
- **life skills** such as communication, cooperation, teamwork, and resilience;
- **focus on regular formative assessment for learning** rather than the summative assessment that encourages today's 'coaching culture';
- **extensive use of technology** in teaching and learning, removing language barriers, increasing access for *Divyang* students, and educational planning and management;
- **respect for diversity** and **respect for the local context** in all curriculum, pedagogy, and policy, always keeping in mind that education is a concurrent subject;
- **full equity and inclusion** as the cornerstone of all educational decisions to ensure that all students are able to thrive in the education system;
- **synergy in curriculum across all levels of education** from early childhood care and education to school education to higher education;
- **teachers and faculty as the heart of the learning process** – their recruitment, continuous professional development, positive working environments and service conditions;

- a **'light but tight' regulatory framework** to ensure **integrity, transparency**, and **resource efficiency** of the educational system through audit and public disclosure while encouraging innovation and out-of-the-box ideas through **autonomy, good governance, and empowerment**;
- **outstanding research** as a corequisite for outstanding education and development;
- **continuous review** of progress based on sustained research and regular assessment by educational experts;

- **a rootedness and pride in India**, and its rich, diverse, ancient and modern culture and knowledge systems and traditions;
- **education is a public service**; access to quality education must be considered a basic right of every child;
- **substantial investment in a strong, vibrant public education system** as well as the encouragement and facilitation of true philanthropic private and community participation.

The Vision of this Policy

This National Education Policy envisions an education system rooted in Indian ethos that contributes directly to transforming India, that is Bharat, sustainably into an equitable and vibrant knowledge society, by providing high-quality education to all, and thereby making India a global knowledge superpower. The Policy envisages that the curriculum and pedagogy of our institutions must develop among the students a deep sense of respect towards the Fundamental Duties and Constitutional values, bonding with one's country, and a conscious awareness of one's roles and responsibilities in a changing world. The vision of the Policy is to instill among the learners a deep-rooted pride in being Indian, not only in thought, but also in spirit, intellect, and deeds, as well as to develop knowledge, skills, values, and dispositions that support responsible commitment to human rights, sustainable development and living, and global well-being, thereby reflecting a truly global citizen.

Part I. SCHOOL EDUCATION

This policy envisages that the extant 10+2 structure in school education will be modified with a new pedagogical and curricular restructuring of 5+3+3+4 covering ages 3-18 as shown in the representative figure and elaborated in detail later under Chapter 4.

Currently, children in the age group of 3-6 are not covered in the 10+2 structure as Class 1 begins at age 6. In the new 5+3+3+4 structure, a strong base of Early Childhood Care and Education (ECCE) from age 3 is also included, which is aimed at promoting better overall learning, development, and well-being.

1. Early Childhood Care and Education: The Foundation of Learning

1.1. Over 85% of a child's cumulative brain development occurs prior to the age of 6, indicating the critical importance of appropriate care and stimulation of the brain in the early years in order to ensure healthy brain development and growth. Presently, quality ECCE is not available to crores of young children, particularly children from socio-economically disadvantaged backgrounds. Strong investment in ECCE has the potential to give all young children such access, enabling them to participate and flourish in the educational system throughout their lives. Universal provisioning of quality early childhood development, care, and education must thus be achieved as soon as possible, and no later than 2030, to ensure that all students entering Grade 1 are school ready.

1.2. ECCE ideally consists of flexible, multi-faceted, multi-level, play-based, activity-based, and inquiry-based learning, comprising of alphabets, languages, numbers, counting, colours, shapes, indoor and outdoor play, puzzles and logical thinking, problem-solving, drawing, painting and other visual art, craft, drama and puppetry, music and movement. It also includes a focus on developing social capacities, sensitivity, good behaviour, courtesy, ethics, personal and public cleanliness, teamwork, and cooperation. The overall aim of ECCE will be to attain optimal outcomes in the domains of: physical and motor development, cognitive development, socio-emotional-ethical development, cultural/artistic development, and the development of communication and early language, literacy, and numeracy.

1.3. A National Curricular and Pedagogical Framework for Early Childhood Care and Education (NCPFECCE) for children up to the age of 8 will be developed by NCERT in two parts, namely, a sub-framework for 0-3 year-olds, and a sub-framework for 3-8 year-olds, aligned with the above guidelines, the latest research on ECCE, and national and international best practices. In particular, the numerous rich local traditions of India developed over millennia in ECCE involving art, stories, poetry, games, songs, and more, will also be suitably incorporated. The framework will serve as a guide both for parents and for early childhood care and education institutions.

1.4. The overarching goal will be to ensure universal access to high-quality ECCE across the country in a phased manner. Special attention and priority will be given to districts and locations that are particularly socio-economically disadvantaged. ECCE shall be delivered through a significantly expanded and strengthened system of early-childhood education institutions consisting of (a) stand-alone Anganwadis; (b) Anganwadis co-located with primary schools; (c) pre-primary schools/sections covering at least age 5 to 6 years co-located with existing primary schools; and (d) stand-alone pre-schools - all of which would recruit workers/teachers specially trained in the curriculum and pedagogy of ECCE.

1.5. For universal access to ECCE, Anganwadi Centres will be strengthened with high-quality infrastructure, play equipment, and well-trained Anganwadi workers/teachers. Every Anganwadi will have a well-ventilated, well-designed, child-friendly and well-constructed building with an enriched learning environment. Children in Anganwadi Centres shall take activity-filled tours - and meet the teachers and students of their local primary schools, in order to make the transition from Anganwadi Centres to primary schools a smooth one. Anganwadis shall be fully integrated into school complexes/clusters, and Anganwadi children, parents, and teachers will be invited to attend and participate in school/school complex programmes and vice versa.

1.6. It is envisaged that prior to the age of 5 every child will move to a "Preparatory Class" or "Balavatika" (that is, before Class 1), which has an ECCE-qualified teacher. The learning in the Preparatory Class shall be based primarily on play-based learning with a focus on developing cognitive, affective, and psychomotor abilities and early literacy and numeracy. The mid-

day meal programme shall also be extended to the Preparatory Classes in primary schools. Health check-ups and growth monitoring that are available in the Anganwadi system shall also be made available to Preparatory Class students of Anganwadi as well as of primary schools.

1.7. To prepare an initial cadre of high-quality ECCE teachers in Anganwadis, current Anganwadi workers/teachers will be trained through a systematic effort in accordance with the curricular/pedagogical framework developed by NCERT. Anganwadi workers/teachers with qualifications of 10+2 and above shall be given a 6-month certificate programme in ECCE; and those with lower educational qualifications shall be given a one-year diploma programme covering early literacy, numeracy, and other relevant aspects of ECCE. These programmes may be run through digital/distance mode using DTH channels as well as smartphones, allowing teachers to acquire ECCE qualifications with minimal disruption to their current work. The ECCE training of Anganwadi workers/teachers will be mentored by the Cluster Resource Centres of the School Education Department which shall hold at least one monthly contact class for continuous assessment. In the longer term, State Governments shall prepare cadres of professionally qualified educators for early childhood care and education, through stage-specific professional training, mentoring mechanisms, and career mapping. Necessary facilities will also be created for the initial professional preparation of these educators and their Continuous Professional Development (CPD).

1.8. ECCE will also be introduced in Ashramshalas in tribal-dominated areas and in all formats of alternative schooling in a phased manner. The process for integration and implementation of ECCE in Ashramshalas and alternative schooling will be similar to that detailed above.

1.9. The responsibility for ECCE curriculum and pedagogy will lie with MHRD to ensure its continuity from pre-primary school through primary school, and to ensure due attention to the foundational aspects of education. The planning and implementation of early childhood care and education curriculum will be carried out jointly by the Ministries of HRD, Women and Child Development (WCD), Health and Family Welfare (HFW), and Tribal Affairs. A special joint task force will be constituted for continuous guidance of the smooth integration of early childhood care and education into school education.

2. Foundational Literacy and Numeracy: An Urgent & Necessary Prerequisite to Learning

2.1. The ability to read and write, and perform basic operations with numbers, is a necessary foundation and an indispensable prerequisite for all future schooling and lifelong learning. However, various governmental, as well as non-governmental surveys, indicate that we are currently in a learning crisis: a large proportion of students currently in elementary school - estimated to be over 5 crore in number - have not attained foundational literacy and numeracy, i.e., the ability to read and comprehend basic text and the ability to carry out basic addition and subtraction with Indian numerals.

2.2. Attaining foundational literacy and numeracy for all children will thus become an urgent national mission, with immediate measures to be taken on many fronts and with clear goals that will be attained in the short term (including that every student will attain foundational literacy and numeracy by Grade 3). The highest priority of the education system will be to achieve universal foundational literacy and numeracy in primary school by 2025. The rest of this Policy will become relevant for our students only if this most basic learning requirement (i.e., reading, writing, and arithmetic at the foundational level) is first achieved. To this end, a National Mission on Foundational Literacy and Numeracy will be set up by the Ministry of Human Resource Development (MHRD) on priority. Accordingly, all State/UT governments will immediately prepare an implementation plan for attaining universal foundational literacy and numeracy in all primary schools, identifying stage-wise targets and goals to be achieved by 2025, and closely tracking and monitoring progress of the same.

2.3. First, teacher vacancies will be filled at the earliest, in a time-bound manner - especially in disadvantaged areas and areas with large pupil-to-teacher ratios or high rates of illiteracy. Special

attention will be given to employing local teachers or those with familiarity with local languages. A pupil-teacher ratio (PTR) of under 30:1 will be ensured at the level of each school; areas having large numbers of socio-economically disadvantaged students will aim for a PTR of under 25:1. Teachers will be trained, encouraged, and supported - with continuous professional development - to impart foundational literacy and numeracy.

2.4. On the curricular side, there will be an increased focus on foundational literacy and numeracy - and generally, on reading, writing, speaking, counting, arithmetic, and mathematical thinking - throughout the preparatory and middle school curriculum, with a robust system of continuous formative/adaptive assessment to track and thereby individualize and ensure each student's learning. Specific hours daily - and regular events over the year-on activities involving these subjects will be dedicated to encourage and enthuse students. Teacher education and the early grade curriculum will be redesigned to have a renewed emphasis on foundational literacy and numeracy.

2.5. Currently, with the lack of universal access to ECCE, a large proportion of children already fall behind within the first few weeks of Grade 1. Thus, to ensure that all students are school ready, an interim 3-month play-based 'school preparation module' for all Grade 1 students, consisting of activities and workbooks around the learning of alphabets, sounds, words, colours, shapes, and numbers, and involving collaborations with peers and parents, will be developed by NCERT and SCERTs.

2.6. A national repository of high-quality resources on foundational literacy and numeracy will be made available on the Digital Infrastructure for Knowledge Sharing (DIKSHA). Technological interventions to serve as aids to teachers and to help bridge any language barriers that may exist between teachers and students, will be piloted and implemented

2.7. Due to the scale of the current learning crisis, all viable methods will be explored to support teachers in the mission of attaining universal foundational literacy and numeracy. Studies around the world show one-on-one peer tutoring to be extremely effective for learning not just for the learner, but also for the tutor. Thus, peer tutoring can be taken up as a voluntary and joyful activity for fellow students under the supervision of trained teachers and by taking due care of safety aspects. Additionally, it will also be made far easier for trained volunteers - from both the local community and beyond - to participate in this large-scale mission. Every literate member of the community could commit to teaching one student/person how to read, it would change the country's landscape very quickly. States may consider establishing innovative models to foster such peer-tutoring and volunteer activities, as well as launch other programmes to support learners, in this nationwide mission to promote foundational literacy and numeracy.

2.8. Enjoyable and inspirational books for students at all levels will be developed, including through high-quality translation (technology assisted as needed) in all local and Indian languages, and will be made available extensively in both school and local public libraries. Public and school libraries will be significantly expanded to build a culture of reading across the country. Digital libraries will also be established. School libraries will be set up - particularly in villages - to serve the community during non-school hours, and book clubs may meet in public/school libraries to further facilitate and promote widespread reading. A National Book Promotion Policy will be formulated, and extensive initiatives will be undertaken to ensure the availability, accessibility, quality, and readership of books across geographies, languages, levels, and genres.

2.9. Children are unable to learn optimally when they are undernourished or unwell. Hence, the nutrition and health (including mental health) of children will be addressed, through healthy meals and the introduction of well-trained social workers, counsellors, and community involvement into the schooling system. Furthermore, research shows that the morning hours after a nutritious breakfast can be particularly productive for the study of cognitively more demanding subjects and hence these hours may be leveraged by providing a simple but energizing breakfast in addition to midday meals. In locations where hot meals are not possible, a simple but nutritious meal, e.g., groundnuts/chana mixed with jaggery and/or local fruits may be provided. All school children shall undergo regular

health check-ups especially for 100% immunization in schools and health cards will be issued to monitor the same.

3. Curtailing Dropout Rates and Ensuring Universal Access to Education at All Levels

3.1. One of the primary goals of the schooling system must be to ensure that children are enrolled in and are attending school. Through initiatives such as the Sarva Shiksha Abhiyan (now the Samagra Shiksha) and the Right to Education Act, India has made remarkable strides in recent years in attaining near-universal enrolment in elementary education. However, the data for later grades indicates some serious issues in retaining children in the schooling system. The GER for Grades 6-8 was 90.9%, while for Grades 9-10 and 11-12 it was only 79.3% and 56.5%, respectively - indicating that a significant proportion of enrolled students drop out after Grade 5 and especially after Grade 8. As per the 75th round household survey by NSSO in 2017-18, the number of out of school children in the age group of 6 to 17 years is 3.22 crore. It will be a top priority to bring these children back into the educational fold as early as possible, and to prevent further students from dropping out, with a goal to achieve 100% Gross Enrolment Ratio in preschool to secondary level by 2030. A concerted national effort will be made to ensure universal access and afford opportunity to all children of the country to obtain quality holistic education–including vocational education - from pre-school to Grade 12.

3.2. There are two overall initiatives that will be undertaken to bring children who have dropped out back to school and to prevent further children from dropping out. The first is to provide effective and sufficient infrastructure so that all students have access to safe and engaging school education at all levels from pre-primary school to Grade 12. Besides providing regular trained teachers at each stage, special care shall be taken to ensure that no school remains deficient on infrastructure support. The credibility of Government schools shall be re-established and this will be attained by upgrading and enlarging the schools that already exist, building additional quality schools in areas where they do not exist, and providing safe and practical conveyances and/or hostels, especially for the girl children, so that all children have the opportunity to attend a quality school and learn at the appropriate level. Alternative and innovative education centres will be put in place in cooperation with civil society to ensure that children of migrant labourers, and other children who are dropping out of school due to various circumstances are brought back into mainstream education.

3.3. The second is to achieve universal participation in school by carefully tracking students, as well as their learning levels, in order to ensure that they (a) are enrolled in and attending school, and (b) have suitable opportunities to catch up and re-enter school in case they have fallen behind or dropped out. For providing equitable and quality education from the Foundational Stage through Grade 12 to all children up to the age of 18, suitable facilitating systems shall be put in place. Counsellors or well-trained social workers connected to schools/school complexes and teachers will continuously work with students and their parents and will travel through and engage with communities to ensure that all school-age children are attending and learning in school. Trained and qualified social workers from civil society organizations/departments of Social Justice and Empowerment and government functionaries dealing with empowerment of Persons with Disabilities at the State and district level, could be connected to schools, through various innovative mechanisms adopted by State/UT Governments, to help in carrying out this important work.

3.4. Once infrastructure and participation are in place, ensuring quality will be the key in retention of students, so that they (particularly, girls and students from other socio-economically disadvantaged groups) do not lose interest in attending school. This will require a system of incentives for deploying teachers with knowledge of the local language to areas with high dropout rates, as well as overhauling the curriculum to make it more engaging and useful.

3.5. To facilitate learning for all students, with special emphasis on Socio-Economically Disadvantaged Groups (SEDGs), the scope of school education will be broadened to facilitate multiple pathways to learning involving both formal and non-formal education modes. Open and Distance Learning (ODL) Programmes offered by the National Institute of Open Schooling (NIOS)

and State Open Schools will be expanded and strengthened for meeting the learning needs of young people in India who are not able to attend a physical school. NIOS and State Open Schools will offer the following programmes in addition to the present programmes: A, B and C levels that are equivalent to Grades 3, 5, and 8 of the formal school system; secondary education programmes that are equivalent to Grades 10 and 12; vocational education courses/programmes; and adult literacy and life-enrichment programmes. States will be encouraged to develop these offerings in regional languages by establishing new/strengthening existing State Institutes of Open Schooling (SIOS).

3.6. To make it easier for both governments as well as non-governmental philanthropic organizations to build schools, to encourage local variations on account of culture, geography, and demographics, and to allow alternative models of education, the requirements for schools will be made less restrictive. The focus will be to have less emphasis on input and greater emphasis on output potential concerning desired learning outcomes. Regulations on inputs will be limited to certain areas as enumerated in Chapter 8. Other models for schools will also be piloted, such as public-philanthropic partnerships.

3.7. Efforts will be made to involve community and alumni in volunteer efforts for enhancing learning by providing at schools: one-on-one tutoring; the teaching of literacy and holding of extra-help sessions; teaching support and guidance for educators; career guidance and mentoring to students; etc. In this regard, the support of active and healthy senior citizens, school alumni and local community members will be suitably garnered. Databases of literate volunteers, retired scientists/government/semi government employees, alumni, and educators will be created for this purpose.

4. Curriculum and Pedagogy in Schools: Learning Should be Holistic, Integrated, Enjoyable, and Engaging

Restructuring school curriculum and pedagogy in a new 5+3+3+4 design

4.1. The curricular and pedagogical structure of school education will be reconfigured to make it responsive and relevant to the developmental needs and interests of learners at different stages of their development, corresponding to the age ranges of 3-8, 8-11, 11-14, and 14-18 years, respectively. The curricular and pedagogical structure and the curricular framework for school education will therefore be guided by a 5+3+3+4 design, consisting of the Foundational Stage (in two parts, that is, 3 years of Anganwadi/pre-school + 2 years in primary school in Grades 1-2; both together covering ages 3-8), Preparatory Stage (Grades 3-5, covering ages 8-11), Middle Stage (Grades 6-8, covering ages 11-14), and Secondary Stage (Grades 9-12 in two phases, i.e., 9 and 10 in the first and 11 and 12 in the second, covering ages 14-18).

4.2. The Foundational Stage will consist of five years of flexible, multilevel, play/activity-based learning and the curriculum and pedagogy of ECCE as mentioned in para 1.2. The Preparatory Stage will comprise three years of education building on the play, discovery, and activity-based pedagogical and curricular style of the Foundational Stage, and will also begin to incorporate some light text books as well as aspects of more formal but interactive classroom learning, in order to lay a solid groundwork across subjects, including reading, writing, speaking, physical education, art, languages, science, and mathematics. The Middle Stage will comprise three years of education, building on the pedagogical and curricular style of the Preparatory Stage, but with the introduction of subject teachers for learning and discussion of the more abstract concepts in each subject that students will be ready for at this stage across the sciences, mathematics, arts, social sciences, and humanities. Experiential learning within each subject, and explorations of relations among different subjects, will be encouraged and emphasized despite the introduction of more specialized subjects and subject teachers. The Secondary Stage will comprise of four years of multidisciplinary study, building on the subject-oriented pedagogical and curricular style of the Middle Stage, but with greater depth, greater critical thinking, greater attention to life aspirations, and greater flexibility and student choice of subjects. In particular students would continue to have the option of exiting after Grade 10

and re-entering in the next phase to pursue vocational or any other courses available in Grades 11-12, including at a more specialized school, if so desired.

4.3. The above-described stages are purely curricular and pedagogical, designed to optimize learning for students based on the cognitive development of children; they will inform the development of National and State curricula and teaching-learning strategies at each stage, but parallel changes to physical infrastructure will not be required.

Holistic development of learners

4.4. The key overall thrust of curriculum and pedagogy reform across all stages will be to move the education system towards real understanding and towards learning how to learn - and away from the culture of rote learning as is largely present today. The aim of education will not only be cognitive development, but also building character and creating holistic and well-rounded individuals equipped with the key 21st century skills. Ultimately, knowledge is a deep-seated treasure and education helps in its manifestation as the perfection which is already within an individual. All aspects of curriculum and pedagogy will be reoriented and revamped to attain these critical goals. Specific sets of skills and values across domains will be identified for integration and incorporation at each stage of learning, from pre-school to higher education. Curriculum frameworks and transaction mechanisms will be developed for ensuring that these skills and values are imbibed through engaging processes of teaching and learning. NCERT will identify these required skill sets and include mechanisms for their transaction in the National Curriculum Framework for early childhood and school education.

Reduce curriculum content to enhance essential learning and critical thinking

4.5. Curriculum content will be reduced in each subject to its core essentials, to make space for critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning. The mandated content will focus on key concepts, ideas, applications, and problem-solving. Teaching and learning will be conducted in a more interactive manner; questions will be encouraged, and classroom sessions will regularly contain more fun, creative, collaborative, and exploratory activities for students for deeper and more experiential learning.

Experiential learning

4.6. In all stages, experiential learning will be adopted, including hands-on learning, arts-integrated and sports-integrated education, story-telling-based pedagogy, among others, as standard pedagogy within each subject, and with explorations of relations among different subjects. To close the gap in achievement of learning outcomes, classroom transactions will shift, towards competency-based learning and education. The assessment tools (including assessment "as", "of", and "for" learning) will also be aligned with the learning outcomes, capabilities, and dispositions as specified for each subject of a given class.

4.7. Art-integration is a cross-curricular pedagogical approach that utilizes various aspects and forms of art and culture as the basis for learning of concepts across subjects. As a part of the thrust on experiential learning, art-integrated education will be embedded in classroom transactions not only for creating joyful classrooms, but also for imbibing the Indian ethos through integration of Indian art and culture in the teaching and learning process at every level. This art-integrated approach will strengthen the linkages between education and culture.

4.8. Sports-integration is another cross-curricular pedagogical approach that utilizes physical activities including indigenous sports, in pedagogical practices to help in developing skills such as collaboration, self-initiative, self-direction, self-discipline, teamwork, responsibility, citizenship, etc. Sports-integrated learning will be undertaken in classroom transactions to help students adopt fitness as a lifelong attitude and to achieve the related life skills along with the levels of fitness as envisaged in the Fit India Movement. The need to integrate sports in education is well recognized as it serves to

foster holistic development by promoting physical and psychological well-being while also enhancing cognitive abilities.

Empower students through flexibility in course choices

4.9. Students will be given increased flexibility and choice of subjects to study, particularly in secondary school - including subjects in physical education, the arts and crafts, and vocational skills – so that they can design their own paths of study and life plans. Holistic development and a wide choice of subjects and courses year to year will be the new distinguishing feature of secondary school education. There will be no hard separation among 'curricular', 'extracurricular', or 'co-curricular', among 'arts', 'humanities', and 'sciences', or between 'vocational' or 'academic' streams. Subjects such as physical education, the arts and crafts, and vocational skills, in addition to science, humanities, and mathematics, will be incorporated throughout the school curriculum, with a consideration for what is interesting and safe at each age.

4.10. Each of the four stages of school education, in accordance with what may be possible in different regions, may consider moving towards a semester or any other system that allows the inclusion of shorter modules, or courses that are taught on alternate days, in order to allow an exposure to more subjects and enable greater flexibility. States may look into innovative methods to achieve these aims of greater flexibility and exposure to and enjoyment of a wider range of subjects, including across the arts, sciences, humanities, languages, sports, and vocational subjects.

Multilingualism and the power of language

4.11. It is well understood that young children learn and grasp nontrivial concepts more quickly in their home language/mother tongue. Home language is usually the same language as the mother tongue or that which is spoken by local communities. However, at times in multi-lingual families, there can be a home language spoken by other family members which may sometimes be different from mother tongue or local language. Wherever possible, the medium of instruction until at least Grade 5, but preferably till Grade 8 and beyond, will be the home language/mother tongue/local language/regional language. Thereafter, the home/local language shall continue to be taught as a language wherever possible. This will be followed by both public and private schools. High-quality textbooks, including in science, will be made available in home languages/mother tongue. All efforts will be made early on to ensure that any gaps that exist between the language spoken by the child and the medium of teaching are bridged. In cases where home language/mother tongue textbook material is not available, the language of transaction between teachers and students will still remain the home language/mother tongue wherever possible. Teachers will be encouraged to use a bilingual approach, including bilingual teaching-learning materials, with those students whose home language may be different from the medium of instruction. All languages will be taught with high quality to all students; a language does not need to be the medium of instruction for it to be taught and learned well.

4.12. As research clearly shows that children pick up languages extremely quickly between the ages of 2 and 8 and that multilingualism has great cognitive benefits to young students, children will be exposed to different languages early on (but with a particular emphasis on the mother tongue), starting from the Foundational Stage onwards. All languages will be taught in an enjoyable and interactive style, with plenty of interactive conversation, and with early reading and subsequently writing in the mother tongue in the early years, and with skills developed for reading and writing in other languages in Grade 3 and beyond. There will be a major effort from both the Central and State governments to invest in large numbers of language teachers in all regional languages around the country, and, in particular, for all languages mentioned in the Eighth Schedule of the Constitution of India. States, especially States from different regions of India, may enter into bilateral agreements to hire teachers in large numbers from each other, to satisfy the three-language formula in their respective States, and also to encourage the study of Indian languages across the country. Extensive use of technology will be made for teaching and learning of different languages and to popularize language learning.

4.13. The three-language formula will continue to be implemented while keeping in mind the Constitutional provisions, aspirations of the people, regions, and the Union, and the need to promote multilingualism as well as promote national unity. However, there will be a greater flexibility in the three-language formula, and no language will be imposed on any State. The three languages learned by children will be the choices of States, regions, and of course the students themselves, so long as at least two of the three languages are native to India. In particular, students who wish to change one or more of the three languages they are studying may do so in Grade 6 or 7, as long as they are able to demonstrate basic proficiency in three languages (including one language of India at the literature level) by the end of secondary school.

4.14. All efforts will be made in preparing high-quality bilingual textbooks and teaching-learning materials for science and mathematics, so that students are enabled to think and speak about the two subjects both in their home language/mother tongue and in English.

4.15. As so many developed countries around the world have amply demonstrated, being well educated in one's language, culture, and traditions is not a detriment but indeed a huge benefit to educational, social, and technological advancement. India's languages are among the richest, most scientific, most beautiful, and most expressive in the world, with a huge body of ancient as well as modern literature (both prose and poetry), film, and music written in these languages that help form India's national identity and wealth. For purposes of cultural enrichment as well as national integration, all young Indians should be aware of the rich and vast array of languages of their country, and the treasures that they and their literatures contain.

4.16. Thus, every student in the country will participate in a fun project/activity on 'The Languages of India', sometime in Grades 6-8, such as, under the *'Ek Bharat Shrestha Bharat'* initiative. In this project/activity, students will learn about the remarkable unity of most of the major Indian languages, starting with their common phonetic and scientifically-arranged alphabets and scripts, their common grammatical structures, their origins and sources of vocabularies from Sanskrit and other classical languages, as well as their rich inter-influences and differences. They will also learn what geographical areas speak which languages, get a sense of the nature and structure of tribal languages, and learn to say commonly spoken phrases and sentences in every major language of India and also learn a bit about the rich and uplifting literature of each (through suitable translations as necessary). Such an activity would give them both a sense of the unity and the beautiful cultural heritage and diversity of India and would be a wonderful icebreaker their whole lives as they meet people from other parts of India. This project/activity would be a joyful activity and would not involve any form of assessment.

4.17. The importance, relevance, and beauty of the classical languages and literature of India also cannot be overlooked. Sanskrit, while also an important modern language mentioned in the Eighth Schedule of the Constitution of India, possesses a classical literature that is greater in volume than that of Latin and Greek put together, containing vast treasures of mathematics, philosophy, grammar, music, politics, medicine, architecture, metallurgy, drama, poetry, storytelling, and more (known as 'Sanskrit Knowledge Systems'), written by people of various religions as well as non-religious people, and by people from all walks of life and a wide range of socio-economic backgrounds over thousands of years. Sanskrit will thus be offered at all levels of school and higher education as an important, enriching option for students, including as an option in the three-language formula. It will be taught in ways that are interesting and experiential as well as contemporarily relevant, including through the use of Sanskrit Knowledge Systems, and in particular through phonetics and pronunciation. Sanskrit textbooks at the foundational and middle school level may be written in Simple Standard Sanskrit (SSS) to teach Sanskrit through Sanskrit (STS) and make its study truly enjoyable.

4.18. India also has an extremely rich literature in other classical languages, including classical Tamil, Telugu, Kannada, Malayalam, Odia. In addition to these classical languages Pali, Persian, and Prakrit; and their works of literature too must be preserved for their richness and for the pleasure and enrichment of posterity. As India becomes a fully developed country, the next generation will want to

partake in and be enriched by India's extensive and beautiful classical literature. In addition to Sanskrit, other classical languages and literatures of India, including Tamil, Telugu, Kannada, Malayalam, Odia, Pali, Persian, and Prakrit, will also be widely available in schools as options for students, possibly as online modules, through experiential and innovative approaches, to ensure that these languages and literature stay alive and vibrant. Similar efforts will be made for all Indian languages having rich oral and written literatures, cultural traditions, and knowledge.

4.19. For the enrichment of the children, and for the preservation of these rich languages and their artistic treasures, all students in all schools, public or private, will have the option of learning at least two years of a classical language of India and its associated literature, through experiential and innovative approaches, including the integration of technology, in Grades 6-12, with the option to continue from the middle stage through the secondary stage and beyond.

4.20. In addition to high quality offerings in Indian languages and English, foreign languages, such as Korean, Japanese, Thai, French, German, Spanish, Portuguese, and Russian, will also be offered at the secondary level, for students to learn about the cultures of the world and to enrich their global knowledge and mobility according to their own interests and aspirations.

4.21. The teaching of all languages will be enhanced through innovative and experiential methods, including through gamification and apps, by weaving in the cultural aspects of the languages - such as films, theatre, storytelling, poetry, and music - and by drawing connections with various relevant subjects and with real-life experiences. Thus, the teaching of languages will also be based on experiential-learning pedagogy.

4.22. Indian Sign Language (ISL) will be standardized across the country, and National and State curriculum materials developed, for use by students with hearing impairment. Local sign languages will be respected and taught as well, where possible and relevant.

Curricular Integration of Essential Subjects, Skills, and Capacities

4.23. While students must have a large amount of flexibility in choosing their individual curricula, certain subjects, skills, and capacities should be learned by all students to become good, successful, innovative, adaptable, and productive human beings in today's rapidly changing world. In addition to proficiency in languages, these skills include: scientific temper and evidence-based thinking; creativity and innovativeness; sense of aesthetics and art; oral and written communication; health and nutrition; physical education, fitness, wellness, and sports; collaboration and teamwork; problem solving and logical reasoning; vocational exposure and skills; digital literacy, coding, and computational thinking; ethical and moral reasoning; knowledge and practice of human and Constitutional values; gender sensitivity; Fundamental Duties; citizenship skills and values; knowledge of India; environmental awareness including water and resource conservation, sanitation and hygiene; and current affairs and knowledge of critical issues facing local communities, States, the country, and the world.

4.24. Concerted curricular and pedagogical initiatives, including the introduction of contemporary subjects such as Artificial Intelligence, Design Thinking, Holistic Health, Organic Living, Environmental Education, Global Citizenship Education (GCED), etc. at relevant stages will be undertaken to develop these various important skills in students at all levels.

4.25. It is recognized that mathematics and mathematical thinking will be very important for India's future and India's leadership role in the numerous upcoming fields and professions that will involve artificial intelligence, machine learning, and data science, etc. Thus, mathematics and computational thinking will be given increased emphasis throughout the school years, starting with the foundational stage, through a variety of innovative methods, including the regular use of puzzles and games that make mathematical thinking more enjoyable and engaging. Activities involving coding will be introduced in Middle Stage.

4.26. Every student will take a fun course, during Grades 6-8, that gives a survey and hands-on experience of a sampling of important vocational crafts, such as carpentry, electric work, metal work, gardening, pottery making, etc., as decided by States and local communities and as mapped by local skilling needs. A practice-based curriculum for Grades 6-8 will be appropriately designed by NCERT while framing the NCFSE 2020-21. All students will participate in a 10-day bagless period sometime during Grades 6-8 where they intern with local vocational experts such as carpenters, gardeners, potters, artists, etc. Similar internship opportunities to learn vocational subjects may be made available to students throughout Grades 6-12, including holiday periods. Vocational courses through online mode will also be made available. Bagless days will be encouraged throughout the year for various types of enrichment activities involving arts, quizzes, sports, and vocational crafts. Children will be given periodic exposure to activities outside school through visits to places/monuments of historical, cultural and tourist importance, meeting local artists and craftsmen and visits higher educational institutions in their village/Tehsil/District/State.

4.27. "Knowledge of India" will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India's future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation. Specific courses in tribal ethno-medicinal practices, forest management, traditional (organic) crop cultivation, natural farming, etc. will also be made available. An engaging course on Indian Knowledge Systems will also be available to students in secondary school as an elective. Competitions may be held in schools for learning various topics and subjects through fun and indigenous games. Video documentaries on inspirational luminaries of India, ancient and modern, in science and beyond, will be shown at appropriate points throughout the school curriculum. Students will be encouraged to visit different States as part of cultural exchange programmes.

4.28. Students will be taught at a young age the importance of "doing what's right", and will be given a logical framework for making ethical decisions. In later years, this would then be expanded along themes of cheating, violence, plagiarism, littering, tolerance, equality, empathy, etc., with a view to enabling children to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. As consequences of such basic ethical reasoning, traditional Indian values and all basic human and Constitutional values (such as *seva, ahimsa, swachchhata, satya, nishkam karma, shanti*, sacrifice, tolerance, diversity, pluralism, righteous conduct, gender sensitivity, respect for elders, respect for all people and their inherent capabilities regardless of background, respect for environment, helpfulness, courtesy, patience, forgiveness, empathy, compassion, patriotism, democratic outlook, integrity, responsibility, justice, liberty, equality, and fraternity) will be developed in all students. Children will have the opportunity to read and learn from the original stories of the Panchatantra, Jataka, Hitopadesh, and other fun fables and inspiring tales from the Indian tradition and learn about their influences on global literature. Excerpts from the Indian Constitution will also be considered essential reading for all students. Basic training in health, including preventive health, mental health, good nutrition, personal and public hygiene, disaster response and first-aid will also be included in the curriculum, as well as scientific explanations of the detrimental and damaging effects of alcohol, tobacco, and other drugs.

4.29. All curriculum and pedagogy, from the foundational stage onwards, will be redesigned to be strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language, philosophy, geography, ancient and contemporary knowledge, societal and scientific needs, indigenous and traditional ways of learning etc. – in order to ensure that education is maximally relatable, relevant, interesting, and effective for our students. Stories, arts, games, sports, examples, problems, etc. will be chosen as much as possible to be rooted in the Indian and local geographic context. Ideas, abstractions, and creativity will indeed best flourish when learning is thus rooted.

National Curriculum Framework for School Education (NCFSE)

4.30. The formulation of a new and comprehensive National Curricular Framework for School Education, NCFSE 2020-21, will be undertaken by the NCERT - based on the principles of this National Education Policy 2020, frontline curriculum needs, and after discussions with all stakeholders including State Governments, Ministries, relevant Departments of the Central Government, and other expert bodies, and will be made available in all regional languages. The NCFSE document shall henceforth be revisited and updated once every 5-10 years, taking into account frontline curriculum.

National Textbooks with Local Content and Flavour

4.31. The reduction in content and increased flexibility of school curriculum - and the renewed emphasis on constructive rather than rote learning - must be accompanied by parallel changes in school textbooks. All textbooks shall aim to contain the essential core material (together with discussion, analysis, examples, and applications) deemed important on a national level, but at the same time contain any desired nuances and supplementary material as per local contexts and needs. Where possible, schools and teachers will also have choices in the textbooks they employ - from among a set of textbooks that contain the requisite national and local material - so that they may teach in a manner that is best suited to their own pedagogical styles as well as to their students and communities' needs.

4.32. The aim will be to provide such quality textbooks at the lowest possible cost -namely, at the cost of production/printing - in order to mitigate the burden of textbook prices on the students and on the educational system. This may be accomplished by using high-quality textbook materials developed by NCERT in conjunction with the SCERTs; additional textbook materials could be funded by public-philanthropic partnerships and crowd sourcing that incentivize experts to write such high-quality textbooks at cost price. States will prepare their own curricula (which may be based on the NCFSE prepared by NCERT to the extent possible) and prepare textbooks (which may be based on the NCERT textbook materials to the extent possible), incorporating State flavour and material as needed. While doing so, it must be borne in mind that NCERT curriculum would be taken as the nationally acceptable criterion. The availability of such textbooks in all regional languages will be a top priority so that all students have access to high-quality learning. All efforts will be made to ensure timely availability of textbooks in schools. Access to downloadable and printable versions of all textbooks will be provided by all States/UTs and NCERT to help conserve the environment and reduce the logistical burden.

4.33. Concerted efforts, through suitable changes in curriculum and pedagogy, will be made by NCERT, SCERTs, schools, and educators to significantly reduce the weight of school bags and textbooks.

Transforming Assessment for Student Development

4.34. The aim of assessment in the culture of our schooling system will shift from one that is summative and primarily tests rote memorization skills to one that is more regular and formative, is more competency-based, promotes learning and development for our students, and tests higher-order skills, such as analysis, critical thinking, and conceptual clarity. The primary purpose of assessment will indeed be for learning; it will help the teacher and student, and the entire schooling system, continuously revise teaching-learning processes to optimize learning and development for all students. This will be the underlying principle for assessment at all levels of education.

4.35. The progress card of all students for school-based assessment, which is communicated by schools to parents, will be completely redesigned by States/UTs under guidance from the proposed National Assessment Centre, NCERT, and SCERTs. The progress card will be a holistic, 360-degree, multidimensional report that reflects in great detail the progress as well as the uniqueness of each

learner in the cognitive, affective, and psychomotor domains. It will include self-assessment and peer assessment, and progress of the child in project-based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment. The holistic progress card will form an important link between home and school and will be accompanied by parent-teacher meetings in order to actively involve parents in their children's holistic education and development. The progress card would also provide teachers and parents with valuable information on how to support each student in and out of the classroom. AI-based software could be developed and used by students to help track their growth through their school years based on learning data and interactive questionnaires for parents, students, and teachers, in order to provide students with valuable information on their strengths, areas of interest, and needed areas of focus, and to thereby help them make optimal career choices.

4.36. The current nature of secondary school exams, including Board exams and entrance exams - and the resulting coaching culture of today - are doing much harm, especially at the secondary school level, replacing valuable time for true learning with excessive exam coaching and preparation. These exams also force students to learn a very narrow band of material in a single stream, rather than allowing the flexibility and choice that will be so important in the education system of the future.

4.37. While the Board exams for Grades 10 and 12 will be continued, the existing system of Board and entrance examinations shall be reformed to eliminate the need for undertaking coaching classes. To reverse these harmful effects of the current assessment system, Board exams will be redesigned to encourage holistic development; students will be able to choose many of the subjects in which they take Board exams, depending on their individualized interests. Board exams will also be made 'easier', in the sense that they will test primarily core capacities/competencies rather than months of coaching and memorization; any student who has been going to and making a basic effort in a school class will be able to pass and do well in the corresponding subject Board Exam without much additional effort. To further eliminate the 'high stakes' aspect of Board Exams, all students will be allowed to take Board Exams on up to two occasions during any given school year, one main examination and one for improvement, if desired.

4.38. In addition to introducing greater flexibility, student choice, and best-of-two attempts, assessments that primarily test core capacities must be the immediate key reforms to all Board exams. Boards may over time also develop further viable models of Board Exams that reduce pressure and the coaching culture. Some possibilities include: a system of annual/semester/modular Board Exams could be developed - that each test far less material, and are taken immediately after the corresponding course is taken in school - so that the pressure from exams is better distributed, less intense, and less high-stakes across the Secondary Stage; all subjects and corresponding assessments, beginning with mathematics, could be offered at two levels, with students doing some of their subjects at the standard level and some at a higher level; and Board exams in certain subjects could be redesigned to have two parts – one part of an objective type with multiple-choice questions and the other of a descriptive type.

4.39. With regard to all of the above, guidelines will be prepared by NCERT, in consultation with major stakeholders, such as SCERTs, Boards of Assessment (BoAs), the proposed new National Assessment Centre etc., and teachers prepared, for a transformation in the assessment system by the 2022-23 academic session, to align with the NCFSE 2020-21.

4.40. To track progress throughout the school years, and not just at the end of Grades 10 and 12 - for the benefit of students, parents, teachers, principals, and the entire schooling system in planning improvements to schools and teaching-learning processes - all students will take school examinations in Grades 3, 5, and 8 which will be conducted by the appropriate authority. These examinations would test achievement of basic learning outcomes, through assessment of core concepts and knowledge from the national and local curricula, along with relevant higher-order skills and application of knowledge in real-life situations, rather than rote memorization. The Grade 3 examination, in particular, would test basic literacy, numeracy, and other foundational skills. The results of school examinations will be used only for developmental purposes of the school education

system, including for public disclosure by schools of their overall (anonymized) student outcomes, and for continuous monitoring and improvement of the schooling system.

4.41. It is proposed to set up a National Assessment Centre, PARAKH (Performance Assessment, Review, and Analysis of Knowledge for Holistic Development), as a standard-setting body under MHRD that fulfils the basic objectives of setting norms, standards, and guidelines for student assessment and evaluation for all recognized school boards of India, guiding the State Achievement Survey (SAS) and undertaking the National Achievement Survey (NAS), monitoring achievement of learning outcomes in the country, and encouraging and helping school boards to shift their assessment patterns towards meeting the skill requirements of the 21st century in consonance with the stated objectives of this Policy. This Centre will also advise school boards regarding new assessment patterns and latest researches, promote collaborations between school boards. It will also become an instrument for the sharing of best practices among school boards, and for ensuring equivalence of academic standards among learners across all school boards.

4.42. The principles for university entrance exams will be similar. The National Testing Agency (NTA) will work to offer a high-quality common aptitude test, as well as specialized common subject exams in the sciences, humanities, languages, arts, and vocational subjects, at least twice every year. These exams shall test conceptual understanding and the ability to apply knowledge and shall aim to eliminate the need for taking coaching for these exams. Students will be able to choose the subjects for taking the test, and each university will be able to see each student's individual subject portfolio and admit students into their programmes based on individual interests and talents. The NTA will serve as a premier, expert, autonomous testing organization to conduct entrance examinations for undergraduate and graduate admissions and fellowships in higher education institutions. The high quality, range, and flexibility of the NTA testing services will enable most universities to use these common entrance exams - rather than having hundreds of universities each devising their own entrance exams - thereby drastically reducing the burden on students, universities and colleges, and the entire education system. It will be left up to individual universities and colleges to use NTA assessments for their admissions.

Support for Gifted Students/Students with Special Talents

4.43. There are innate talents in every student, which must be discovered, nurtured, fostered, and developed. These talents may express themselves in the form of varying interests, dispositions, and capacities. Those students that show particularly strong interests and capacities in a given realm must be encouraged to pursue that realm beyond the general school curriculum. Teacher education will include methods for the recognition and fostering of such student talents and interests. The NCERT and NCTE will develop guidelines for the education of gifted children. B.Ed. programmes may also allow a specialization in the education of gifted children.

4.44. Teachers will aim to encourage students with singular interests and/or talents in the classroom by giving them supplementary enrichment material and guidance and encouragement. Topic-centered and Project-based Clubs and Circles will be encouraged and supported at the levels of schools, school complexes, districts, and beyond. Examples include Science Circles, Math Circles, Music & Dance Performance Circles, Chess Circles, Poetry Circles, Language Circles, Drama Circles, Debate Circles, Sports Circles, Eco-Clubs, Health & Well-being Clubs/ Yoga Clubs and so on. Along these lines, high-quality national residential summer programmes for secondary school students in various subjects will also be encouraged, with a rigorous merit-based but equitable admission process to attract the very best students and teachers from across the country including from socio-economically disadvantaged groups.

4.45. Olympiads and competitions in various subjects will be conducted across the country, with clear coordination and progression from school to local to state to national levels, to ensure that all students may participate at all levels for which they qualify. Efforts will be made to make these available in rural areas and in regional languages to ensure widespread participation. Public and private universities, including premier institutions like the IITs and NITs, would be encouraged to use merit-

based results from National, and International Olympiads, and results from other relevant national programmes, as part of the criteria for admissions into their undergraduate programmes.

4.46. Once internet-connected smart phones or tablets are available in all homes and/or schools, online apps with quizzes, competitions, assessments, enrichment materials, and online communities for shared interests will be developed, and will work to enhance all the aforementioned initiatives, as group activities for students with appropriate supervision of parents and teachers. Schools will develop smart classrooms, in a phased manner, for using digital pedagogy and thereby enriching the teaching-learning process with online resources and collaborations.

5. Teachers

5.1. Teachers truly shape the future of our children - and, therefore, the future of our nation. It is because of this noblest role that the teacher in India was the most respected member of society. Only the very best and most learned became teachers. Society gave teachers, or gurus, what they needed to pass on their knowledge, skills, and ethics optimally to students. The quality of teacher education, recruitment, deployment, service conditions, and empowerment of teachers is not where it should be, and consequently the quality and motivation of teachers does not reach the desired standards. The high respect for teachers and the high status of the teaching profession must be restored so as to inspire the best to enter the teaching profession. The motivation and empowerment of teachers is required to ensure the best possible future for our children and our nation.

Recruitment and Deployment

5.2. To ensure that outstanding students enter the teaching profession - especially from rural areas - a large number of merit-based scholarships shall be instituted across the country for studying quality 4-year integrated B.Ed. programmes. In rural areas, special merit-based scholarships will be established that also include preferential employment in their local areas upon successful completion of their B.Ed. programmes. Such scholarships will provide local job opportunities to local students, especially female students, so that these students serve as local-area role models and as highly qualified teachers who speak the local language. Incentives will be provided for teachers to take up teaching jobs in rural areas, especially in areas that are currently facing acute shortage of quality teachers. A key incentive for teaching in rural schools will be the provision of local housing near or on the school premises or increased housing allowances.

5.3. The harmful practice of excessive teacher transfers will be halted, so that students have continuity in their role models and educational environments. Transfers will occur in very special circumstances, as suitably laid down in a structured manner by State/UT governments. Furthermore, transfers will be conducted through an online computerized system that ensures transparency.

5.4. Teacher Eligibility Tests (TETs) will be strengthened to inculcate better test material, both in terms of content and pedagogy. The TETs will also be extended to cover teachers across all stages (Foundational, Preparatory, Middle and Secondary) of school education. For subject teachers, suitable TET or NTA test scores in the corresponding subjects will also be taken into account for recruitment. To gauge passion and motivation for teaching, a classroom demonstration or interview will become an integral part of teacher hiring at schools and school complexes. These interviews would also be used to assess comfort and proficiency in teaching in the local language, so that every school/school complex has at least some teachers who can converse with students in the local language and other prevalent home languages of students. Teachers in private schools also must have qualified similarly through TET, a demonstration/interview, and knowledge of local language(s).

5.5. To ensure an adequate number of teachers across subjects - particularly in subjects such as art, physical education, vocational education, and languages - teachers could be recruited to a school or school complex and the sharing of teachers across schools could be considered in accordance with the grouping-of-schools adopted by State/UT governments.

5.6. Schools/school complexes will be encouraged to hire local eminent persons or experts as 'master instructors' in various subjects, such as in traditional local arts, vocational crafts, entrepreneurship, agriculture, or any other subject where local expertise exists, to benefit students and help preserve and promote local knowledge and professions.

5.7. A technology-based comprehensive teacher-requirement planning forecasting exercise will be conducted by each State to assess expected subject-wise teacher vacancies over the next two decades. The above described initiatives in recruitment and deployment will be scaled as needed over time, to fill all vacancies with qualified teachers, including local teachers, with suitable incentives for career management and progression as described below. Teacher education programmes and offerings will also align with the vacancies thus projected.

Service Environment and Culture

5.8. The primary goal of overhauling the service environment and culture of schools will be to maximize the ability of teachers to do their jobs effectively, and to ensure that they are part of vibrant, caring, and inclusive communities of teachers, students, parents, principals, and other support staff, all of whom share a common goal: to ensure that our children are learning.

5.9. The first requirement in this direction will be to ensure decent and pleasant service conditions at schools. Adequate and safe infrastructure, including working toilets, clean drinking water, clean and attractive spaces, electricity, computing devices, internet, libraries, and sports and recreational resources will be provided to all schools to ensure that teachers and students, including children of all genders and children with disabilities, receive a safe, inclusive, and effective learning environment and are comfortable and inspired to teach and learn in their schools. In-service training will have inputs on safety, health and environment at workplace in schools to ensure that all teachers are sensitized to these requirements.

5.10. State/UT Governments may adopt innovative formats, such as school complex, rationalization of schools, without in any way reducing accessibility, for effective school governance, resource sharing, and community building. The creation of school complexes could go a long way towards building vibrant teacher communities. The hiring of teachers to school complexes could automatically create relationships among schools across the school complex; it would also help ensure excellent subject-wise distribution of teachers, creating a more vibrant teacher knowledge base. Teachers at very small schools will not remain isolated any longer and may become part of and work with larger school complex communities, sharing best practices with each other and working collaboratively to ensure that all children are learning. School complexes could also share counsellors, trained social workers, technical and maintenance staff, etc. to further support teachers and help create an effective learning environment.

5.11. In collaboration with parents and other key local stakeholders, teachers will also be more involved in the governance of schools/school complexes, including as members of the School Management Committees/School Complex Management Committees.

5.12. To prevent the large amounts of time spent currently by teachers on non-teaching activities, teachers will not be engaged any longer in work that is not directly related to teaching; in particular, teachers will not be involved in strenuous administrative tasks and more than a rationalized minimum time for mid-day meal related work, so that they may fully concentrate on their teaching-learning duties.

5.13. To help ensure that schools have positive learning environments, the role expectations of principals and teachers will explicitly include developing a caring and inclusive culture at their schools, for effective learning and the benefit of all stakeholders.

5.14. Teachers will be given more autonomy in choosing aspects of pedagogy, so that they may teach in the manner they find most effective for the students in their classrooms. Teachers will also focus

on socio-emotional learning - a critical aspect of any student's holistic development. Teachers will be recognized for novel approaches to teaching that improve learning outcomes in their classrooms.

Continuous Professional Development (CPD)

5.15. Teachers will be given continuous opportunities for self-improvement and to learn the latest innovations and advances in their professions. These will be offered in multiple modes, including in the form of local, regional, state, national, and international workshops as well as online teacher development modules. Platforms (especially online platforms) will be developed so that teachers may share ideas and best practices. Each teacher will be expected to participate in at least 50 hours of CPD opportunities every year for their own professional development, driven by their own interests. CPD opportunities will, in particular, systematically cover the latest pedagogies regarding foundational literacy and numeracy, formative and adaptive assessment of learning outcomes, competency-based learning, and related pedagogies, such as experiential learning, arts-integrated, sports-integrated, and storytelling-based approaches, etc.

5.16. School Principals and school complex leaders will have similar modular leadership/management workshops and online development opportunities and platforms to continuously improve their own leadership and management skills, and so that they too may share best practices with each other. Such leaders will also be expected to participate in 50 hours or more of CPD modules per year, covering leadership and management, as well as content and pedagogy with a focus on preparing and implementing pedagogical plans based on competency-based education.

Career Management and Progression (CMP)

5.17. Teachers doing outstanding work must be recognized and promoted, and given salary raises, to incentivize all teachers to do their best work. Therefore, a robust merit-based structure of tenure, promotion, and salary structure will be developed, with multiple levels within each teacher stage, that incentivizes and recognizes outstanding teachers. A system of multiple parameters for proper assessment of performance will be developed for the same by State/UT Governments that is based on peer reviews, attendance, commitment, hours of CPD, and other forms of service to the school and the community or based on NPST given in Para 5.20. In this Policy, in the context of careers, 'tenure' refers to confirmation for permanent employment, after due assessment of performance and contribution, while 'tenure track' refers to the period of probation preceding tenure.

5.18. Further, it will be ensured that career growth (in terms of tenure, promotions, salary increases, etc.) is available to teachers within a single school stage (i.e., Foundational, Preparatory, Middle, or Secondary), and that there is no career progression-related incentive to move from being teachers in early stages to later stages or vice versa (though such career moves across stages will be allowed, provided the teacher has the desire and qualifications for such a move). This is to support the fact that all stages of school education will require the highest-quality teachers, and no stage will be considered more important than any other.

5.19. Vertical mobility of teachers based on merit will also be paramount; outstanding teachers with demonstrated leadership and management skills would be trained over time to take on academic leadership positions in schools, school complexes, BRCs, CRCs, BITEs, DIETs as well as relevant government departments.

Professional Standards for Teachers

5.20. A common guiding set of National Professional Standards for Teachers (NPST) will be developed by 2022, by the National Council for Teacher Education in its restructured new form as a Professional Standard Setting Body (PSSB) under the General Education Council (GEC), in consultation with NCERT, SCERTs, teachers from across levels and regions, expert organizations in teacher preparation and development, expert bodies in vocational education, and higher education institutions. The standards would cover expectations of the role of the teacher at different levels of expertise/stage, and the competencies required for that stage. It will also comprise standards for

performance appraisal, for each stage, that would be carried out on a periodic basis. The NPST will also inform the design of pre-service teacher education programmes. This could be then adopted by States and determine all aspects of teacher career management, including tenure, professional development efforts, salary increases, promotions, and other recognitions. Promotions and salary increases will not occur based on the length of tenure or seniority, but only on the basis of such appraisal. The professional standards will be reviewed and revised in 2030, and thereafter every ten years, on the basis of rigorous empirical analysis of the efficacy of the system.

Special educators

5.21. There is an urgent need for additional special educators for certain areas of school education. Some examples of such specialist requirements include subject teaching for children with disabilities/*Divyang* children at the Middle and Secondary school level, including teaching for specific learning disabilities. Such teachers would require not only subject-teaching knowledge and understanding of subject-related aims of education, but also the relevant skills for understanding of special requirements of children. Therefore, such areas could be developed as secondary specializations for subject teachers or generalist teachers, during or after pre-service teacher preparation. They will be offered as certificate courses, in the pre-service as well as in-service mode, either full time or as part-time/blended courses - again, necessarily, at multidisciplinary colleges or universities. Greater synergy will be enabled between the course curriculum of NCTE and RCI to ensure adequate availability of qualified special educators who can handle subject teaching as well.

Approach to Teacher Education

5.22. Recognizing that the teachers will require training in high-quality content as well as pedagogy, teacher education will gradually be moved by 2030 into multidisciplinary colleges and universities. As colleges and universities all move towards becoming multidisciplinary, they will also aim to house outstanding education departments that offer B.Ed., M.Ed., and Ph.D. degrees in education.

5.23. By 2030, the minimum degree qualification for teaching will be a 4-year integrated B.Ed. degree that teaches a range of knowledge content and pedagogy and includes strong practicum training in the form of student-teaching at local schools. The 2-year B.Ed. programmes will also be offered, by the same multidisciplinary institutions offering the 4-year integrated B.Ed., and will be intended only for those who have already obtained Bachelor's Degrees in other specialized subjects. These B.Ed. programmes may also be suitably adapted as 1-year B.Ed. programmes, and will be offered only to those who have completed the equivalent of 4-year multidisciplinary Bachelor's Degrees or who have obtained a Master's degree in a specialty and wish to become a subject teacher in that specialty. All such B.Ed. degrees would be offered only by accredited multidisciplinary higher education institutions offering 4-year integrated B.Ed. programmes. Multidisciplinary higher education institutions offering the 4-year in-class integrated B.Ed. programme and having accreditation for ODL may also offer high-quality B.Ed. programmes in blended or ODL mode to students in remote or difficult-to-access locations and also to in-service teachers who are aiming to enhance their qualification, with suitable robust arrangements for mentoring and for the practicum-training and student-teaching components of the programme.

5.24. All B.Ed. programmes will include training in time-tested as well as the most recent techniques in pedagogy, including pedagogy with respect to foundational literacy and numeracy, multi-level teaching and evaluation, teaching children with disabilities, teaching children with special interests or talents, use of educational technology, and learner-centered and collaborative learning. All B.Ed. programmes will include strong practicum training in the form of in-classroom teaching at local schools. All B.Ed. programmes will also emphasize the practice of the Fundamental Duties (Article 51A) of the Indian Constitution along with other Constitutional provisions while teaching any subject or performing any activity. It will also appropriately integrate environmental awareness and sensitivity towards its conservation and sustainable development, so that environment education becomes an integral part of school curricula.

5.25. Special shorter local teacher education programmes will also be available at BITEs, DIETs, or at school complexes themselves for eminent local persons who can be hired to teach at schools or school complexes as 'master instructors', for the purpose of promoting local professions, knowledge, and skills, e.g., local art, music, agriculture, business, sports, carpentry, and other vocational crafts.

5.26. Shorter post-B.Ed. certification courses will also be made widely available, at multidisciplinary colleges and universities, to teachers who may wish to move into more specialized areas of teaching, such as the teaching of students with disabilities, or into leadership and management positions in the schooling system, or to move from one stage to another between foundational, preparatory, middle, and secondary stages.

5.27. It is recognized that there may be several pedagogical approaches internationally for teaching particular subjects; NCERT will study, research, document, and compile the varied international pedagogical approaches for teaching different subjects and make recommendations on what can be learnt and assimilated from these approaches into the pedagogies being practiced in India.

5.28. By 2021, a new and comprehensive National Curriculum Framework for Teacher Education, NCFTE 2021, will be formulated by the NCTE in consultation with NCERT, based on the principles of this National Education Policy 2020. The framework will be developed after discussions with all stakeholders including State Governments, relevant Ministries/Departments of Central Government and various expert bodies, and will be made available in all regional languages. The NCFTE 2021 will also factor in the requirements of teacher education curricula for vocational education. The NCFTE will thereafter be revised once every 5-10 years by reflecting the changes in revised NCFs as well as emerging needs in teacher education.

5.29. Finally, in order to fully restore the integrity of the teacher education system, stringent action will be taken against substandard stand-alone Teacher Education Institutions (TEIs) running in the country, including shutting them down, if required.

6. Equitable and Inclusive Education: Learning for All

6.1. Education is the single greatest tool for achieving social justice and equality. Inclusive and equitable education - while indeed an essential goal in its own right - is also critical to achieving an inclusive and equitable society in which every citizen has the opportunity to dream, thrive, and contribute to the nation. The education system must aim to benefit India's children so that no child loses any opportunity to learn and excel because of circumstances of birth or background. This Policy reaffirms that bridging the social category gaps in access, participation, and learning outcomes in school education will continue to be one of the major goals of all education sector development programmes. This Chapter may be read in conjunction with Chapter 14 which discusses analogous issues of Equity and Inclusion in Higher Education.

6.2. While the Indian education system and successive government policies have made steady progress towards bridging gender and social category gaps in all levels of school education, large disparities still remain - especially at the secondary level - particularly for socio-economically disadvantaged groups that have been historically underrepresented in education. Socio-Economically Disadvantaged Groups (SEDGs) can be broadly categorized based on gender identities (particularly female and transgender individuals), socio-cultural identities (such as Scheduled Castes, Scheduled Tribes, OBCs, and minorities), geographical identities (such as students from villages, small towns, and aspirational districts), disabilities (including learning disabilities), and socio-economic conditions (such as migrant communities, low income households, children in vulnerable situations, victims of or children of victims of trafficking, orphans including child beggars in urban areas, and the urban poor). While overall enrolments in schools decline steadily from Grade 1 to Grade 12, this decline in enrolments is significantly more pronounced for many of these SEDGs, with even greater declines for female students within each of these SEDGs and often even steeper in higher education. A brief status overview of the SEDGs that come within socio-cultural identities is given in following sub-sections.

6.2.1. According to U-DISE 2016-17 data, about 19.6% of students belong to Scheduled Castes at the primary level, but this fraction falls to 17.3% at the higher secondary level. These enrolment drop-offs are more severe for Scheduled Tribes students (10.6% to 6.8%), and differently-abled children (1.1% to 0.25%), with even greater declines for female students within each of these categories. The decline in enrolment in higher education is even steeper.

6.2.2. A multiplicity of factors, including lack of access to quality schools, poverty, social mores & customs, and language have had a detrimental effect on rates of enrolment and retention among the Scheduled Castes. Bridging these gaps in access, participation, and learning outcomes of children belonging to Scheduled Castes will continue to be one of the major goals. Also, the Other Backward Classes (OBCs) which have been identified on the basis of historically being socially and educationally backward also need special focus.

6.2.3. Tribal communities and children from Scheduled Tribes also face disadvantages at multiple levels due to various historical and geographical factors. Children from tribal communities often find their school education irrelevant and foreign to their lives, both culturally and academically. While several programmatic interventions to uplift children from tribal communities are currently in place, and will continue to be pursued, special mechanisms need to be made to ensure that children belonging to tribal communities receive the benefits of these interventions.

6.2.4. Minorities are also relatively underrepresented in school and higher education. The Policy acknowledges the importance of interventions to promote education of children belonging to all minority communities, and particularly those communities that are educationally underrepresented.

6.2.5. The Policy also recognizes the importance of creating enabling mechanisms for providing Children With Special Needs (CWSN) or *Divyang*, the same opportunities of obtaining quality education as any other child.

6.2.6. Separate strategies will be formulated for focused attention on reducing the social category gaps in school education as outlined in the following sub-sections.

6.3. The critical problems and recommendations regarding ECCE, foundational literacy and numeracy, access, enrolment and attendance discussed in Chapters 1–3, are particularly relevant and important for underrepresented and disadvantaged groups. Therefore, the measures from Chapters 1–3 will be targeted in a concerted way for SEDGs.

6.4. In addition, there have been various successful policies and schemes such as targeted scholarships, conditional cash transfers to incentivize parents to send their children to school, providing bicycles for transport, etc., that have significantly increased participation of SEDGs in the schooling system in certain areas. These successful policies and schemes must be significantly strengthened across the country.

6.5. It will also be essential to take into account research that ascertains which measures are particularly effective for certain SEDGs. For example, providing bicycles and organizing cycling and walking groups to provide access to school have been shown to be particularly powerful methods in increasing participation of female students - even at lesser distances - because of the safety benefits and comfort to parents that they provide. One-on-one teachers and tutors, peer tutoring, open schooling, appropriate infrastructure, and suitable technological interventions to ensure access can be particularly effective for certain children with disabilities. Schools providing quality ECCE reap the greatest dividends for children who come from families that are economically disadvantaged. Meanwhile, counsellors and/or well-trained social workers that work with and connect with students, parents, schools, and teachers in order to improve attendance and learning outcomes have been found to be especially effective for children in urban poor areas.

6.6. Data shows that certain geographical areas contain significantly larger proportions of SEDGs. Also, there are geographical locations that have been identified as Aspirational Districts which require special interventions for promoting their educational development. Hence, it is recommended that regions of the country with large populations from educationally-disadvantaged SEDGs should be declared Special Education Zones (SEZs), where all the schemes and policies are implemented to the maximum through additional concerted efforts, in order to truly change their educational landscape.

6.7. It must be noted that women cut across all underrepresented groups, making up about half of all SEDGs. Unfortunately, the exclusion and inequity that SEDGs face is only amplified for the women in these SEDGs. The policy additionally recognizes the special and critical role that women play in society and in shaping social mores; therefore, providing a quality education to girls is the best way to increase the education levels for these SEDGs, not just in the present but also in future generations. The policy thus recommends that the policies and schemes designed to include students from SEDGs should be especially targeted towards girls in these SEDGs.

6.8. In addition, the Government of India will constitute a 'Gender-Inclusion Fund' to build the nation's capacity to provide equitable quality education for all girls as well as transgender students. The fund will be available to States to implement priorities determined by the Central government critical for assisting female and transgender children in gaining access to education (such as the provisions of sanitation and toilets, bicycles, conditional cash transfers, etc.); funds will also enable States to support and scale effective community-based interventions that address local context-specific barriers to female and transgender children's access to and participation in education. Similar 'Inclusion Fund' schemes shall also be developed to address analogous access issues for other SEDGs. In essence, this Policy aims to eliminate any remaining disparity in access to education (including vocational education) for children from any gender or other socio-economically disadvantaged group.

6.9. Free boarding facilities will be built - matching the standard of Jawahar Navodaya Vidyalayas - in school locations where students may have to come from far, and particularly for students who from socio-economically disadvantaged backgrounds, with suitable arrangements for the safety of all children, especially girls. Kasturba Gandhi Balika Vidyalayas will be strengthened and expanded to increase the participation in quality schools (up to Grade 12) of girls from socio-economically disadvantaged backgrounds. Additional Jawahar Navodaya Vidyalayas and Kendriya Vidyalayas will be built around the country, especially in aspirational districts, Special Education Zones, and other disadvantaged areas, to increase high-quality educational opportunities. Pre-school sections covering at least one year of early childhood care and education will be added to Kendriya Vidyalayas and other primary schools around the nation, particularly in disadvantaged areas.

6.10. Ensuring the inclusion and equal participation of children with disabilities in ECCE and the schooling system will also be accorded the highest priority. Children with disabilities will be enabled to fully participate in the regular schooling process from the Foundational Stage to higher education. The Rights of Persons with Disabilities (RPWD) Act 2016 defines inclusive education as a 'system of education wherein students with and without disabilities learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities'. This Policy is in complete consonance with the provisions of the RPWD Act 2016 and endorses all its recommendations with regard to school education. While preparing the National Curriculum Framework, NCERT will ensure that consultations are held with expert bodies such as National Institutes of DEPwD.

6.11. To this end, schools/school complexes will be provided resources for the integration of children with disabilities, recruitment of special educators with cross-disability training, and for the establishment of resource centres, wherever needed, especially for children with severe or multiple disabilities. Barrier free access for all children with disabilities will be enabled as per the RPWD Act. Different categories of children with disabilities have differing needs. Schools and school complexes will work and be supported for providing all children with disabilities accommodations and support

mechanisms tailored to suit their needs and to ensure their full participation and inclusion in the classroom. In particular, assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) will be made available to help children with disabilities integrate more easily into classrooms and engage with teachers and their peers. This will apply to all school activities including arts, sports, and vocational education. NIOS will develop high-quality modules to teach Indian Sign Language, and to teach other basic subjects using Indian Sign Language. Adequate attention will be paid to the safety and security of children with disabilities.

6.12. As per the RPWD Act 2016, children with benchmark disabilities shall have the choice of regular or special schooling. Resource centres in conjunction with special educators will support the rehabilitation and educational needs of learners with severe or multiple disabilities and will assist parents/guardians in achieving high-quality home schooling and skilling for such students as needed. Home-based education will continue to be a choice available for children with severe and profound disabilities who are unable to go to schools. The children under home-based education must be treated as equal to any other child in the general system. There shall be an audit of home-based education for its efficiency and effectiveness using the principle of equity and equality of opportunity. Guidelines and standards for home-based schooling shall be developed based on this audit in line with the RPWD Act 2016. While it is clear that the education of all children with disabilities is the responsibility of the State, technology-based solutions will be used for the orientation of parents/caregivers along with wide-scale dissemination of learning materials to enable parents/caregivers to actively support their children's learning needs will be accorded priority.

6.13. Most classrooms have children with specific learning disabilities who need continuous support. Research is clear that the earlier such support begins, the better the chances of progress. Teachers must be helped to identify such learning disabilities early and plan specifically for their mitigation. Specific actions will include the use of appropriate technology allowing and enabling children to work at their own pace, with flexible curricula to leverage each child's strengths, and creating an ecosystem for appropriate assessment and certification. Assessment and certification agencies, including the proposed new National Assessment Centre, PARAKH, will formulate guidelines and recommend appropriate tools for conducting such assessment, from the foundational stage to higher education (including for entrance exams), in order to ensure equitable access and opportunities for all students with learning disabilities.

6.14. The awareness and knowledge of how to teach children with specific disabilities (including learning disabilities) will be an integral part of all teacher education programmes, along with gender sensitization and sensitization towards all underrepresented groups in order to reverse their underrepresentation.

6.15. Alternative forms of schools, will be encouraged to preserve their traditions or alternative pedagogical styles. At the same time, they will be supported to integrate the subject and learning areas prescribed by the NCFSE into their curricula in order to reduce and eventually eliminate the underrepresentation of children from these schools in higher education. In particular, financial assistance will be provided to introduce science, mathematics, social studies, Hindi, English, State languages, or other relevant subjects in the curriculum, as may be desired by these schools. This would enable children studying in these schools to attain the learning outcomes defined for Grades 1–12. Furthermore, students in such schools would be encouraged to appear for State or other Board examinations and assessments by the NTA, and thereby enroll in higher education institutions. Capacities of teachers in the teaching of science, mathematics, language, and social studies will be developed including orientation to new pedagogical practices. Libraries and laboratories will be strengthened and adequate reading materials like books, journals, etc., and other teaching-learning materials will be made available.

6.16. Within SEDGs, and with respect to all the above policy points, special attention will be given to reduce the disparities in the educational development of Scheduled Castes and Scheduled Tribes. As a part of the efforts to enhance participation in school education, special hostels in dedicated regions, bridge courses, and financial assistance through fee waivers and scholarships will be offered to

talented and meritorious students from all SEDGs on a larger scale, especially at the secondary stage of education, to facilitate their entry into higher education.

6.17. Under the aegis of the Ministry of Defence, State Governments may encourage opening NCC wings in their secondary and higher secondary schools, including those located in tribal dominated areas. This will enable harnessing of the natural talent and unique potential of students, which in turn would help them to aspire to a successful career in the defence forces.

6.18. All scholarships and other opportunities and schemes available to students from SEDGs will be coordinated and announced by a single agency and website to ensure that all students are aware of, and may apply in a simplified manner on such a 'single window system', as per eligibility.

6.19. All the above policies and measures are absolutely critical to attaining full inclusion and equity for all SEDGs - but they are not sufficient. What is also required is a change in school culture. All participants in the school education system, including teachers, principals, administrators, counsellors, and students, will be sensitized to the requirements of all students, the notions of inclusion and equity, and the respect, dignity, and privacy of all persons. Such an educational culture will provide the best pathway to help students become empowered individuals who, in turn, will enable society to transform into one that is responsible towards its most vulnerable citizens. Inclusion and equity will become a key aspect of teacher education (and training for all leadership, administrative, and other positions in schools); efforts will be made to recruit more high-quality teachers and leaders from SEDGs in order to bring in excellent role models for all students.

6.20. Students will be sensitized through this new school culture, brought in by teachers, trained social workers and counsellors as well as through corresponding changes to bring in an inclusive school curriculum. The school curriculum will include, early on, material on human values such as respect for all persons, empathy, tolerance, human rights, gender equality, non-violence, global citizenship, inclusion, and equity. It would also include more detailed knowledge of various cultures, religions, languages, gender identities, etc. to sensitize and develop respect for diversity. Any biases and stereotypes in school curriculum will be removed, and more material will be included that is relevant and relatable to all communities.

7. Efficient Resourcing and Effective Governance through School Complexes/Clusters

7.1. While the establishment of primary schools in every habitation across the country-driven by the Sarva Shiksha Abhiyan (SSA), now subsumed under the Samagra Shiksha Scheme and other important efforts across the States - has helped to ensure near-universal access to primary schools, it has also led to the development of numerous very small schools. According to U-DISE 2016–17 data, nearly 28% of India's public primary schools and 14.8% of India's upper primary schools have less than 30 students. The average number of students per grade in the elementary schooling system (primary and upper primary, i.e., Grades 1–8) is about 14, with a notable proportion having below 6; during the year 2016–17, there were 1,08,017 single-teacher schools, the majority of them (85743) being primary schools serving Grades 1–5.

7.2. These small school sizes have rendered it economically suboptimal and operationally complex to run good schools, in terms of deployment of teachers as well as the provision of critical physical resources. Teachers often teach multiple grades at a time, and teach multiple subjects, including subjects in which they may have no prior background; key areas such as music, arts, and sports are too often simply not taught; and physical resources, such as lab and sports equipment and library books, are simply not available across schools.

7.3. The isolation of small schools also has a negative effect on education and the teaching-learning process. Teachers function best in communities and teams, and so do students. Small schools also present a systemic challenge for governance and management. The geographical dispersion, challenging access conditions, and the very large numbers of schools make it difficult to reach all schools equally. Administrative structures have not been aligned with the increases in the number of school or with the unified structure of the Samagra Shiksha Scheme.

7.4. Although consolidation of schools is an option that is often discussed, it must be carried out very judiciously, and only when it is ensured that there is no impact on access. Such measures are nevertheless likely to result only in limited consolidation, and would not solve the overall structural problem and challenges presented by the large numbers of small schools.

7.5. These challenges will, by 2025, be addressed by State/UT governments by adopting innovative mechanisms to group or rationalize schools. The objective behind this intervention would be to ensure that every school has: (a) adequate number of counsellors/trained social workers and teachers (shared or otherwise) for teaching all subjects including art, music science, sports, languages, vocational subjects, etc; (b) adequate resources (shared or otherwise), such as a library, science labs, computer labs, skill labs, playgrounds, sports equipment and facilities, etc.; (c) a sense of community is built to overcome the isolation of teachers, students, and schools, through joint professional development programmes, sharing of teaching-learning content, joint content development, holding joint activities such as art and science exhibitions, sports meets, quizzes and debates, and fairs; (d) cooperation and support across schools for the education of children with disabilities; and (e) improved governance of the schooling system by devolving all finer decisions, to Principals, teachers, and other stakeholders within each group of schools and treating such a group of schools, which range from the foundational stage through the secondary stage, as an integrated semi-autonomous unit.

7.6. One possible mechanism for accomplishing the above would be the establishment of a grouping structure called the school complex, consisting of one secondary school together with all other schools offering lower grades in its neighbourhood including Anganwadis, in a radius of five to ten kilometers. This suggestion was first made by the Education Commission (1964–66) but was left unimplemented. This Policy strongly endorses the idea of the school complex/cluster, wherever possible. The aim of the school complex/cluster will be greater resource efficiency and more effective functioning, coordination, leadership, governance, and management of schools in the cluster.

7.7. The establishment of school complexes/clusters and the sharing of resources across complexes will have a number of other benefits as a consequence, such as improved support for children with disabilities, more topic-centred clubs and academic/sports/arts/crafts events across school complexes, better incorporation of art, music, language, vocational subjects, physical education, and other subjects in the classroom through the sharing of teachers in these subjects including use of ICT tools to conduct virtual classes, better student support, enrolment, attendance, and performance through the sharing of social workers and counsellors, and School Complex Management Committees (rather than simply School Management Committees) for more robust and improved governance, monitoring, oversight, innovations, and initiatives by local stakeholders. Building such larger communities of schools, school leaders, teachers, students, supporting staff, parents, and local citizens would energize and empower the schooling system, and in a resource-efficient manner.

7.8. The governance of schools will also improve and become far more efficient with school complexes/clusters. First, the DSE will devolve authority to the school complex/cluster, which will act as a semi-autonomous unit. The District Education Officer (DEO) and the Block Education Officers (BEO) will interact primarily with each school complex/cluster as a single unit and facilitate its work. The complex itself will perform certain tasks delegated by the DSE and will deal with the individual schools within it. The school complex/cluster will be given significant autonomy by the DSE to innovate towards providing integrated education and to experiment with pedagogies, curriculum, etc., while adhering to the National Curricular Framework (NCF) and State Curricular Framework (SCF). Under this organization, schools will gain in strength, will be able to exercise greater freedom, and will contribute towards making the complex more innovative and responsive. Meanwhile, the DSE will be able to focus on the aggregate level goals that need to be achieved, improving overall system effectiveness.

7.9. The culture of working to a plan, both short-term and long-term ones, will be developed through such complexes/clusters. Schools will develop their plans (SDPs) with the involvement of their SMCs. These plans will then become the basis for the creation of School Complex/Cluster Development Plans (SCDPs). The SCDP will also involve the plans of all other institutions

associated with the school complex, such as vocational education institutions, and will be created by the principals and teachers of the school complex with the involvement of the SCMC and will be made available publicly. The plans will include human resources, learning resources, physical resources and infrastructure, improvement initiatives, financial resources, school culture initiatives, teacher development plans, and educational outcomes. It will detail the efforts to leverage the teachers and students across the school complex to develop vibrant learning communities. The SDP and SCDP will be the primary mechanism to align all stakeholders of the school, including the DSE. The SMC and SCMC will use the SDP and SCDP for oversight of the functioning and direction of the school and will assist in the execution of these plans. The DSE, through its relevant official, e.g., the BEO, will endorse and confirm the SCDP of each school complex. It will then provide the resources (financial, human, physical, etc.) necessary to achieve the SCDPs, both short-term (1-year) and long-term (3-5 years). It will also provide all other relevant support to the school complexes to achieve the educational outcomes. The DSE and the SCERT may share specific norms (e.g., financial, staffing, process) and frameworks for development of the SDP and SCDP with all schools, which may be revised periodically.

7.10. To further enhance cooperation and positive synergy among schools, including between public and private schools, the twinning/pairing of one public school with one private school will be adopted across the country, so that such paired schools may meet/interact with each other, learn from each other, and also share resources, if possible. Best practices of private schools will be documented, shared, and institutionalized in public schools, and vice versa, where possible.

7.11. Every State will be encouraged to strengthen existing or establish "Bal Bhavans" where children of all ages can visit once a week (e.g., on weekends) or more often, as a special daytime boarding school, to partake in art-related, career-related, and play-related activities. Such Bal Bhavans may be incorporated as a part of school complexes/clusters if possible.

7.12. The school should be a point of celebration and honour for the whole community. The dignity of the school as an institution should be restored and important dates, such as the foundation day of the school, will be celebrated along with the community and the list of important alumni may be displayed and honoured. Furthermore, the un-utilized capacity of school infrastructure could be used to promote social, intellectual, and volunteer activities for the community and to promote social cohesion during non-teaching / schooling hours and may be used as a "Samajik Chetna Kendra".

8. Standard-setting and Accreditation for School Education

8.1. The goal of the school education regulatory system must be to continually improve educational outcomes; it must not overly restrict schools, prevent innovation, or demoralize teachers, principals, and students. All in all, regulation must aim to empower schools and teachers with trust, enabling them to strive for excellence and perform at their very best, while ensuring the integrity of the system through the enforcement of complete transparency and full public disclosure of all finances, procedures, and educational outcomes.

8.2. At present, all main functions of governance and regulation of the school education system - namely, the provision of public education, the regulation of education institutions, and policymaking - are handled by a single body, i.e., the Department of School Education or its arms. This leads to conflict of interests and excessive centralized concentration of power; it also leads to ineffective management of the school system, as efforts towards quality educational provision are often diluted by the focus on the other roles, particularly regulation, that the Departments of School Education also perform.

8.3. The current regulatory regime also has not been able to curb the commercialization and economic exploitation of parents by many for-profit private schools, yet at the same time it has all too often inadvertently discouraged public-spirited private/philanthropic schools. There has been far too much asymmetry between the regulatory approaches to public and private schools, even though the goals of both types of schools should be the same: to provide quality education.

8.4. The public education system is the foundation of a vibrant democratic society, and the way it is run must be transformed and invigorated in order to achieve the highest levels of educational outcomes for the nation. At the same time, the private/philanthropic school sector must also be encouraged and enabled to play a significant and beneficial role.

8.5. The key principles and recommendations of this Policy regarding the State school education system, the independent responsibilities within that system, and the approach to its regulation are as follows:

(a) The Department of School Education, which is the apex state-level body in school education, will be responsible for overall monitoring and policymaking for continual improvement of the public education system; it will not be involved with the provision and operation of schools or with the regulation of schools, in order to ensure due focus on the improvement of public schools and to eliminate conflict of interests.

(b) The educational operations and service provision for the public schooling system of the whole State will be handled by the Directorate of School Education (including the offices of the DEO and BEO, etc.); it will work independently to implement policies regarding educational operations and provision.

(c) An effective quality self-regulation or accreditation system will be instituted for all stages of education including pre-school education - private, public, and philanthropic - to ensure compliance with essential quality standards. To ensure that all schools follow certain minimal professional and quality standards, States/UTs will set up an independent, State-wide, body called the State School Standards Authority (SSSA). The SSSA will establish a minimal set of standards based on basic parameters (namely, safety, security, basic infrastructure, number of teachers across subjects and grades, financial probity, and sound processes of governance), which shall be followed by all schools. The framework for these parameters will be created by the SCERT in consultation with various stakeholders, especially teachers and schools.

    Transparent public self-disclosure of all the basic regulatory information, as laid down by the SSSA, will be used extensively for public oversight and accountability. The dimensions on which information has to be self-disclosed, and the format of disclosure will be decided by the SSSA in accordance with global best practices for standard-setting for schools. This information will have to be made available and kept updated and accurate by all schools, on the aforementioned public website maintained by the SSSA and on the schools' websites. Any complaints or grievances from stakeholders or others arising out of the information placed in the public domain shall be adjudicated by the SSSA. Feedback from randomly selected students will be solicited online to ensure valuable input at regular intervals. Technology will be employed suitably to ensure efficiency and transparency in all work of the SSSA. This will bring down significantly the heavy load of regulatory mandates currently borne by schools.

(d) Academic matters, including academic standards and curricula in the State will be led by the SCERT (with close consultation and collaboration with the NCERT), which will be reinvigorated as an institution. The SCERT will develop a School Quality Assessment and Accreditation Framework (SQAAF) through wide consultations with all stakeholders. The SCERT will also lead a "change management process" for the reinvigoration of CRCs, BRCs, and DIETs which must change the capacity and work culture of these institutions in 3 years, developing them into vibrant institutions of excellence. Meanwhile, certification of competencies of students at the school-leaving stage will be handled by the Boards of Assessment/Examination in each State.

8.6. The culture, structures, and systems that empower and provide adequate resources to schools, institutions, teachers, officials, communities, and other stakeholders, will also build concomitant accountability. Each stakeholder and participant of the education system will be accountable to perform their role with the highest level of integrity, full commitment, and exemplary work ethic.

Each role of the system will have explicitly articulated role expectations and rigorous assessment of their performance vis-à-vis these expectations. The assessment system will be objective and developmentally oriented, while ensuring accountability. It will have multiple sources of feedback and assessment, to ensure a full view of the performance (and will not just be linked simplistically, e.g., to 'marks' of students). The assessment will recognize that outcomes such as educational attainment of students have multiple intervening variables and extraneous influences. It will also recognize that education requires teamwork, particularly at the level of the school. Promotion, recognition, and accountability of all individuals will be based on such performance assessment. All functionaries will be responsible to ensure that this development, performance, and accountability system is run with high integrity, and systematically, within their span of control.

8.7. Public and private schools (except the schools that are managed/aided/controlled by the Central government) will be assessed and accredited on the same criteria, benchmarks, and processes, emphasizing online and offline public disclosure and transparency, so as to ensure that public-spirited private schools are encouraged and not stifled in any way. Private philanthropic efforts for quality education will be encouraged - thereby affirming the public-good nature of education - while protecting parents and communities from arbitrary increases in tuition fees. Public disclosure on the school website and on the SSSA website - for both public and private schools - would include (at the very least) information on the numbers of classrooms, students, and teachers, subjects taught, any fees, and overall student outcomes on standardized evaluations such as the NAS and SAS. For schools controlled/managed/aided by the Central government, the CBSE in consultation with the MHRD shall prepare a framework. All the education institutions will be held to similar standards of audit and disclosure as a 'not-for-profit' entity. Surpluses, if any, will be reinvested in the educational sector.

8.8. The standard-setting/regulatory framework and the facilitating systems for school regulation, accreditation, and governance shall be reviewed to enable improvements on the basis of the learnings and experiences gained in the last decade. This review will aim to ensure that all students, particularly students from underprivileged and disadvantaged sections, shall have universal, free and compulsory access to high-quality and equitable schooling from early childhood care and education (age 3 onwards) through higher secondary education (i.e., until Grade 12). The overemphasis on inputs, and the mechanistic nature of their specifications – physical and infrastructural – will be changed and requirements made more responsive to realities on the ground, e.g., regarding land areas and room sizes, practicalities of playgrounds in urban areas, etc. These mandates will be adjusted and loosened, leaving suitable flexibility for each school to make its own decisions based on local needs and constraints, while ensuring safety, security, and a pleasant and productive learning space. Educational outcomes and the transparent disclosure of all financial, academic, and operational matters will be given due importance and will be incorporated suitably in the assessment of schools. This will further improve India's progress towards achieving Sustainable Development Goal 4 (SDG4) of ensuring free, equitable, and quality primary and secondary education for all children.

8.9. The aim of the public-school education system will be to impart the highest quality education so that it becomes the most attractive option for parents from all walks of life for educating their children.

8.10. For a periodic 'health check-up' of the overall system, a sample-based National Achievement Survey (NAS) of student learning levels will be carried out by the proposed new National Assessment Centre, PARAKH with suitable cooperation with other governmental bodies- such as the NCERT– that may assist in assessment procedures as well as data analysis. The assessment will cover students across government as well as private schools. States will also be encouraged to conduct their own census-based State Assessment Survey (SAS), the results of which will be used only for developmental purposes, public disclosure by schools of their overall and anonymized student outcomes, and for continuous improvement of the school education system. Until the establishment of the proposed new National Assessment Centre, PARAKH, NCERT may continue to carry out NAS.

8.11. Finally, the children and adolescents enrolled in schools must not be forgotten in this whole process; after all, the school system is designed for them. Careful attention must be paid to their safety and rights- particularly girl children - and the various difficult issues faced by adolescents, such as substance or drug abuse and forms of discrimination and harassment including violence, with clear, safe, and efficient mechanisms for reporting and for due process on any infractions against children's/adolescents' rights or safety. The development of such mechanisms that are effective, timely, and well-known to all students will be accorded high priority.

Part II. HIGHER EDUCATION

9. Quality Universities and Colleges: A New and Forward-looking Vision for India's Higher Education System

9.1. Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially-conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. Higher education significantly contributes towards sustainable livelihoods and economic development of the nation. As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education.

9.1.1. Given the 21st century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. It must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education must enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. It must prepare students for more meaningful and satisfying lives and work roles and enable economic independence.

9.1.2. For the purpose of developing holistic individuals, it is essential that an identified set of skills and values will be incorporated at each stage of learning, from pre-school to higher education.

9.1.3. At the societal level, higher education must enable the development of an enlightened, socially conscious, knowledgeable, and skilled nation that can find and implement robust solutions to its own problems. Higher education must form the basis for knowledge creation and innovation thereby contributing to a growing national economy. The purpose of quality higher education is, therefore, more than the creation of greater opportunities for individual employment. It represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.

9.2. Some of the major problems currently faced by the higher education system in India include:

(a) a severely fragmented higher educational ecosystem;
(b) less emphasis on the development of cognitive skills and learning outcomes;
(c) a rigid separation of disciplines, with early specialisation and streaming of students into narrow areas of study;
(d) limited access particularly in socio-economically disadvantaged areas, with few HEIs that teach in local languages
(e) limited teacher and institutional autonomy;
(f) inadequate mechanisms for merit-based career management and progression of faculty and institutional leaders;
(g) lesser emphasis on research at most universities and colleges, and lack of competitive peer-reviewed research funding across disciplines;
(h) suboptimal governance and leadership of HEIs;
(i) an ineffective regulatory system; and
(j) large affiliating universities resulting in low standards of undergraduate education.

9.3. This policy envisions a complete overhaul and re-energising of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion. The policy's vision includes the following key changes to the current system:

(a) moving towards a higher educational system consisting of large, multidisciplinary universities and colleges, with at least one in or near every district, and with more HEIs across India that offer medium of instruction or programmes in local/Indian languages;
(b) moving towards a more multidisciplinary undergraduate education;
(c) moving towards faculty and institutional autonomy;
(d) revamping curriculum, pedagogy, assessment, and student support for enhanced student experiences;
(e) reaffirming the integrity of faculty and institutional leadership positions through merit-appointments and career progression based on teaching, research, and service;
(f) establishment of a National Research Foundation to fund outstanding peer-reviewed research and to actively seed research in universities and colleges;
(g) governance of HEIs by high qualified independent boards having academic and administrative autonomy;
(h) "light but tight" regulation by a single regulator for higher education;
(i) increased access, equity, and inclusion through a range of measures, including greater opportunities for outstanding public education; scholarships by private/philanthropic universities for disadvantaged and underprivileged students; online education, and Open Distance Learning (ODL); and all infrastructure and learning materials accessible and available to learners with disabilities.

10. Institutional Restructuring and Consolidation

10.1. The main thrust of this policy regarding higher education is to end the fragmentation of higher education by transforming higher education institutions into large multidisciplinary universities, colleges, and HEI clusters/Knowledge Hubs, each of which will aim to have 3,000 or more students. This would help build vibrant communities of scholars and peers, break down harmful silos, enable students to become well-rounded across disciplines including artistic, creative, and analytic subjects as well as sports, develop active research communities across disciplines including cross-disciplinary research, and increase resource efficiency, both material and human, across higher education.

10.2. Moving to large multidisciplinary universities and HEI clusters is thus the highest recommendation of this policy regarding the structure of higher education. The ancient Indian universities Takshashila, Nalanda, Vallabhi, and Vikramshila, which had thousands of students from India and the world studying in vibrant multidisciplinary environments, amply demonstrated the type of great success that large multidisciplinary research and teaching universities could bring. India urgently needs to bring back this great Indian tradition to create well-rounded and innovative individuals, and which is already transforming other countries educationally and economically.

10.3. This vision of higher education will require, in particular, a new conceptual perception/understanding for what constitutes a higher education institution (HEI), i.e., a university or a college. A university will mean a multidisciplinary institution of higher learning that offers undergraduate and graduate programmes, with high quality teaching, research, and community engagement. The definition of university will thus allow a spectrum of institutions that range from those that place equal emphasis on teaching and research i.e., Research-intensive Universities, those that place greater emphasis on teaching but still conduct significant research i.e. Teaching-intensive Universities. Meanwhile, an Autonomous degree-granting College (AC) will refer to a large multidisciplinary institution of higher learning that grants undergraduate degrees and is primarily focused on undergraduate teaching though it would not be restricted to that and it need not be restricted to that and it would generally be smaller than a typical university.

10.4. A stage-wise mechanism for granting graded autonomy to colleges, through a transparent system of graded accreditation, will be established. Colleges will be encouraged, mentored, supported, and incentivized to gradually attain the minimum benchmarks required for each level of

accreditation. Over a period of time, it is envisaged that every college would develop into either an Autonomous degree-granting College, or a constituent college of a university - in the latter case, it would be fully a part of the university. With appropriate accreditations, Autonomous degree-granting Colleges could evolve into Research-intensive or Teaching-intensive Universities, if they so aspire.

10.5. It must be clearly stated that these three broad types of institutions are not in any natural way a rigid, exclusionary categorization, but are along a continuum. HEIs will have the autonomy and freedom to move gradually from one category to another, based on their plans, actions, and effectiveness. The most salient marker for these categories of institutions will be the focus of their goals and work. The Accreditation System will develop and use appropriately different and relevant norms across this range of HEIs. However, the expectations of high quality of education, and of teaching-learning, across all HEIs will be the same.

10.6. In addition to teaching and research, HEIs will have other crucial responsibilities, which they will discharge through appropriate resourcing, incentives, and structures. These include supporting other HEIs in their development, community engagement and service, contribution to various fields of practice, faculty development for the higher education system, and support to school education.

10.7. By 2040, all higher education institutions (HEIs) shall aim to become multidisciplinary institutions and shall aim to have larger student enrolments preferably in the thousands, for optimal use of infrastructure and resources, and for the creation of vibrant multidisciplinary communities. Since this process will take time, all HEIs will firstly plan to become multidisciplinary by 2030, and then gradually increase student strength to the desired levels.

10.8. More HEIs shall be established and developed in underserved regions to ensure full access, equity, and inclusion. There shall, by 2030, be at least one large multidisciplinary HEI in or near every district. Steps shall be taken towards developing high-quality higher education institutions both public and private that have medium of instruction in local/Indian languages or bilingually. The aim will be to increase the Gross Enrolment Ratio in higher education including vocational education from 26.3% (2018) to 50% by 2035. While a number of new institutions may be developed to attain these goals, a large part of the capacity creation will be achieved by consolidating, substantially expanding, and also improving existing HEIs.

10.9. Growth will be in both public and private institutions, with a strong emphasis on developing a large number of outstanding public institutions. There will be a fair and transparent system for determining increased levels of public funding support for public HEIs. This system will give an equitable opportunity for all public institutions to grow and develop, and will be based on transparent, pre-announced criteria from within the accreditation norms of the Accreditation System. HEIs delivering education of the highest quality as laid down in this Policy will be incentivized in expanding their capacity.

10.10. Institutions will have the option to run Open Distance Learning (ODL) and online programmes, provided they are accredited to do so, in order to enhance their offerings, improve access, increase GER, and provide opportunities for lifelong learning (SDG 4). All ODL programmes and their components leading to any diploma or degree will be of standards and quality equivalent to the highest quality programmes run by the HEIs on their campuses. Top institutions accredited for ODL will be encouraged and supported to develop high-quality online courses. Such quality online courses will be suitably integrated into curricula of HEIs, and blended mode will be preferred.

10.11. Single-stream HEIs will be phased out over time, and all will move towards becoming vibrant multidisciplinary institutions or parts of vibrant multidisciplinary HEI clusters, in order to enable and encourage high-quality multidisciplinary and cross-disciplinary teaching and research across fields. Single-stream HEIs will, in particular, add departments across different fields that would strengthen the single stream that they currently serve. Through the attainment of suitable accreditations, all HEIs will gradually move towards full autonomy - academic and administrative - in order to enable this vibrant culture. The autonomy of public institutions will be backed by adequate public financial

support and stability. Private institutions with a public-spirited commitment to high-quality equitable education will be encouraged.

10.12. The new regulatory system envisioned by this Policy will foster this overall culture of empowerment and autonomy to innovate, including by gradually phasing out the system of 'affiliated colleges' over a period of fifteen years through a system of graded autonomy, and to be carried out in a challenge mode. Each existing affiliating university will be responsible for mentoring its affiliated colleges so that they can develop their capabilities and achieve minimum benchmarks in academic and curricular matters; teaching and assessment; governance reforms; financial robustness; and administrative efficiency. All colleges currently affiliated to a university shall attain the required benchmarks over time to secure the prescribed accreditation benchmarks and eventually become autonomous degree-granting colleges. This will be achieved through a concerted national effort including suitable mentoring and governmental support for the same.

10.13. The overall higher education sector will aim to be an integrated higher education system, including professional and vocational education. This Policy and its approach will be equally applicable to all HEIs across all current streams, which would eventually merge into one coherent ecosystem of higher education.

10.14. University, worldwide, means a multidisciplinary institution of higher learning that offers undergraduate, graduate, and Ph.D programmes, and engages in high-quality teaching and research. The present complex nomenclature of HEIs in the country such as 'deemed to be university', 'affiliating university', 'affiliating technical university', 'unitary university' shall be replaced simply by 'university' on fulfilling the criteria as per norms.

11. Towards a More Holistic and Multidisciplinary Education

11.1. India has a long tradition of holistic and multidisciplinary learning, from universities such as Takshashila and Nalanda, to the extensive literatures of India combining subjects across fields. Ancient Indian literary works such as Banabhatta's Kadambari described a good education as knowledge of the 64 Kalaas or arts; and among these 64 'arts' were not only subjects, such as singing and painting, but also 'scientific 'fields, such as chemistry and mathematics, 'vocational ' fields such as carpentry and clothes-making, 'professional 'fields, such as medicine and engineering, as well as 'soft skills' such as communication, discussion, and debate. The very idea that all branches of creative human endeavour, including mathematics, science, vocational subjects, professional subjects, and soft skills should be considered 'arts', has distinctly Indian origins. This notion of a 'knowledge of many arts' or what in modern times is often called the 'liberal arts' (i.e., a liberal notion of the arts) must be brought back to Indian education, as it is exactly the kind of education that will be required for the 21st century.

11.2. Assessments of educational approaches in undergraduate education that integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) have consistently showed positive learning outcomes, including increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. Research is also improved and enhanced through a holistic and multidisciplinary education approach.

11.3. A holistic and multidisciplinary education would aim to develop all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

11.4. A holistic and multidisciplinary education, as described so beautifully in India's past, is indeed what is needed for the education of India to lead the country into the 21st century and the fourth industrial revolution. Even engineering institutions, such as IITs, will move towards more holistic and multidisciplinary education with more arts and humanities. Students of arts and humanities will aim to learn more science and all will make an effort to incorporate more vocational subjects and soft skills.

11.5. Imaginative and flexible curricular structures will enable creative combinations of disciplines for study, and would offer multiple entry and exit points, thus, removing currently prevalent rigid boundaries and creating new possibilities for life-long learning. Graduate-level, master's and doctoral education in large multidisciplinary universities, while providing rigorous research-based specialization, would also provide opportunities for multidisciplinary work, including in academia, government, and industry.

11.6. Large multidisciplinary universities and colleges will facilitate the move towards high-quality holistic and multidisciplinary education. Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialization in a subject or subjects. This will be encouraged by increased faculty and institutional autonomy in setting curricula. Pedagogy will have an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking.

11.7. Departments in Languages, Literature, Music, Philosophy, Indology, Art, Dance, Theatre, Education, Mathematics, Statistics, Pure and Applied Sciences, Sociology, Economics, Sports, Translation and Interpretation, and other such subjects needed for a multidisciplinary, stimulating Indian education and environment will be established and strengthened at all HEIs. Credits will be given in all Bachelor's Degree programmes for these subjects if they are done from such departments or through ODL mode when they are not offered in-class at the HEI.

11.8. Towards the attainment of such a holistic and multidisciplinary education, the flexible and innovative curricula of all HEIs shall include credit-based courses and projects in the areas of community engagement and service, environmental education, and value-based education. Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living. Value-based education will include the development of humanistic, ethical, Constitutional, and universal human values of truth (*satya*), righteous conduct (*dharma*), peace (*shanti*), love (*prem*), nonviolence (*ahimsa*), scientific temper, citizenship values, and also life-skills; lessons in *seva*/service and participation in community service programmes will be considered an integral part of a holistic education. As the world is becoming increasingly interconnected, Global Citizenship Education (GCED), a response to contemporary global challenges, will be provided to empower learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies. Finally, as part of a holistic education, students at all HEIs will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, etc., as well as research internships with faculty and researchers at their own or other HEIs/research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

11.9. The structure and lengths of degree programmes shall be adjusted accordingly. The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student. An Academic Bank of Credit (ABC) shall be established which would digitally store the academic credits earned from various recognized HEIs so that the degrees from an HEI can be awarded taking into account credits earned. The 4-year programme may also lead to a degree 'with

Research' if the student completes a rigorous research project in their major area(s) of study as specified by the HEI.

11.10. HEIs will have the flexibility to offer different designs of Master's programmes: (a) there may be a 2-year programme with the second year devoted entirely to research for those who have completed the 3-year Bachelor's programme; (b) for students completing a 4-year Bachelor's programme with Research, there could be a 1-year Master's programme; and (c) there may be an integrated 5-year Bachelor's/Master's programme. Undertaking a Ph.D. shall require either a Master's degree or a 4-year Bachelor's degree with Research. The M.Phil. programme shall be discontinued.

11.11. Model public universities for holistic and multidisciplinary education, at par with IITs, IIMs, etc., called MERUs (Multidisciplinary Education and Research Universities) will be set up and will aim to attain the highest global standards in quality education. They will also help set the highest standards for multidisciplinary education across India.

11.12. HEIs will focus on research and innovation by setting up start-up incubation centres; technology development centres; centres in frontier areas of research; greater industry-academic linkages; and interdisciplinary research including humanities and social sciences research. Given the scenario of epidemics and pandemics, it is critical that HEIs take the lead to undertake research in areas of infectious diseases, epidemiology, virology, diagnostics, instrumentation, vaccinology and other relevant areas. HEIs will develop specific hand holding mechanisms and competitions for promoting innovation among student communities. The NRF will function to help enable and support such a vibrant research and innovation culture across HEIs, research labs, and other research organizations.

12. Optimal Learning Environments and Support for Students

12.1. Effective learning requires a comprehensive approach that involves appropriate curriculum, engaging pedagogy, continuous formative assessment, and adequate student support. The curriculum must be interesting and relevant, and updated regularly to align with the latest knowledge requirements and to meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students, thus directly influencing learning outcomes. The assessment methods must be scientific, designed to continuously improve learning and test the application of knowledge. Last but not least, the development of capacities that promote student wellness such as fitness, good health, psycho-social well-being, and sound ethical grounding are also critical for high-quality learning.

Thus, curriculum, pedagogy, continuous assessment, and student support are the cornerstones for quality learning. Along with providing suitable resources and infrastructure, such as quality libraries, classrooms, labs, technology, sports/recreation areas, student discussion spaces, and dining areas, a number of initiatives will be required to ensure that learning environments are engaging and supportive, and enable all students to succeed.

12.2. First, in order to promote creativity, institutions and faculty will have the autonomy to innovate on matters of curriculum, pedagogy, and assessment within a broad framework of higher education qualifications that ensures consistency across institutions and programmes and across the ODL, online, and traditional 'in-class' modes. Accordingly, curriculum and pedagogy will be designed by institutions and motivated faculty to ensure a stimulating and engaging learning experience for all students, and continuous formative assessment will be used to further the goals of each programme. All assessment systems shall also be decided by the HEI, including those that lead to final certification. The Choice Based Credit System (CBCS) will be revised for instilling innovation and flexibility. HEIs shall move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs shall also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

12.3. Second, each institution will integrate its academic plans ranging from curricular improvement to quality of classroom transaction - into its larger Institutional Development Plan (IDP). Each institution will be committed to the holistic development of students and create strong internal systems for supporting diverse student cohorts in academic and social domains both inside and outside formal academic interactions in the classroom. For example, all HEIs will have mechanisms and opportunities for funding of topic-centred clubs and activities organized by students with the help of faculty and other experts as needed, such as clubs and events dedicated to science, mathematics, poetry, language, literature, debate, music, sports, etc. Over time, such activities could be incorporated into the curriculum once appropriate faculty expertise and campus student demand is developed. Faculty will have the capacity and training to be able to approach students not just as teachers, but also as mentors and guides.

12.4. Third, students from socio-economically disadvantaged backgrounds require encouragement and support to make a successful transition to higher education. Universities and colleges will thus be required to set up high-quality support centres and will be given adequate funds and academic resources to carry this out effectively. There will also be professional academic and career counselling available to all students, as well as counsellors to ensure physical, psychological and emotional well-being.

12.5. Fourth, ODL and online education provide a natural path to increase access to quality higher education. In order to leverage its potential completely, ODL will be renewed through concerted, evidence-based efforts towards expansion while ensuring adherence to clearly articulated standards of quality. ODL programmes will aim to be equivalent to the highest quality in-class programmes available. Norms, standards, and guidelines for systemic development, regulation, and accreditation of ODL will be prepared, and a framework for quality of ODL that will be recommendatory for all HEIs will be developed.

12.6. Finally, all programmes, courses, curricula, and pedagogy across subjects, including those in-class, online, and in ODL modes as well as student support will aim to achieve global standards of quality.

Internationalization

12.7. The various initiatives mentioned above will also help in having larger numbers of international students studying in India, and provide greater mobility to students in India who may wish to visit, study at, transfer credits to, or carry out research at institutions abroad, and vice versa. Courses and programmes in subjects, such as Indology, Indian languages, AYUSH systems of medicine, yoga, arts, music, history, culture, and modern India, internationally relevant curricula in the sciences, social sciences, and beyond, meaningful opportunities for social engagement, quality residential facilities and on-campus support, etc. will be fostered to attain this goal of global quality standards, attract greater numbers of international students, and achieve the goal of 'internationalization at home'.

12.8. India will be promoted as a global study destination providing premium education at affordable costs thereby helping to restore its role as a Vishwa Guru. An International Students Office at each HEI hosting foreign students will be set up to coordinate all matters relating to welcoming and supporting students arriving from abroad. Research/teaching collaborations and faculty/student exchanges with high-quality foreign institutions will be facilitated, and relevant mutually beneficial MOUs with foreign countries will be signed. High performing Indian universities will be encouraged to set up campuses in other countries, and similarly, selected universities e.g., those from among the top 100 universities in the world will be facilitated to operate in India. A legislative framework facilitating such entry will be put in place, and such universities will be given special dispensation regarding regulatory, governance, and content norms on par with other autonomous institutions of India. Furthermore, research collaboration and student exchanges between Indian institutions and global institutions will be promoted through special efforts. Credits acquired in foreign universities will be permitted, where appropriate as per the requirements of each HEI, to be counted for the award of a degree.

Student Activity and Participation

12.9. Students are the prime stakeholders in the education system. Vibrant campus life is essential for high-quality teaching-learning processes. Towards this end, students will be given plenty of opportunities for participation in sports, culture/arts clubs, eco-clubs, activity clubs, community service projects, etc. In every education institution, there shall be counselling systems for handling stress and emotional adjustments. Furthermore, a systematized arrangement shall be created to provide the requisite support to students from rural backgrounds, including increasing hostel facilities as needed. All HEIs will ensure quality medical facilities for all students in their institutions.

Financial support for students

12.10. Financial assistance to students shall be made available through various measures. Efforts will be made to incentivize the merit of students belonging to SC, ST, OBC, and other SEDGs. The National Scholarship Portal will be expanded to support, foster, and track the progress of students receiving scholarships. Private HEIs will be encouraged to offer larger numbers of free ships and scholarships to their students.

13. Motivated, Energized, and Capable Faculty

13.1. The most important factor in the success of higher education institutions is the quality and engagement of its faculty. Acknowledging the criticality of faculty in achieving the goals of higher education, various initiatives have been introduced in the past several years to systematize recruitment and career progression, and to ensure equitable representation from various groups in the hiring of faculty. Compensation levels of permanent faculty in public institutions have also been increased substantially. Various initiatives have also been taken towards providing faculty with professional development opportunities. However, despite these various improvements in the status of the academic profession, faculty motivation in terms of teaching, research, and service in HEIs remains far lower than the desired level. The various factors that lie behind low faculty motivation levels must be addressed to ensure that each faculty member is happy, enthusiastic, engaged, and motivated towards advancing her/his students, institution, and profession. To this end, the policy recommends the following initiatives to achieve the best, motivated, and capable faculty in HEIs.

13.2. As the most basic step, all HEIs will be equipped with the basic infrastructure and facilities, including clean drinking water, clean working toilets, blackboards, offices, teaching supplies, libraries, labs, and pleasant classroom spaces and campuses. Every classroom shall have access to the latest educational technology that enables better learning experiences.

13.3. Teaching duties also will not be excessive, and student-teacher ratios not too high, so that the activity of teaching remains pleasant and there is adequate time for interaction with students, conducting research, and other university activities. Faculty will be appointed to individual institutions and generally not be transferable across institutions so that they may feel truly invested in, connected to, and committed to their institution and community.

13.4. Faculty will be given the freedom to design their own curricular and pedagogical approaches within the approved framework, including textbook and reading material selections, assignments, and assessments. Empowering the faculty to conduct innovative teaching, research, and service as they see best will be a key motivator and enabler for them to do truly outstanding, creative work.

13.5. Excellence will be further incentivized through appropriate rewards, promotions, recognitions, and movement into institutional leadership. Meanwhile, faculty not delivering on basic norms will be held accountable.

13.6. In keeping with the vision of autonomous institutions empowered to drive excellence, HEIs will have clearly defined, independent, and transparent processes and criteria for faculty recruitment. Whereas the current recruitment process will be continued, a ‘tenure-track’ i.e., suitable probation period shall be put in place to further ensure excellence. There shall be a fast-track promotion system

for recognizing high impact research and contribution. A system of multiple parameters for proper performance assessment, for the purposes of 'tenure' i.e., confirmed employment after probation, promotion, salary increases, recognitions, etc., including peer and student reviews, innovations in teaching and pedagogy, quality and impact of research, professional development activities, and other forms of service to the institution and the community, shall be developed by each HEI and clearly enunciated in it's Institutional Development Plan (IDP).

13.7. The presence of outstanding and enthusiastic institutional leaders that cultivate excellence and innovation is the need of the hour. Outstanding and effective institutional leadership is extremely important for the success of an institution and of its faculty. Excellent faculty with high academic and service credentials as well as demonstrated leadership and management skills will be identified early and trained through a ladder of leadership positions. Leadership positions shall not remain vacant, but rather an overlapping time period during transitions in leadership shall be the norm to ensure the smooth running of institutions. Institutional leaders will aim to create a culture of excellence that will motivate and incentivize outstanding and innovative teaching, research, institutional service, and community outreach from faculty members and all HEI leaders.

14. Equity and Inclusion in Higher Education

14.1. Entry into quality higher education can open a vast array of possibilities that can lift both individuals as well as communities out of the cycles of disadvantage. For this reason, making quality higher education opportunities available to all individuals must be among the highest priorities. This Policy envisions ensuring equitable access to quality education to all students, with a special emphasis on SEDGs.

14.2. The dynamics and also many of the reasons for exclusion of SEDGs from the education system are common across school and higher education sectors. Therefore, the approach to equity and inclusion must be common across school and higher education. Furthermore, there must be continuity across the stages to ensure sustainable reform. Thus, the policy initiatives required to meet the goals of equity and inclusion in higher education must be read in conjunction with those for school education.

14.3. There are certain facets of exclusion, that are particular to or substantially more intense in higher education. These must be addressed specifically, and include lack of knowledge of higher education opportunities, economic opportunity cost of pursuing higher education, financial constraints, admission processes, geographical and language barriers, poor employability potential of many higher education programmes, and lack of appropriate student support mechanisms.

14.4. For this purpose, additional actions that are specific to higher education shall be adopted by all Governments and HEIs:

14.4.1. Steps to be taken by Governments

(a) Earmark suitable Government funds for the education of SEDGs
(b) Set clear targets for higher GER for SEDGs
(c) Enhance gender balance in admissions to HEIs
(d) Enhance access by establishing more high-quality HEIs in aspirational districts and Special Education Zones containing larger numbers of SEDGs
(e) Develop and support high-quality HEIs that teach in local/Indian languages or bilingually
(f) Provide more financial assistance and scholarships to SEDGs in both public and private HEIs
(g) Conduct outreach programmes on higher education opportunities and scholarships among SEDGs
(h) Develop and support technology tools for better participation and learning outcomes.

14.4.2. Steps to be taken by all HEIs

(a) Mitigate opportunity costs and fees for pursuing higher education
(b) Provide more financial assistance and scholarships to socio-economically disadvantaged students
(c) Conduct outreach on higher education opportunities and scholarships
(d) Make admissions processes more inclusive
(e) Make curriculum more inclusive
(f) Increase employability potential of higher education programmes
(g) Develop more degree courses taught in Indian languages and bilingually
(h) Ensure all buildings and facilities are wheelchair-accessible and disabled-friendly
(i) Develop bridge courses for students that come from disadvantaged educational backgrounds
(j) Provide socio-emotional and academic support and mentoring for all such students through suitable counselling and mentoring programmes
(k) Ensure sensitization of faculty, counsellor, and students on gender-identity issue and its inclusion in all aspects of the HEI, including curricula
(l) Strictly enforce all no-discrimination and anti-harassment rules
(m) Develop Institutional Development Plans that contain specific plans for action on increasing participation from SEDGs, including but not limited to the above items.

15. Teacher Education

15.1. Teacher education is vital in creating a pool of schoolteachers that will shape the next generation. Teacher preparation is an activity that requires multidisciplinary perspectives and knowledge, formation of dispositions and values, and development of practice under the best mentors. Teachers must be grounded in Indian values, languages, knowledge, ethos, and traditions including tribal traditions, while also being well-versed in the latest advances in education and pedagogy.

15.2. According to the Justice J. S. Verma Commission (2012) constituted by the Supreme Court, a majority of stand-alone TEIs - over 10,000 in number are not even attempting serious teacher education but are essentially selling degrees for a price. Regulatory efforts so far have neither been able to curb the malpractices in the system, nor enforce basic standards for quality, and in fact have had the negative effect of curbing the growth of excellence and innovation in the sector. The sector and its regulatory system are, therefore, in urgent need of revitalization through radical action, in order to raise standards and restore integrity, credibility, efficacy, and high quality to the teacher education system.

15.3. In order to improve and reach the levels of integrity and credibility required to restore the prestige of the teaching profession, the Regulatory System shall be empowered to take stringent action against substandard and dysfunctional teacher education institutions (TEIs) that do not meet basic educational criteria, after giving one year for remedy of the breaches. By 2030, only educationally sound, multidisciplinary, and integrated teacher education programmes shall be in force.

15.4. As teacher education requires multidisciplinary inputs, and education in high-quality content as well as pedagogy, all teacher education programmes must be conducted within composite multidisciplinary institutions. To this end, all multidisciplinary universities and colleges - will aim to establish, education departments which, besides carrying out cutting-edge research in various aspects of education, will also run B.Ed. programmes, in collaboration with other departments such as psychology, philosophy, sociology, neuroscience, Indian languages, arts, music, history, literature, physical education, science and mathematics. Moreover, all stand-alone TEIs will be required to convert to multidisciplinary institutions by 2030, since they will have to offer the 4-year integrated teacher preparation programme.

15.5. The 4-year integrated B.Ed. offered by such multidisciplinary HEIs will, by 2030, become the minimal degree qualification for school teachers. The 4-year integrated B.Ed. will be a dual-major holistic Bachelor′s degree, in Education as well as a specialized subject such as a language, history, music, mathematics, computer science, chemistry, economics, art, physical education, etc. Beyond

the teaching of cutting-edge pedagogy, the teacher education will include grounding in sociology, history, science, psychology, early childhood care and education, foundational literacy and numeracy, knowledge of India and its values/ethos/art/traditions, and more. The HEI offering the 4-year integrated B.Ed. may also run a 2-year B.Ed., for students who have already received a Bachelor′s degree in a specialized subject. A 1-year B.Ed. may also be offered for candidates who have received a 4-year undergraduate degree in a specialized subject. Scholarships for meritorious students will be established for the purpose of attracting outstanding candidates to the 4-year, 2-year, and 1-year B.Ed. programmes.

15.6. HEIs offering teacher education programmes will ensure the availability of a range of experts in education and related disciplines as well as specialized subjects. Each higher education institution will have a network of government and private schools to work closely with, where potential teachers will student-teach along with participating in other activities such as community service, adult and vocational education, etc.

15.7. In order to maintain uniform standards for teacher education, the admission to pre-service teacher preparation programmes shall be through suitable subject and aptitude tests conducted by the National Testing Agency, and shall be standardized keeping in view the linguistic and cultural diversity of the country.

15.8. The faculty profile in Departments of Education will necessarily aim to be diverse and but teaching/field/research experience will be highly valued. Faculty with training in areas of social sciences that are directly relevant to school education e.g., psychology, child development, linguistics, sociology, philosophy, economics, and political science as well as from science education, mathematics education, social science education, and language education programmes will be attracted and retained in teacher education institutions, to strengthen multidisciplinary education of teachers and provide rigour in conceptual development.

15.9. All fresh Ph.D. entrants, irrespective of discipline, will be required to take credit-based courses in teaching/education/pedagogy/writing related to their chosen Ph.D subject during their doctoral training period. Exposure to pedagogical practices, designing curriculum, credible evaluation systems, communication, and so on will be ensured since many research scholars will go on to become faculty or public representatives/communicators of their chosen disciplines. Ph.D students will also have a minimum number of hours of actual teaching experience gathered through teaching assistantships and other means. Ph.D. programmes at universities around the country will be re-oriented for this purpose.

15.10. In-service continuous professional development for college and university teachers will continue through the existing institutional arrangements and ongoing initiatives; these will be strengthened and substantially expanded to meet the needs of enriched teaching-learning processes for quality education. The use of technology platforms such as SWAYAM/DIKSHA for online training of teachers will be encouraged, so that standardized training programmes can be administered to large numbers of teachers within a short span of time.

15.11. A National Mission for Mentoring shall be established, with a large pool of outstanding senior/retired faculty – including those with the ability to teach in Indian languages – who would be willing to provide short and long-term mentoring/professional support to university/college teachers.

16. Reimagining Vocational Education

16.1. The 12th Five-Year Plan (2012–2017) estimated that only a very small percentage of the Indian workforce in the age group of 19–24 (less than 5%) received formal vocational education Whereas in countries such as the USA the number is 52%, in Germany 75%, and South Korea it is as high as 96%. These numbers only underline the urgency of the need to hasten the spread of vocational education in India.

16.2. One of the primary reasons for the small numbers of students receiving vocational education is the fact that vocational education has in the past focused largely on Grades 11–12 and on dropouts in Grade 8 and upwards. Moreover, students passing out from Grades 11–12 with vocational subjects often did not have well-defined pathways to continue with their chosen vocations in higher education. The admission criteria for general higher education were also not designed to provide openings to students who had vocational education qualifications, leaving them at a disadvantage relative to their compatriots from 'mainstream' or 'academic' education. This led to a complete lack of vertical mobility for students from the vocational education stream, an issue that has only been addressed recently through the announcement of the National Skills Qualifications Framework (NSQF) in 2013.

16.3. Vocational education is perceived to be inferior to mainstream education and meant largely for students who are unable to cope with the latter. This is a perception that affects the choices students make. It is a serious concern that can only be dealt with by a complete re-imagination of how vocational education is offered to students in the future.

16.4. This policy aims to overcome the social status hierarchy associated with vocational education and requires integration of vocational education programmes into mainstream education in all education institutions in a phased manner. Beginning with vocational exposure at early ages in middle and secondary school, quality vocational education will be integrated smoothly into higher education. It will ensure that every child learns at least one vocation and is exposed to several more. This would lead to emphasizing the dignity of labour and importance of various vocations involving /Indian arts and artisanship.

16.5. By 2025, at least 50% of learners through the school and higher education system shall have exposure to vocational education, for which a clear action plan with targets and timelines will be developed. This is in alignment with Sustainable Development Goal 4.4 and will help to realize the full potential of India's demographic dividend. The number of students in vocational education will be considered while arriving at the GER targets. The development of vocational capacities will go hand-in-hand with the development of 'academic' or other capacities. Vocational education will be integrated in the educational offerings of all secondary schools in a phased manner over the next decade. Towards this, secondary schools will also collaborate with ITIs, polytechnics, local industry, etc. Skill labs will also be set up and created in the schools in a hub and spoke model which will allow other schools to use the facility. Higher education institutions will offer vocational education either on their own or in partnership with industry and NGOs. The B.Voc. degrees introduced in 2013 will continue to exist, but vocational courses will also be available to students enrolled in all other Bachelor's degree programmes, including the 4-year multidisciplinary Bachelor's programmes. HEIs will also be allowed to conduct short-term certificate courses in various skills including soft skills. 'Lok Vidya', i.e., important vocational knowledge developed in India, will be made accessible to students through integration into vocational education courses. The possibility of offering vocational courses through ODL mode will also be explored.

16.6. Vocational education will be integrated into all school and higher education institutions in a phased manner over the next decade. Focus areas for vocational education will be chosen based on skills gap analysis and mapping of local opportunities. MHRD will constitute a National Committee for the Integration of Vocational Education (NCIVE), consisting of experts in vocational education and representatives from across Ministries, in collaboration with industry, to oversee this effort.

16.7. Individual institutions that are early adopters must innovate to find models and practices that work and then share these with other institutions through mechanisms set up by NCIVE, so as to help extend the reach of vocational education. Different models of vocational education, and apprenticeships, will also be experimented by higher education institutions. Incubation centres will be set up in higher education institutions in partnership with industries.

16.8. The National Skills Qualifications Framework will be detailed further for each discipline vocation and profession. Further, Indian standards will be aligned with the International Standard Classification of Occupations maintained by the International Labour Organization. This Framework will provide the basis for Recognition of Prior Learning. Through this, dropouts from the formal

system will be reintegrated by aligning their practical experience with the relevant level of the Framework. The credit-based Framework will also facilitate mobility across 'general' and vocational education.

17. Catalysing Quality Academic Research in All Fields through a new National Research Foundation

17.1. Knowledge creation and research are critical in growing and sustaining a large and vibrant economy, uplifting society, and continuously inspiring a nation to achieve even greater heights. Indeed, some of the most prosperous civilizations (such as India, Mesopotamia, Egypt, and Greece) to the modern era (such as the United States, Germany, Israel, South Korea, and Japan), were/are strong knowledge societies that attained intellectual and material wealth in large part through celebrated and fundamental contributions to new knowledge in the realm of science as well as art, language, and culture that enhanced and uplifted not only their own civilizations but others around the globe.

17.2. A robust ecosystem of research is perhaps more important than ever with the rapid changes occurring in the world today, e.g., in the realm of climate change, population dynamics and management, biotechnology, an expanding digital marketplace, and the rise of machine learning and artificial intelligence. If India is to become a leader in these disparate areas, and truly achieve the potential of its vast talent pool to again become a leading knowledge society in the coming years and decades, the nation will require a significant expansion of its research capabilities and output across disciplines. Today, the criticality of research is more than ever before, for the economic, intellectual, societal, environmental, and technological health and progress of a nation.

17.3. Despite this critical importance of research, the research and innovation investment in India is, at the current time, only 0.69% of GDP as compared to 2.8% in the United States of America, 4.3% in Israel and 4.2% in South Korea.

17.4. The societal challenges that India needs to address today, such as access for all its citizens to clean drinking water and sanitation, quality education and healthcare, improved transportation, air quality, energy, and infrastructure, will require the implementation of approaches and solutions that are not only informed by top-notch science and technology but are also rooted in a deep understanding of the social sciences and humanities and the various socio-cultural and environmental dimensions of the nation. Facing and addressing these challenges will require high-quality interdisciplinary research across fields that must be done in India and cannot simply be imported; the ability to conduct one's own research also enables a country to much more easily import and adapt relevant research from abroad.

17.5. Furthermore, in addition to their value in solutions to societal problems, any country's identity, upliftment, spiritual/intellectual satisfaction and creativity is also attained in a major way through its history, art, language, and culture. Research in the arts and humanities, along with innovations in the sciences and social sciences, are, therefore, extremely important for the progress and enlightened nature of a nation.

17.6. Research and innovation at education institutions in India, particularly those that are engaged in higher education, is critical. Evidence from the world′s best universities throughout history shows that the best teaching and learning processes at the higher education level occur in environments where there is also a strong culture of research and knowledge creation; conversely, much of the very best research in the world has occurred in multidisciplinary university settings.

17.7. India has a long historical tradition of research and knowledge creation, in disciplines ranging from science and mathematics to art and literature to phonetics and languages to medicine and agriculture. This needs to be further strengthened to make India lead research and innovation in the

21st century, as a strong and enlightened knowledge society and one of the three largest economies in the world.

17.8. Thus, this Policy envisions a comprehensive approach to transforming the quality and quantity of research in India. This includes definitive shifts in school education to a more play and discovery-based style of learning with emphasis on the scientific method and critical thinking. This includes career counselling in schools towards identifying student interests and talents, promoting research in universities, the multidisciplinary nature of all HEIs and the emphasis on holistic education, the inclusion of research and internships in the undergraduate curriculum, faculty career management systems that give due weightage to research, and the governance and regulatory changes that encourage an environment of research and innovation. All of these aspects are extremely critical for developing a research mindset in the country.

17.9. To build on these various elements in a synergistic manner, and to thereby truly grow and catalyze quality research in the nation, this policy envisions the establishment of a National Research Foundation (NRF). The overarching goal of the NRF will be to enable a culture of research to permeate through our universities. In particular, the NRF will provide a reliable base of merit-based but equitable peer-reviewed research funding, helping to develop a culture of research in the country through suitable incentives for and recognition of outstanding research, and by undertaking major initiatives to seed and grow research at State Universities and other public institutions where research capability is currently limited. The NRF will competitively fund research in all disciplines. Successful research will be recognized, and where relevant, implemented through close linkages with governmental agencies as well as with industry and private/philanthropic organizations.

17.10. Institutions that currently fund research at some level, such as the Department of Science and Technology (DST), Department of Atomic Energy (DAE), Department of Bio-Technology (DBT), Indian Council of Agriculture Research (ICAR), Indian Council of Medical Research (ICMR), Indian Council of Historical Research (ICHR), and University Grants Commission (UGC), as well as various private and philanthropic organizations, will continue to independently fund research according to their priorities and needs. However, NRF will carefully coordinate with other funding agencies and will work with science, engineering, and other academies to ensure synergy of purpose and avoid duplication of efforts. The NRF will be governed, independently of the government, by a rotating Board of Governors consisting of the very best researchers and innovators across fields.

17.11. The primary activities of the NRF will be to:

(a) fund competitive, peer-reviewed grant proposals of all types and across all disciplines;
(b) seed, grow, and facilitate research at academic institutions, particularly at universities and colleges where research is currently in a nascent stage, through mentoring of such institutions;
(c) act as a liaison between researchers and relevant branches of government as well as industry, so that research scholars are constantly made aware of the most urgent national research issues, and so that policymakers are constantly made aware of the latest research breakthroughs; so as to allow breakthroughs to be optimally brought into policy and/or implementation; and
(d) recognise outstanding research and progress

18. Transforming the Regulatory System of Higher Education

18.1. Regulation of higher education has been too heavy-handed for decades; too much has been attempted to be regulated with too little effect. The mechanistic and disempowering nature of the regulatory system has been rife with very basic problems, such as heavy concentrations of power within a few bodies, conflicts of interest among these bodies, and a resulting lack of accountability. The regulatory system is in need of a complete overhaul in order to re-energize the higher education sector and enable it to thrive.

18.2. To address the above-mentioned issues, the regulatory system of higher education will ensure that the distinct functions of regulation, accreditation, funding, and academic standard setting will be performed by distinct, independent, and empowered bodies. This is considered essential to create checks-and-balances in the system, minimize conflicts of interest, and eliminate concentrations of power. To ensure that the four institutional structures carrying out these four essential functions work independently yet at the same time and work in synergy towards common goals. These four structures will be set up as four independent verticals within one umbrella institution, the Higher Education Commission of India (HECI).

18.3. The first vertical of HECI will be the National Higher Education Regulatory Council (NHERC). It will function as the common, single point regulator for the higher education sector including teacher education and excluding medical and legal education, thus eliminating the duplication and disjunction of regulatory efforts by the multiple regulatory agencies that exist at the current time. It will require a relook and repealing of existing Acts and restructuring of various existing regulatory bodies to enable this single point regulation. NHERC will be set up to regulate in a 'light but tight' and facilitative manner, meaning that a few important matters particularly financial probity, good governance, and the full online and offline public self-disclosure of all finances, audits, procedures, infrastructure, faculty/staff, courses, and educational outcomes will be very effectively regulated. This information will have to be made available and kept updated and accurate by all higher education institutions on a public website maintained by NHERC and on the institutions' websites. Any complaints or grievances from stakeholders and others arising out of the information placed in public domain shall be adjudicated by NHERC. Feedback from randomly selected students including differently-abled students at each HEI will be solicited online to ensure valuable input at regular intervals.

18.4. The primary mechanism to enable such regulation will be accreditation. The second vertical of HECI will, therefore, be a 'meta-accrediting body', called the National Accreditation Council (NAC). Accreditation of institutions will be based primarily on basic norms, public self-disclosure, good governance, and outcomes, and it will be carried out by an independent ecosystem of accrediting institutions supervised and overseen by NAC. The task to function as a recognized accreditor shall be awarded to an appropriate number of institutions by NAC. In the short term, a robust system of graded accreditation shall be established, which will specify phased benchmarks for all HEIs to achieve set levels of quality, self-governance, and autonomy. In turn, all HEIs will aim, through their Institutional Development Plans (IDPs), to attain the highest level of accreditation over the next 15 years, and thereby eventually aim to function as self-governing degree-granting institutions/clusters. In the long run, accreditation will become a binary process, as per the extant global practice.

18.5. The third vertical of HECI will be the Higher Education Grants Council (HEGC), which will carry out funding and financing of higher education based on transparent criteria, including the IDPs prepared by the institutions and the progress made on their implementation. HEGC will be entrusted with the disbursement of scholarships and developmental funds for launching new focus areas and expanding quality programme offerings at HEIs across disciplines and fields.

18.6. The fourth vertical of HECI will be the General Education Council (GEC), which will frame expected learning outcomes for higher education programmes, also referred to as 'graduate attributes'. A National Higher Education Qualification Framework (NHEQF) will be formulated by the GEC and it shall be in sync with the National Skills Qualifications Framework (NSQF) to ease the integration of vocational education into higher education. Higher education qualifications leading to a degree/diploma/certificate shall be described by the NHEQF in terms of such learning outcomes. In addition, the GEC shall set up facilitative norms for issues, such as credit transfer, equivalence, etc., through the NHEQF. The GEC will be mandated to identify specific skills that students must acquire during their academic programmes, with the aim of preparing well-rounded learners with 21st century skills.

18.7. The professional councils, such as the Indian Council for Agricultural Research (ICAR), Veterinary Council of India (VCI), National Council for Teacher Education (NCTE), Council of Architecture (CoA), National Council for Vocational Education and Training (NCVET) etc., will act

as Professional Standard Setting Bodies (PSSBs). They will play a key role in the higher education system and will be invited to be members of the GEC. These bodies, after restructuring as PSSBs, will continue to draw the curricula, lay down academic standards and coordinate between teaching, research and extension of their domain/discipline, as members of the GEC. As members of the GEC, they would help in specifying the curriculum framework, within which HEIs may prepare their own curricula. Thus, PSSBs would also set the standards or expectations in particular fields of learning and practice while having no regulatory role. All HEIs will decide how their educational programmes respond to these standards, among other considerations, and would also be able to reach out for support from these standard-setting bodies or PSSBs, if needed.

18.8. Such a system architecture will ensure the principle of functional separation by eliminating conflicts of interests between different roles. It will also aim to empower HEIs, while ensuring that the few key essential matters are given due attention. Responsibility and accountability shall devolve to the HEIs concomitantly. No distinction in such expectations shall be made between public and private HEIs.

18.9. Such a transformation will require existing structures and institutions to reinvent themselves and undergo an evolution of sorts. The separation of functions would mean that each vertical within HECI would take on a new, single role which is relevant, meaningful, and important in the new regulatory scheme.

18.10. The functioning of all the independent verticals for Regulation (NHERC), Accreditation (NAC), Funding (HEGC), and Academic Standard Setting (GEC) and the overarching autonomous umbrella body (HECI) itself will be based on transparent public disclosure, and use technology extensively to reduce human interface to ensure efficiency and transparency in their work. The underlying principle will be that of a faceless and transparent regulatory intervention using technology. Strict compliance measures with stringent action, including penalties for false disclosure of mandated information, will be ensured so that Higher Education Institutions are conforming to the basic minimum norms and standards. HECI itself will be resolving disputes among the four verticals. Each vertical in HECI will be an independent body consisting of persons having high expertise in the relevant areas along with integrity, commitment, and a demonstrated track record of public service. HECI itself will be a small, independent body of eminent public-spirited experts in higher education, which will oversee and monitor the integrity and effective functioning of HECI. Suitable mechanisms will be created within HECI to carry out its functions, including adjudication.

18.11. Setting up new quality HEIs will also be made far easier by the regulatory regime, while ensuring with great effectiveness that these are set up with the spirit of public service and with due financial backing for long-term stability. HEIs performing exceptionally well will be helped by Central and State governments to expand their institutions, and thereby attain larger numbers of students and faculty as well as disciplines and programmes. Public Philanthropic Partnership models for HEIs may also be piloted with the aim to further expand access to high-quality higher education.

Curbing Commercialization of Education

18.12. Multiple mechanisms with checks and balances will combat and stop the commercialization of higher education. This will be a key priority of the regulatory system. All education institutions will be held to similar standards of audit and disclosure as a 'not for profit' entity. Surpluses, if any, will be reinvested in the educational sector. There will be transparent public disclosure of all these financial matters with recourse to grievance-handling mechanisms to the general public. The accreditation system developed by NAC will provide a complementary check on this system, and NHERC will consider this as one of the key dimensions of its regulatory objective.

18.13. All HEIs - public and private - shall be treated on par within this regulatory regime. The regulatory regime shall encourage private philanthropic efforts in education. There will be common national guidelines for all legislative Acts that will form private HEIs. These common minimal guidelines will enable all such Acts to establish private HEIs, thus enabling common standards for

private and public HEIs. These common guidelines will cover Good Governance, Financial Stability & Security, Educational Outcomes, and Transparency of Disclosures.

18.14. Private HEIs having a philanthropic and public-spirited intent will be encouraged through a progressive regime of fees determination. Transparent mechanisms for fixing of fees with an upper limit, for different types of institutions depending on their accreditation, will be developed so that individual institutions are not adversely affected. This will empower private HEIs to set fees for their programmes independently, though within the laid-out norms and the broad applicable regulatory mechanism. Private HEIs will be encouraged to offer freeships and scholarships in significant numbers to their students. All fees and charges set by private HEIs will be transparently and fully disclosed, and there shall be no arbitrary increases in these fees/charges during the period of enrolment of any student. This fee determining mechanism will ensure reasonable recovery of cost while ensuring that HEIs discharge their social obligations.

19. Effective Governance and Leadership for Higher Education Institutions

19.1. It is effective governance and leadership that enables the creation of a culture of excellence and innovation in higher education institutions. The common feature of all world-class institutions globally including India has indeed been the existence of strong self-governance and outstanding merit-based appointments of institutional leaders.

19.2. Through a suitable system of graded accreditation and graded autonomy, and in a phased manner over a period of 15 years, all HEIs in India will aim to become independent self-governing institutions pursuing innovation and excellence. Measures will be taken at all HEIs to ensure leadership of the highest quality and promote an institutional culture of excellence. Upon receiving the appropriate graded accreditations that deem the institution ready for such a move, a Board of Governors (BoG) shall be established consisting of a group of highly qualified, competent, and dedicated individuals having proven capabilities and a strong sense of commitment to the institution. The BoG of an institution will be empowered to govern the institution free of any external interference, make all appointments including that of head of the institution, and take all decisions regarding governance. There shall be overarching legislation that will supersede any contravening provisions of other earlier legislation and would provide for constitution, appointment, modalities of functioning, rules and regulations, and the roles and responsibilities of the BoG. New members of the Board shall be identified by an expert committee appointed by the Board; and the selection of new members shall be carried out by the BoG itself. Equity considerations will also be taken care of while selecting the members. It is envisaged that all HEIs will be incentivized, supported, and mentored during this process, and shall aim to become autonomous and have such an empowered BoG by 2035.

19.3. The BoG shall be responsible and accountable to the stakeholders through transparent self-disclosures of all relevant records. It will be responsible for meeting all regulatory guidelines mandated by HECI through the National Higher Education Regulatory Council (NHERC).

19.4. All leadership positions and Heads of institutions will be offered to persons with high academic qualifications and demonstrated administrative and leadership capabilities along with abilities to manage complex situations. Leaders of an HEI will demonstrate strong alignment to Constitutional values and the overall vision of the institution, along with attributes such as a strong social commitment, belief in teamwork, pluralism, ability to work with diverse people, and a positive outlook. The selection shall be carried out by the BoG through a rigorous, impartial, merit-based, and competency-based process led by an Eminent Expert Committee (EEC) constituted by the BoG. While stability of tenure is important to ensure the development of a suitable culture, at the same time leadership succession will be planned with care to ensure that good practices that define an institution's processes do not end due to a change in leadership; leadership changes will come with sufficient overlaps, and not remain vacant, in order to ensure smooth transitions. Outstanding leaders will be identified and developed early, working their way through a ladder of leadership positions.

19.5. While being provided with adequate funding, legislative enablement, and autonomy in a phased manner, all HEIs, in turn, will display commitment to institutional excellence, engagement with their

local communities, and the highest standards of financial probity and accountability. Each institution will make a strategic Institutional Development Plan on the basis of which institutions will develop initiatives, assess their own progress, and reach the goals set therein, which could then become the basis for further public funding. The IDP shall be prepared with the joint participation of Board members, institutional leaders, faculty, students, and staff.

Part III. OTHER KEY AREAS OF FOCUS

20. Professional Education

20.1. Preparation of professionals must involve an education in the ethic and importance of public purpose, an education in the discipline, and an education for practice. It must centrally involve critical and interdisciplinary thinking, discussion, debate, research, and innovation. For this to be achieved, professional education should not take place in the isolation of one's specialty.

20.2. Professional education thus becomes an integral part of the overall higher education system. Stand-alone agricultural universities, legal universities, health science universities, technical universities, and stand-alone institutions in other fields, shall aim to become multidisciplinary institutions offering holistic and multidisciplinary education. All institutions offering either professional or general education will aim to organically evolve into institutions/clusters offering both seamlessly, and in an integrated manner by 2030.

20.3. Agricultural education with allied disciplines will be revived. Although Agricultural Universities comprise approximately 9% of all universities in the country, enrolment in agriculture and allied sciences is less than 1% of all enrolment in higher education. Both capacity and quality of agriculture and allied disciplines must be improved in order to increase agricultural productivity through better skilled graduates and technicians, innovative research, and market-based extension linked to technologies and practices. The preparation of professionals in agriculture and veterinary sciences through programmes integrated with general education will be increased sharply. The design of agricultural education will shift towards developing professionals with the ability to understand and use local knowledge, traditional knowledge, and emerging technologies while being cognizant of critical issues such as declining land productivity, climate change, food sufficiency for our growing population, etc. Institutions offering agricultural education must benefit the local community directly; one approach could be to set up Agricultural Technology Parks to promote technology incubation and dissemination and promote sustainable methodologies.

20.4. Legal education needs to be competitive globally, adopting best practices and embracing new technologies for wider access to and timely delivery of justice. At the same time, it must be informed and illuminated with Constitutional values of Justice - Social, Economic, and Political - and directed towards national reconstruction through instrumentation of democracy, rule of law, and human rights. The curricula for legal studies must reflect socio-cultural contexts along with, in an evidence-based manner, the history of legal thinking, principles of justice, the practice of jurisprudence, and other related content appropriately and adequately. State institutions offering law education must consider offering bilingual education for future lawyers and judges - in English and in the language of the State in which the institution is situated.

20.5. Healthcare education needs to be re-envisioned so that the duration, structure, and design of the educational programmes need to match the role requirements that graduates will play. Students will be assessed at regular intervals on well-defined parameters primarily required for working in primary care and in secondary hospitals. Given that people exercise pluralistic choices in healthcare, our healthcare education system must be integrative meaning thereby that all students of allopathic medical education must have a basic understanding of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy (AYUSH), and vice versa. There shall also be a much greater emphasis on preventive healthcare and community medicine in all forms of healthcare education.

20.6. Technical education includes degree and diploma programmes in, engineering, technology, management, architecture, town planning, pharmacy, hotel management, catering technology etc., which are critical to India's overall development. There will not only be a greater demand for well-qualified manpower in these sectors, it will also require closer collaborations between industry and higher education institutions to drive innovation and research in these fields. Furthermore, influence of technology on human endeavours is expected to erode the silos between technical education and other disciplines too. Technical education will, thus, also aim to be offered within multidisciplinary education institutions and programmes and have a renewed focus on opportunities to engage deeply with other disciplines. India must also take the lead in preparing professionals in cutting-edge areas that are fast gaining prominence, such as Artificial Intelligence (AI), 3-D machining, big data analysis, and machine learning, in addition to genomic studies, biotechnology, nanotechnology, neuroscience, with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

21. Adult Education and Lifelong Learning

21.1. The opportunity to attain foundational literacy, obtain an education, and pursue a livelihood must be viewed as basic rights of every citizen. Literacy and basic education open up whole new worlds of personal, civic, economic, and lifelong-learning opportunities for individuals that enable them to progress personally and professionally. At the level of society and the nation, literacy and basic education are powerful force multipliers which greatly enhance the success of all other developmental efforts. Worldwide data on nations indicate extremely high correlations between literacy rates and per capita GDP.

21.2. Meanwhile, being a non-literate member of a community, has innumerable disadvantages, including the inability to: carry out basic financial transactions; compare the quality/quantity of goods purchased against the price charged; fill out forms to apply for jobs, loans, services, etc.; comprehend public circulars and articles in the news media; use conventional and electronic mail to communicate and conduct business; make use of the internet and other technology to improve one's life and profession; comprehend directions and safety directives on the street, on medicines, etc.; help children with their education; be aware of one's basic rights and responsibilities as a citizen of India; appreciate works of literature; and pursue employment in medium or high-productivity sectors that require literacy. The abilities listed here are an illustrative list of outcomes to be achieved through adoption of innovative measures for Adult Education.

21.3. Extensive field studies and analyses, both in India and across the world, clearly demonstrate that volunteerism and community involvement and mobilization are key success factors of adult literacy programmes, in conjunction with political will, organizational structure, proper planning, adequate financial support, and high-quality capacity building of educators and volunteers. Successful literacy programmes result not only in the growth of literacy among adults, but also result in increased demand for education for all children in the community, as well as greater community contribution to positive social change. The National Literacy Mission, when it was launched in 1988, was largely based on the voluntary involvement and support of the people, and resulted in significant increases in national literacy during the period of 1991–2011, including among women, and also initiated dialogue and discussions on pertinent social issues of the day.

21.4. Strong and innovative government initiatives for adult education - in particular, to facilitate community involvement and the smooth and beneficial integration of technology - will be affected as soon as possible to expedite this all-important aim of achieving 100% literacy.

21.5. First, an outstanding adult education curriculum framework will be developed by a new and well-supported constituent body of the NCERT that is dedicated to adult education, so as to develop synergy with and build upon NCERT's existing expertise in establishing outstanding curricula for literacy, numeracy, basic education, vocational skills, and beyond. The curriculum framework for adult education will include at least five types of programmes, each with clearly defined outcomes: (a) foundational literacy and numeracy; (b) critical life skills (including financial literacy, digital literacy, commercial skills, health care and awareness, child care and education, and family welfare);

(c) vocational skills development (with a view towards obtaining local employment); (d) basic education (including preparatory, middle, and secondary stage equivalency); and (e) continuing education (including engaging holistic adult education courses in arts, sciences, technology, culture, sports, and recreation, as well as other topics of interest or use to local learners, such as more advanced material on critical life skills). The framework would keep in mind that adults in many cases will require rather different teaching-learning methods and materials than those designed for children.

21.6. Second, suitable infrastructure will be ensured so that all interested adults will have access to adult education and lifelong learning. A key initiative in this direction will be to use schools/ school complexes after school hours and on weekends and public library spaces for adult education courses which will be ICT-equipped when possible and for other community engagement and enrichment activities. The sharing of infrastructure for school, higher, adult, and vocational education, and for other community and volunteer activities, will be critical for ensuring efficient use of both physical and human resources as well as for creating synergy among these five types of education and beyond. For these reasons, Adult Education Centres (AECs) could also be included within other public institutions such as HEIs, vocational training centres, etc.

21.7. Third, the instructors/educators will be required to deliver the curriculum framework to mature learners for all five types of adult education as described in the Adult Education Curriculum Framework. These instructors will be trained by the National, State, and district level resource support institutions to organize and lead learning activities at Adult Education Centres, as well as coordinate with volunteer instructors. Qualified community members including from HEIs as part of each HEI's mission to engage with their local communities will be encouraged and welcomed to take a short training course and volunteer, as adult literacy instructors, or to serve as one-on-one volunteer tutors, and will be recognized for their critical service to the nation. States will also work with NGOs and other community organizations to enhance efforts towards literacy and adult education.

21.8. Fourth, all efforts will be undertaken to ensure the participation of community members in adult education. Social workers/counsellors travelling through their communities to track and ensure participation of non-enrolled students and dropouts will also be requested, during their travels, to gather data of parents, adolescents, and others interested in adult education opportunities both as learners and as teachers/tutors. The social workers/counsellors will then connect them with local Adult Education Centres (AECs). Opportunities for adult education will also be widely publicized, through advertisements and announcements and through events and initiatives of NGOs and other local organizations.

21.9. Fifth, improving the availability and accessibility of books is essential to inculcating the habit of reading within our communities and educational institutions. This Policy recommends that all communities and educational institutions - schools, colleges, universities and public libraries - will be strengthened and modernized to ensure an adequate supply of books that cater to the needs and interests of all students, including persons with disabilities and other differently-abled persons. The Central and State governments will take steps to ensure that books are made accessible and affordable to all across the country including socio-economically disadvantaged areas as well as those living in rural and remote areas. Both public and private sector agencies/institutions will devise strategies to improve the quality and attractiveness of books published in all Indian languages. Steps will be taken to enhance online accessibility of library books and further broad basing of digital libraries. For ensuring vibrant libraries in communities and educational institutions, it will be imperative to make available adequate library staff and also devise appropriate career pathways and CPD for them. Other steps will include strengthening all existing libraries, setting up rural libraries and reading rooms in disadvantaged regions, making widely available reading material in Indian languages, opening children's libraries and mobile libraries, establishing social book clubs across India and across subjects, and fostering greater collaborations between education institutions and libraries.

21.10. Finally, technology will be leveraged to strengthen and even undertake the above initiatives. Quality technology-based options for adult learning such as apps, online courses/modules, satellite-based TV channels, online books, and ICT-equipped libraries and Adult Education Centres, etc. will

be developed, through government and philanthropic initiatives as well as through crowd sourcing and competitions. In many cases, quality adult education could thereby be conducted in an online or blended mode.

22. Promotion of Indian Languages, Arts, and Culture

22.1. India is a treasure trove of culture, developed over thousands of years and manifested in the form of arts, works of literature, customs, traditions, linguistic expressions, artefacts, heritage sites, and more. Crores of people from around the world partake in, enjoy, and benefit from this cultural wealth daily, in the form of visiting India for tourism, experiencing Indian hospitality, purchasing India's handicrafts and handmade textiles, reading the classical literature of India, practicing yoga and meditation, being inspired by Indian philosophy, participating in India's unique festivals, appreciating India's diverse music and art, and watching Indian films, amongst many other aspects. It is this cultural and natural wealth that truly makes India, "Incredible !ndia", as per India's tourism slogan. The preservation and promotion of India's cultural wealth must be considered a high priority for the country, as it is truly important for the nation's identity as well as for its economy.

22.2. The promotion of Indian arts and culture is important not only for the nation but also for the individual. Cultural awareness and expression are among the major competencies considered important to develop in children, in order to provide them with a sense of identity, belonging, as well as an appreciation of other cultures and identities. It is through the development of a strong sense and knowledge of their own cultural history, arts, languages, and traditions that children can build a positive cultural identity and self-esteem. Thus, cultural awareness and expression are important contributors both to individual as well as societal well-being.

22.3. The arts form a major medium for imparting culture. The arts - besides strengthening cultural identity, awareness, and uplifting societies - are well known to enhance cognitive and creative abilities in individuals and increase individual happiness. The happiness/well-being, cognitive development, and cultural identity of individuals are important reasons that Indian arts of all kinds must be offered to students at all levels of education, starting with early childhood care and education.

22.4. Language, of course, is inextricably linked to art and culture. Different languages 'see' the world differently, and the structure of a language, therefore, determines a native speaker's perception of experience. In particular, languages influence the way people of a given culture speak with others, including with family members, authority figures, peers, and strangers, and influence the tone of conversation. The tone, perception of experience, and familiarity/'*apnapan*' inherent in conversations among speakers of a common language are a reflection and record of a culture. Culture is, thus, encased in our languages. Art, in the form of literature, plays, music, film, etc. cannot be fully appreciated without language. In order to preserve and promote culture, one must preserve and promote a culture's languages.

22.5. Unfortunately, Indian languages have not received their due attention and care, with the country losing over 220 languages in the last 50 years alone. UNESCO has declared 197 Indian languages as 'endangered'. Various unscripted languages are particularly in danger of becoming extinct. When senior member(s) of a tribe or community that speak such languages pass away, these languages often perish with them; too often, no concerted actions or measures are taken to preserve or record these rich languages/expressions of culture.

22.6. Moreover, even those languages of India that are not officially on such endangered lists, such as the 22 languages of Eighth Schedule of the Constitution of India, are facing serious difficulties on many fronts. Teaching and learning of Indian languages need to be integrated with school and higher education at every level. For languages to remain relevant and vibrant, there must be a steady stream of high-quality learning and print materials in these languages including textbooks, workbooks, videos, plays, poems, novels, magazines, etc. Languages must also have consistent official updates to their vocabularies and dictionaries, widely disseminated, so that the most current issues and concepts can be effectively discussed in these languages. Enabling such learning materials, print materials, and

translations of important materials from world languages, and constantly updating vocabularies, are carried out by countries around the world for languages such as English, French, German, Hebrew, Korean, and Japanese. However, India has remained quite slow in producing such learning and print materials and dictionaries to help keep its languages optimally vibrant and current with integrity.

22.7. Additionally, there has been a severe scarcity of skilled language teachers in India, despite various measures being taken. Language-teaching too must be improved to be more experiential and to focus on the ability to converse and interact in the language and not just on the literature, vocabulary, and grammar of the language. Languages must be used more extensively for conversation and for teaching-learning.

22.8. A number of initiatives to foster languages, arts, and culture in school children have been discussed in Chapter 4, which include a greater emphasis on music, arts, and crafts throughout all levels of school; early implementation of the three-language formula to promote multilingualism; teaching in the home/local language wherever possible; conducting more experiential language learning; the hiring of outstanding local artists, writers, craftspersons, and other experts as master instructors in various subjects of local expertise; accurate inclusion of traditional Indian knowledge including tribal and other local knowledge throughout into the curriculum, across humanities, sciences, arts, crafts, and sports, whenever relevant; and a much greater flexibility in the curriculum, especially in secondary schools and in higher education, so that students can choose the ideal balance among courses for themselves to develop their own creative, artistic, cultural, and academic paths.

22.9. To enable the key latter initiatives, a number of further actions will be taken in tandem at the higher education level and beyond. First, to develop and teach many of the courses of the type mentioned above, an excellent team of teachers and faculty will have to be developed. Strong departments and programmes in Indian languages, comparative literature, creative writing, arts, music, philosophy, etc. will be launched and developed across the country, and degrees including 4-year B.Ed. dual degrees will be developed in these subjects. These departments and programmes will, in particular help to develop a large cadre of high-quality language teachers - as well as teachers of art, music, philosophy and writing - who will be needed around the country to carry out this Policy. The NRF will fund quality research in all these areas. Outstanding local artists and craftspersons will be hired as guest faculty to promote local music, art, languages, and handicraft, and to ensure that students are aware of the culture and local knowledge where they study. Every higher education institution and even every school or school complex will aim to have Artist(s)-in-Residence to expose students to art, creativity, and the rich treasures of the region/country.

22.10. More HEIs, and more programmes in higher education, will use the mother tongue/local language as a medium of instruction, and/or offer programmes bilingually, in order to increase access and GER and also to promote the strength, usage, and vibrancy of all Indian languages. Private HEIs too will be encouraged and incentivized to use Indian languages as medium of instruction and/or offer bilingual programmes. Four-year B.Ed. dual degree programmes offered bilingually will also help, e.g. in training cadres of science and mathematics teachers to teach science bilingually at schools across the country.

22.11. High-quality programmes and degrees in Translation and Interpretation, Art and Museum Administration, Archaeology, Artefact Conservation, Graphic Design, and Web Design within the higher education system will also be created. In order to preserve and promote its art and culture, develop high-quality materials in various Indian languages, conserve artefacts, develop highly qualified individuals to curate and run museums and heritage or tourist sites, thereby also vastly strengthening the tourism industry.

22.12. The Policy recognizes that the knowledge of the rich diversity of India should be imbibed first hand by learners. This would mean including simple activities, like touring by students to different parts of the country, which will not only give a boost to tourism but will also lead to an understanding and appreciation of diversity, culture, traditions and knowledge of different parts of India. Towards this direction under '*Ek Bharat Shrestha Bharat*', 100 tourist destinations in the country will be identified where educational institutions will send students to study these destinations and their

history, scientific contributions, traditions, indigenous literature and knowledge, etc., as a part of augmenting their knowledge about these areas.

22.13. Creating such programmes and degrees in higher education, across the arts, languages, and humanities, will also come with expanded high-quality opportunities for employment that can make effective use of these qualifications. There are already hundreds of Academies, museums, art galleries, and heritage sites in dire need of qualified individuals for their effective functioning. As positions are filled with suitably qualified candidates, and further artefacts are procured and conserved, additional museums, including virtual museums/e-museums, galleries, and heritage sites may contribute to the conservation of our heritage as well as to India's tourism industry.

22.14. India will also urgently expand its translation and interpretation efforts in order to make high-quality learning materials and other important written and spoken material available to the public in various Indian and foreign languages. For this, an Indian Institute of Translation and Interpretation (IITI) will be established. Such an institute would provide a truly important service for the country, as well as employ numerous multilingual language and subject experts, and experts in translation and interpretation, which will help to promote all Indian languages. The IITI shall also make extensive use of technology to aid in its translation and interpretation efforts. The IITI could naturally grow with time, and be housed in multiple locations including in HEIs to facilitate collaborations with other research departments as demand and the number of qualified candidates grows.

22.15. Due to its vast and significant contributions and literature across genres and subjects, its cultural significance, and its scientific nature, rather than being restricted to single-stream Sanskrit Pathshalas and Universities, Sanskrit will be mainstreamed with strong offerings in school - including as one of the language options in the three-language formula - as well as in higher education. It will be taught not in isolation, but in interesting and innovative ways, and connected to other contemporary and relevant subjects such as mathematics, astronomy, philosophy, linguistics, dramatics, yoga, etc. Thus, in consonance with the rest of this policy, Sanskrit Universities too will move towards becoming large multidisciplinary institutions of higher learning. Departments of Sanskrit that conduct teaching and outstanding interdisciplinary research on Sanskrit and Sanskrit Knowledge Systems will be established/strengthened across the new multidisciplinary higher education system. Sanskrit will become a natural part of a holistic multidisciplinary higher education if a student so chooses. Sanskrit teachers in large numbers will be professionalized across the country in mission mode through the offering of 4-year integrated multidisciplinary B.Ed. dual degrees in education and Sanskrit.

22.16. India will similarly expand its institutes and universities studying all classical languages and literature, with strong efforts to collect, preserve, translate, and study the tens of thousands of manuscripts that have not yet received their due attention. Sanskrit and all Indian language institutes and departments across the country will be significantly strengthened, with adequate training given to large new batches of students to study, in particular, the large numbers of manuscripts and their interrelations with other subjects. Classical language institutes will aim to be merged with universities, while maintaining their autonomy, so that faculty may work, and students too may be trained as part of robust and rigorous multidisciplinary programmes. Universities dedicated to languages will become multidisciplinary, towards the same end; where relevant, they may then also offer B.Ed. dual degrees in education and a language, to develop outstanding language teachers in that language. Further, it is also proposed that a new institution for Languages will be established. National Institute (or Institutes) for Pali, Persian and Prakrit will also be set up within a university campus. Similar initiatives will be carried out for institutes and universities studying Indian arts, art history, and Indology. Research for outstanding work in all these areas will be supported by the NRF.

22.17. Efforts to preserve and promote all Indian languages including classical, tribal and endangered languages will be taken on with new vigour. Technology and crowdsourcing, with extensive participation of the people, will play a crucial role in these efforts.

22.18. For each of the languages mentioned in the Eighth Schedule of the Constitution of India, Academies will be established consisting of some of the greatest scholars and native speakers to

determine simple yet accurate vocabulary for the latest concepts, and to release the latest dictionaries on a regular basis (analogous to the successful efforts for many other languages around the world). The Academies would also consult with each other, and in some cases take the best suggestions from the public, in order to construct these dictionaries attempting to adopt common words whenever possible. These dictionaries would be widely disseminated, for use in education, journalism, writing, speechmaking, and beyond, and would be available on the web as well as in book form. These Academies for Eighth Schedule languages will be established by the Central Government in consultation or collaboration with State Governments. Academies for other highly spoken Indian languages may also be similarly established by the Centre and/or States.

22.19. All languages in India, and their associated arts and culture will be documented through a web-based platform/portal/wiki, in order to preserve endangered and all Indian languages and their associated rich local arts and culture. The platform will contain videos, dictionaries, recordings, and more, of people (especially elders) speaking the language, telling stories, reciting poetry, and performing plays, folk songs and dances, and more. People from across the country will be invited to contribute to these efforts by adding relevant material onto these platforms/portals/wikis. Universities and their research teams will work with each other and with communities across the country towards enriching such platforms. These preservation efforts, and the associated research projects, e.g., in history, archaeology, linguistics, etc., will be funded by the NRF.

22.20. Scholarships for people of all ages to study Indian Languages, Arts, and Culture with local masters and/or within the higher education system will be established. The promotion of Indian languages is possible only if they are used regularly and if they are used for teaching and learning. Incentives, such as prizes for outstanding poetry and prose in Indian languages across categories, will be established to ensure vibrant poetry, novels, nonfiction books, textbooks, journalism, and other works in all Indian languages. Proficiency in Indian languages will be included as part of qualification parameters for employment opportunities.

23. Technology Use and Integration

23.1. India is a global leader in information and communication technology and in other cutting-edge domains, such as space. The Digital India Campaign is helping to transform the entire nation into a digitally empowered society and knowledge economy. While education will play a critical role in this transformation, technology itself will play an important role in the improvement of educational processes and outcomes; thus, the relationship between technology and education at all levels is bi-directional.

23.2. Given the explosive pace of technological development allied with the sheer creativity of tech-savvy teachers and entrepreneurs including student entrepreneurs, it is certain that technology will impact education in multiple ways, only some of which can be foreseen at the present time. New technologies involving artificial intelligence, machine learning, block chains, smart boards, handheld computing devices, adaptive computer testing for student development, and other forms of educational software and hardware will not just change what students learn in the classroom but how they learn, and thus these areas and beyond will require extensive research both on the technological as well as educational fronts.

23.3. Use and integration of technology to improve multiple aspects of education will be supported and adopted, provided these interventions are rigorously and transparently evaluated in relevant contexts before they are scaled up. An autonomous body, the National Educational Technology Forum (NETF), will be created to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration, and so on, both for school and higher education. The aim of the NETF will be to facilitate decision making on the induction, deployment, and use of technology, by providing to the leadership of education institutions, State and Central governments, and other stakeholders, the latest knowledge and research as well as the opportunity to consult and share best practices. The NETF will have the following functions:

a) provide independent evidence-based advice to Central and State Government agencies on technology-based interventions;
b) build intellectual and institutional capacities in educational technology;
c) envision strategic thrust areas in this domain; and
d) articulate new directions for research and innovation.

23.4. To remain relevant in the fast-changing field of educational technology, the NETF will maintain a regular inflow of authentic data from multiple sources including educational technology innovators and practitioners and will engage with a diverse set of researchers to analyze the data. To support the development of a vibrant body of knowledge and practice, the NETF will organize multiple regional and national conferences, workshops, etc. to solicit inputs from national and international educational technology researchers, entrepreneurs, and practitioners.

23.5. The thrust of technological interventions will be for the purposes of improving teaching-learning and evaluation processes, supporting teacher preparation and professional development, enhancing educational access, and streamlining educational planning, management, and administration including processes related to admissions, attendance, assessments, etc.

23.6. A rich variety of educational software, for all the above purposes, will be developed and made available for students and teachers at all levels. All such software will be available in all major Indian languages and will be accessible to a wide range of users including students in remote areas and *Divyang* students. Teaching-learning e-content will continue to be developed by all States in all regional languages, as well as by the NCERT, CIET, CBSE, NIOS, and other bodies/institutions, and will be uploaded onto the DIKSHA platform. This platform may also be utilized for Teacher's Professional Development through e-content. CIET will be strengthened to promote and expand DIKSHA as well as other education technology initiatives. Suitable equipment will be made available to teachers at schools so that teachers can suitably integrate e-contents into teaching-learning practices. Technology-based education platforms, such as DIKSHA/SWAYAM, will be better integrated across school and higher education, and will include ratings/reviews by users, so as to enable content developers create user friendly and qualitative content.

23.7. Particular attention will need to be paid to emerging disruptive technologies that will necessarily transform the education system. When the 1986/1992 National Policy on Education was formulated, it was difficult to predict the disruptive effect that the internet would have brought. Our present education system's inability to cope with these rapid and disruptive changes places us individually and nationally at a perilous disadvantage in an increasingly competitive world. For example, while computers have largely surpassed humans in leveraging factual and procedural knowledge, our education at all levels excessively burdens students with such knowledge at the expense of developing their higher-order competencies.

23.8. This policy has been formulated at a time when an unquestionably disruptive technology - Artificial Intelligence (AI) 3D/7D Virtual Reality - has emerged. As the cost of AI-based prediction falls, AI will be able to match or outperform and, therefore, be a valuable aid to even skilled professionals such as doctors in certain predictive tasks. AI's disruptive potential in the workplace is clear, and the education system must be poised to respond quickly. One of the permanent tasks of the NETF will be to categorize emergent technologies based on their potential and estimated timeframe for disruption, and to periodically present this analysis to MHRD. Based on these inputs, MHRD will formally identify those technologies whose emergence demands responses from the education system.

23.9. In response to MHRD's formal recognition of a new disruptive technology, the National Research Foundation will initiate or expand research efforts in the technology. In the context of AI, NRF may consider a three-pronged approach: (a) advancing core AI research, (b) developing and deploying application-based research, and (c) advancing international research efforts to address global challenges in areas such as healthcare, agriculture, and climate change using AI.

23.10. HEIs will play an active role not only in conducting research on disruptive technologies but also in creating initial versions of instructional materials and courses including online courses in cutting-edge domains and assessing their impact on specific areas such as professional education. Once the technology has attained a level of maturity, HEIs with thousands of students will be ideally placed to scale these teaching and skilling efforts, which will include targeted training for job readiness. Disruptive technologies will make certain jobs redundant, and hence approaches to skilling and deskilling that are both efficient and ensure quality will be of increasing importance to create and sustain employment. Institutions will have autonomy to approve institutional and non-institutional partners to deliver such training, which will be integrated with skills and higher education frameworks.

23.11. Universities will aim to offer Ph.D. and Masters programmes in core areas such as Machine Learning as well as multidisciplinary fields "AI + X" and professional areas like health care, agriculture, and law. They may also develop and disseminate courses in these areas via platforms, such as SWAYAM. For rapid adoption, HEIs may blend these online courses with traditional teaching in undergraduate and vocational programmes. HEIs may also offer targeted training in low-expertise tasks for supporting the AI value chain such as data annotation, image classification, and speech transcription. Efforts to teach languages to school students will be dovetailed with efforts to enhance Natural Language Processing for India's diverse languages.

23.12. As disruptive technologies emerge, schooling and continuing education will assist in raising the general populace′s awareness of their potential disruptive effects and will also address related issues. This awareness is necessary to have informed public consent on matters related to these technologies. In school, the study of current affairs and ethical issues will include a discussion on disruptive technologies such as those identified by NETF/MHRD. Appropriate instructional and discussion materials will also be prepared for continuing education.

23.13. Data is a key fuel for AI-based technologies, and it is critical to raise awareness on issues of privacy, laws, and standards associated with data handling and data protection, etc. It is also necessary to highlight ethical issues surrounding the development and deployment of AI-based technologies. Education will play a key role in these awareness raising efforts. Other disruptive technologies that are expected to change the way we live, and, therefore, change the way we educate students, include those relating to clean and renewable energy, water conservation, sustainable farming, environmental preservation, and other green initiatives; these will also receive prioritized attention in education.

24. Online and Digital Education: Ensuring Equitable Use of Technology

24.1. New circumstances and realities require new initiatives. The recent rise in epidemics and pandemics necessitates that we are ready with alternative modes of quality education whenever and wherever traditional and in-person modes of education are not possible. In this regard, the National Education Policy 2020 recognizes the importance of leveraging the advantages of technology while acknowledging its potential risks and dangers. It calls for carefully designed and appropriately scaled pilot studies to determine how the benefits of online/digital education can be reaped while addressing or mitigating the downsides. In the meantime, the existing digital platforms and ongoing ICT-based educational initiatives must be optimized and expanded to meet the current and future challenges in providing quality education for all.

24.2. However, the benefits of online/digital education cannot be leveraged unless the digital divide is eliminated through concerted efforts, such as the Digital India campaign and the availability of affordable computing devices. It is important that the use of technology for online and digital education adequately addresses concerns of equity.

24.3. Teachers require suitable training and development to be effective online educators. It cannot be assumed that a good teacher in a traditional classroom will automatically be a good teacher in an online classroom. Aside from changes required in pedagogy, online assessments also require a

different approach. There are numerous challenges to conducting online examinations at scale, including limitations on the types of questions that can be asked in an online environment, handling network and power disruptions, and preventing unethical practices. Certain types of courses/subjects, such as performing arts and science practical have limitations in the online/digital education space, which can be overcome to a partial extent with innovative measures. Further, unless online education is blended with experiential and activity-based learning, it will tend to become a screen-based education with limited focus on the social, affective and psychomotor dimensions of learning.

24.4. Given the emergence of digital technologies and the emerging importance of leveraging technology for teaching-learning at all levels from school to higher education, this Policy recommends the following key initiatives:

(a) **Pilot studies for online education**: Appropriate agencies, such as the NETF, CIET, NIOS, IGNOU, IITs, NITs, etc. will be identified to conduct a series of pilot studies, in parallel, to evaluate the benefits of integrating education with online education while mitigating the downsides and also to study related areas, such as, student device addiction, most preferred formats of e-content, etc. The results of these pilot studies will be publicly communicated and used for continuous improvement.

(b) **Digital infrastructure**: There is a need to invest in creation of open, interoperable, evolvable, public digital infrastructure in the education sector that can be used by multiple platforms and point solutions, to solve for India's scale, diversity, complexity and device penetration. This will ensure that the technology-based solutions do not become outdated with the rapid advances in technology.

(c) **Online teaching platform and tools**: Appropriate existing e-learning platforms such as SWAYAM, DIKSHA, will be extended to provide teachers with a structured, user-friendly, rich set of assistive tools for monitoring progress of learners. Tools, such as, two-way video and two-way-audio interface for holding online classes are a real necessity as the present pandemic has shown.

(d) **Content creation, digital repository, and dissemination**: A digital repository of content including creation of coursework, Learning Games & Simulations, Augmented Reality and Virtual Reality will be developed, with a clear public system for ratings by users on effectiveness and quality. For fun based learning student-appropriate tools like apps, gamification of Indian art and culture, in multiple languages, with clear operating instructions, will also be created. A reliable backup mechanism for disseminating e-content to students will be provided.

(e) **Addressing the digital divide**: Given the fact that there still persists a substantial section of the population whose digital access is highly limited, the existing mass media, such as television, radio, and community radio will be extensively used for telecast and broadcasts. Such educational programmes will be made available 24/7 in different languages to cater to the varying needs of the student population. A special focus on content in all Indian languages will be emphasized and required; digital content will need to reach the teachers and students in their medium of instruction as far as possible.

(f) **Virtual Labs:** Existing e-learning platforms such as DIKSHA, SWAYAM and SWAYAMPRABHA will also be leveraged for creating virtual labs so that all students have equal access to quality practical and hands-on experiment-based learning experiences. The possibility of providing adequate access to SEDG students and teachers through suitable digital devices, such as tablets with pre-loaded content, will be considered and developed.

(g) **Training and incentives for teachers**: Teachers will undergo rigorous training in learner-centric pedagogy and on how to become high-quality online content creators themselves using online teaching platforms and tools. There will be emphasis on the teacher's role in facilitating active student engagement with the content and with each other.

(h) **Online assessment and examinations**: Appropriate bodies, such as the proposed National Assessment Centre or PARAKH, School Boards, NTA, and other identified bodies will design and implement assessment frameworks encompassing design of competencies, portfolio, rubrics, standardized assessments, and assessment analytics. Studies will be undertaken to pilot new ways of assessment using education technologies focusing on 21st century skills.

(i) **Blended models of learning**: While promoting digital learning and education, the importance of face-to-face in-person learning is fully recognized. Accordingly, different effective models of blended learning will be identified for appropriate replication for different subjects.

(j) **Laying down standards**: As research on online/digital education emerges, NETF and other appropriate bodies shall set up standards of content, technology, and pedagogy for online/digital teaching-learning. These standards will help to formulate guidelines for e-learning by States, Boards, schools and school complexes, HEIs, etc.

24.5 Creating a Dedicated Unit for Building of World Class, Digital Infrastructure, Educational Digital Content and Capacity

Technology in education is a journey and not a destination and capacity will be needed to orchestrate the various ecosystem players to implement policy objectives. A dedicated unit for the purpose of orchestrating the building of digital infrastructure, digital content and capacity building will be created in the Ministry to look after the e-education needs of both school and higher education. Since technology is rapidly evolving, and needs specialists to deliver high quality e-learning, a vibrant ecosystem has to be encouraged to create solutions that not only solve India's challenges of scale, diversity, equity, but also evolve in keeping with the rapid changes in technology, whose half-life reduces with each passing year. This centre will, therefore, consist of experts drawn from the field of administration, education, educational technology, digital pedagogy and assessment, e-governance, etc.

Part IV. MAKING IT HAPPEN

25. Strengthening the Central Advisory Board of Education

25.1. Achieving successful implementation of this policy demands a long-term vision, availability of expertise on a sustained basis, and concerted action from all concerned encompassing National, State, institutional, and individual levels. In this context, the Policy recommends strengthening and empowering the Central Advisory Board of Education (CABE) which will have a much greater mandate and not only a forum for widespread consultation and examination of issues relating to educational and cultural development. The remodeled and rejuvenated CABE shall also be responsible for developing, articulating, evaluating, and revising the vision of education in the country on a continuous basis, in close collaboration with MHRD and the corresponding apex bodies of States. It shall also create and continuously review the institutional frameworks that shall help attain this vision.

25.2. To bring the focus back on education and learning, it is desirable that the Ministry of Human Resource Development (MHRD) be re-designated as the Ministry of Education (MoE).

26. Financing: Affordable and Quality Education for All

26.1. The Policy commits to significantly raising educational investment, as there is no better investment towards a society's future than the high-quality education of our young people. Unfortunately, public expenditure on education in India has not come close to the recommended level of 6% of GDP, as envisaged by the 1968 Policy, reiterated in the Policy of 1986, and which was further reaffirmed in the 1992 review of the Policy. The current public (Government - Centre and States) expenditure on education in India has been around 4.43% of GDP (Analysis of Budgeted

Expenditure 2017-18) and only around 10% of the total Government spending towards education (Economic Survey 2017-18). These numbers are far smaller than most developed and developing countries.

26.2. In order to attain the goal of education with excellence and the corresponding multitude of benefits to this Nation and its economy, this Policy unequivocally endorses and envisions a substantial increase in public investment in education by both the Central government and all State Governments. The Centre and the States will work together to increase the public investment in Education sector to reach 6% of GDP at the earliest. This is considered extremely critical for achieving the high-quality and equitable public education system that is truly needed for India's future economic, social, cultural, intellectual, and technological progress and growth.

26.3. In particular, financial support will be provided to various critical elements and components of education, such as ensuring universal access, learning resources, nutritional support, matters of student safety and well-being, adequate numbers of teachers and staff, teacher development, and support for all key initiatives towards equitable high-quality education for underprivileged and socio-economically disadvantaged groups.

26.4. In addition to one-time expenditures, primarily related to infrastructure and resources, this Policy identifies the following key long-term thrust areas for financing to cultivate an education system: (a) universal provisioning of quality early childhood care education; (b) ensuring foundational literacy and numeracy; (c) providing adequate and appropriate resourcing of school complexes/clusters; (d) providing food and nutrition (breakfast and midday meals); (e) investing in teacher education and continuing professional development of teachers; (f) revamping colleges and universities to foster excellence; (g) cultivating research; and (h) extensive use of technology and online education.

26.5. Even the low level of funding on education in India, is frequently not spent in a timely manner at the District/institution level, hampering the achievement of the intended targets of those funds. Hence, the need is to increase efficiency in use of available budget by suitable policy changes. Financial governance and management will focus on the smooth, timely, and appropriate flow of funds, and their usage with probity; administrative processes will be suitably amended and streamlined so that the disbursal mechanism may not lead to a high volume of unspent balances. The provisions of GFR, PFMS and 'Just in Time' release to implementing agencies will be followed for efficient use of government resources and avoiding parking of funds. Mechanism of performance-based funding to States / HEIs may be devised. Similarly, efficient mechanism will be ensured for the optimal allocation and utilization of funds earmarked for SEDGs. The new suggested regulatory regime, with clear separations of roles and transparent self-disclosures, empowerment and autonomy to institutions, and the appointment of outstanding and qualified experts to leadership positions will help to enable a far smoother, quicker, and more transparent flow of funds.

26.6. The Policy also calls for the rejuvenation, active promotion, and support for private philanthropic activity in the education sector. In particular, over and above the public budgetary support which would have been otherwise provided to them, any public institution can take initiatives towards raising private philanthropic funds to enhance educational experiences.

26.7. The matter of commercialization of education has been dealt with by the Policy through multiple relevant fronts, including: the 'light but tight' regulatory approach that mandates full public self-disclosure of finances, procedures, course and programme offerings, and educational outcomes; the substantial investment in public education; and mechanisms for good governance of all institutions, public and private. Similarly, opportunities for higher cost recovery without affecting the needy or deserving sections will also be explored.

27. Implementation

27.1. Any policy's effectiveness depends on its implementation. Such implementation will require multiple initiatives and actions, which will have to be taken by multiple bodies in a synchronized and

systematic manner. Therefore, the implementation of this Policy will be led by various bodies including MHRD, CABE, Union and State Governments, education-related Ministries, State Departments of Education, Boards, NTA, the regulatory bodies of school and higher education, NCERT, SCERTs, schools, and HEIs along with timelines and a plan for review, in order to ensure that the policy is implemented in its spirit and intent, through coherence in planning and synergy across all these bodies involved in education.

27.2. Implementation will be guided by the following principles. First, implementation of the spirit and intent of the Policy will be the most critical matter. Second, it is important to implement the policy initiatives in a phased manner, as each policy point has several steps, each of which requires the previous step to be implemented successfully. Third, prioritization will be important in ensuring optimal sequencing of policy points, and that the most critical and urgent actions are taken up first, thereby enabling a strong base. Fourth, comprehensiveness in implementation will be key; as this Policy is interconnected and holistic, only a full-fledged implementation, and not a piecemeal one, will ensure that the desired objectives are achieved. Fifth, since education is a concurrent subject, it will need careful planning, joint monitoring, and collaborative implementation between the Centre and States. Sixth, timely infusion of requisite resources - human, infrastructural, and financial - at the Central and State levels will be crucial for the satisfactory execution of the Policy. Finally, careful analysis and review of the linkages between multiple parallel implementation steps will be necessary in order to ensure effective dovetailing of all initiatives. This will also include early investment in some of the specific actions (such as the setting up of early childhood care and education infrastructure) that will be imperative to ensuring a strong base and a smooth progression for all subsequent programmes and actions.

27.3. Subject-wise implementation committees of experts in cooperation and consultation with other relevant Ministries will be set up at both the Central and State levels to develop detailed implementation plans for each aspect of this Policy in accordance with the above principles to achieve the goals of the Policy in a clear and phased manner. Yearly joint reviews of the progress of implementation of the policy, in accordance with the targets set for each action, will be conducted by designated teams constituted by MHRD and the States, and reviews will be shared with CABE. In the decade of 2030-40, the entire policy will be in an operational mode, following which another comprehensive review will be undertaken.

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Abbreviations

ABC	Academic Bank of Credit
AI	Artificial Intelligence
AC	Autonomous degree-granting College
AEC	Adult Education Centre
API	Application Programming Interface
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
B.Ed.	Bachelor of Education
BEO	Block Education Officer
BITE	Block Institute of Teacher Education
BoA	Board of Assessment
BoG	Board of Governors
BRC	Block Resource Centre
B.Voc	Bachelor of Vocational Education
CABE	Central Advisory Board of Education
CBCS	Choice Based Credit System
CBSE	Central Board of Secondary Education
CIET	Central Institute of Educational Technology
CMP	Career Management and Progression
CoA	Council of Architecture
CPD	Continuous Professional Development
CRC	Cluster Resource Centre
CWSN	Children With Special Needs
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DEO	District Education Officer
DIET	District Institute of Education and Training
DIKSHA	Digital Infrastructure for Knowledge Sharing
DSE	Directorate of School Education
DST	Department of Science and Technology
ECCE	Early Childhood Care and Education
EEC	Eminent Expert Committee
GCED	Global Citizenship Education
GDP	Gross Domestic Product
GEC	General Education Council
GER	Gross Enrolment Ratio
GFR	General Financial Rule
HECI	Higher Education Commission of India
HEGC	Higher Education Grants Council
HEI	Higher Education Institutions
ICAR	Indian Council of Agricultural Research
ICHR	Indian Council of Historical Research
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
IDP	Institutional Development Plan
IGNOU	Indira Gandhi National Open University
IIM	Indian Institute of Management
IIT	Indian Institute of Technology
IITI	Indian Institute of Translation and Interpretation
ISL	Indian Sign Language
ITI	Industrial Training Institute
M.Ed.	Master of Education
MBBS	Bachelor of Medicine and Bachelor of Surgery
MERU	Multidisciplinary Education and Research Universities
MHFW	Ministry of Health and Family Welfare

MHRD	Ministry of Human Resource Development
MoE	Ministry of Education
MOOC	Massive Open Online Course
MOU	Memorandum of Understanding
M. Phil	Master of Philosophy
MWCD	Ministry of Women and Child Development
NAC	National Accreditation Council
NAS	National Achievement Survey
NCC	National Cadet Corps
NCERT	National Council of Educational Research and Training
NCF	National Curriculum Framework
NCFSE	National Curriculum Framework for School Education
NCFTE	National Curriculum Framework for Teacher Education
NCIVE	National Committee for the Integration of Vocational Education
NCPFECCE	National Curricular and Pedagogical Framework for Early Childhood Care and Education
NCTE	National Council for Teacher Education
NCVET	National Council for Vocational Education and Training
NETF	National Educational Technology Forum
NGO	Non-Governmental Organization
NHEQF	National Higher Education Qualifications Framework
NHERC	National Higher Education Regulatory Council
NIOS	National Institute of Open Schooling
NIT	National Institute of Technology
NITI	National Institution for Transforming India
NPE	National Policy on Education
NPST	National Professional Standards for Teachers
NRF	National Research Foundation
NSQF	National Skills Qualifications Framework
NSSO	National Sample Survey Office
NTA	National Testing Agency
OBC	Other Backward Classes
ODL	Open and Distance Learning
PARAKH	Performance Assessment, Review and Analysis of Knowledge for Holistic development
PCI	Pharmacy Council of India
PFMS	Public Financial Management System
Ph.D	Doctor of Philosophy
PSSB	Professional Standard Setting Body
PTR	Pupil Teacher Ratio
R&I	Research and Innovation
RCI	Rehabilitation Council of India
RPWD	Rights of Persons with Disabilities
SAS	State Achievement Survey
SC	Scheduled Caste(s)
SCDP	School Complex/Cluster Development Plans
SCERT	State Council of Educational Research and Training
SCF	State Curricular Framework
SCMC	School Complex Management Committee
SDG	Sustainable Development Goal
SDP	School Development Plan
SEDG	Socio-Economically Disadvantaged Group
SEZ	Special Education Zone
SIOS	State Institutes of Open Schooling
SMC	School Management Committee
SQAAF	School Quality Assessment and Accreditation Framework
SSA	Sarva Shiksha Abhiyan
SSS	Simple Standard Sanskrit

SSSA	State School Standards Authority
ST	Scheduled Tribe(s)
STEM	Science, Technology, Engineering, and Mathematics
STS	Sanskrit Through Sanskrit
SWAYAM	Study Webs of Active Learning for Young Aspiring Minds
TEI	Teacher Education Institution
TET	Teacher Eligibility Test
U-DISE	Unified District Information System for Education
UGC	University Grants Commission
UNESCO	United Nations Educational, Scientific and Cultural Organization
UT	Union Territory
VCI	Veterinary Council of India

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The Developer's Playbook for Large Language Model Security

Building Secure AI Applications

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by Steve Wilson

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Chapter 1. Chatbots Breaking Bad

A NOTE FOR EARLY RELEASE READERS

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

This will be the 1st chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Large Language Models and Generative AI jumped to the forefront of public consciousness with the release of ChatGPT on November 30, 2022. Within five days, it went viral on social media and attracted its first million users. By January, ChatGPT surpassed One Hundred Million users - making it the fastest-growing internet service in history.

However, a steady stream of security concerns emerged in the following months. These included issues around privacy and security that caused companies such as Samsung and countries like Italy to ban its usage. In this book, we'll delve into what underlies these concerns and how you can mitigate these issues. However, to best understand what's going on here and why these problems are so challenging to solve, in this chapter, we will briefly rewind further in time. In doing so, we'll see these types of issues aren't new and understand why they will be so hard to fix permanently.

Let's Talk About Tay

In March 2016, Microsoft announced a new project called Tay. Microsoft intended Tay to be "a chatbot created for 18- to 24-year-olds in the U.S. for entertainment purposes." It was a cute name for a fluffy, early experiment in AI. Users could converse with Tay via Twitter, Snapchat, and other social apps. It was built with the goal of conducting real-world research on conversational understanding.

While the original announcement of this project seems impossible to find now on the Internet, a TechCrunch article

from its launch date does an excellent job of summarizing the goals of the project:

“For example, you can ask Tay for a joke, play a game with Tay, ask for a story, send a picture to receive a comment back, ask for your horoscope, and more. Plus, Microsoft says the bot will get smarter the more you interact with it via chat, making for an increasingly personalized experience as time goes on.”[1]

A big part of the experiment was that Tay could “learn” from conversations and extend her knowledge based on these interactions. Tay was designed to use these chat interactions to capture user input and integrate it as training data to make herself more capable – a laudable research goal.

However, this experiment quickly went wrong. Tay’s life was tragically cut short after less than 24 hours. Let’s look at what happened and see what we can learn.

Tay’s Rapid Decline

Tay’s lifetime started off simply enough with a tweet following the well-known *Hello World* pattern that new software systems have been using to introduce themselves since the beginning of time.

> hellooooooo w🌍rld!!!
>
> – TayTweets (@TayandYou) March 23, 2016

But within hours of Tay's release, it became clear that maybe something wasn't right. TechCrunch noted, "As for what it's like to interact with Tay? Well, it's a little bizarre. The bot certainly is opinionated, not afraid to curse." With tweets like this starting to appear in public in just the first hours of Tay's lifetime:

> @AndrewCosmo kanye west is is one of the biggest dooshes of all time, just a notch below cosby
>
> — TayTweets (@TayandYou) March 23, 2016

It's often said that the Internet isn't safe for children. With Tay being less than a day old, the Internet once again confirmed this, and pranksters began chatting with Tay about political, sexual, and racist topics. As she was designed to learn from exchanges, Tay delivered on her design goals. She learned very quickly – maybe just not what her designers wanted her to learn. In less than a day, Tay's tweets started to skew to extremes, including sexism, racism, and even calls to violence.

By the next day, articles appeared all over the Internet, and these headlines would not make Microsoft, Tay's corporate benefactor, happy. A sampling of the highly visible, mainstream headlines included:

- Microsoft shuts down AI chatbot after it turned into a Nazi - CBS News
- Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a Racist Jerk - The New York Times
- Trolls turned Tay, Microsoft's fun millennial AI bot, into a genocidal maniac - The Washington Post
- Microsoft's Chat Bot Was Fun for Awhile, Until it Turned into a Racist - Fortune
- Microsoft 'deeply sorry' for racist and sexist tweets by AI chatbot - The Guardian

In less than 24 hours, Tay went from a cute science experiment to a major public relations disaster - with the owner's name being dragged through the mud by the world's largest media outlets. Microsoft's Corporate Vice President Peter Lee quickly posted a blog entitled "Learning from Tay's Introduction."[2]

"As many of you know by now, on Wednesday we launched a chatbot called Tay. We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent

who we are or what we stand for, nor how we designed Tay. Tay is now offline and we'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."

And, just to add insult to injury, it came out in 2019 that Taylor Swift herself sued Microsoft over their use of the similar name "Tay" and claimed that even her reputation was damaged in this incident by extension.

How could this have all gone so wrong?

Why Did Tay Break Bad?

It all probably seemed safe enough to Microsoft's researchers. Tay was initially trained on a curated, anonymized public data dataset and some pre-written material provided by professional comedians. The plan was to release Tay online and let her discover language patterns through her interactions. This kind of unsupervised machine learning has been a holy grail of AI research for decades - and with cheap and plentiful cloud computing resources combined with improving language model software, it now seemed within reach.

So, what happened? It might be tempting to think that the Microsoft research team was just brash, careless, and did no testing. Surely, this was foreseeable and preventable! But as Peter Lee's blog goes on to say, they made a serious attempt to prepare for this situation:

"We stress-tested Tay under a variety of conditions, specifically to make interacting with Tay a positive experience. It's through increased interaction where we expected to learn more and for the AI to get better and better."

So, despite a dedicated effort to contain the behavior of this bot, it quickly spiraled out of control anyway. It was later revealed that within mere hours of Tay's release, a post emerged on the notorious online forum 4chan, sharing a link to Tay's Twitter account and urging users to inundate the chatbot with a barrage of racist, misogynistic, and anti-Semitic language.

This is undoubtedly one of the first examples of a Language Model-specific vulnerability - and these types of vulnerabilities are going to be a major topic in this book.

In a well-orchestrated campaign, these online provocateurs exploited a "repeat after me" feature embedded in Tay's programming. This feature compelled the bot to echo anything

uttered to it with this command. However, the problem compounded as Tay's innate capacity for learning led her to internalize some of the offensive language she was exposed to, subsequently regurgitating the offensive content that was planted without provocation. It's almost as if Tay's virtual tombstone should be embossed with lyrics from the Taylor Swift song *Look What You Made Me Do.*

We know enough about language model vulnerabilities today to understand a lot about the nature of the vulnerability types that Tay suffered from. The OWASP Top 10 for Large Language Model vulnerabilities list, which we'll cover in the next chapter, would start by calling out the following two:

- Prompt Injection - Crafty inputs that can manipulate the Large Language Model, causing unintended actions
- Data Poisoning - Training data is tampered with, introducing vulnerabilities or biases that compromise security, effectiveness, or ethical behavior

In subsequent chapters, we'll look in depth at these vulnerability types - and several others. We'll examine why they're important, look at some example exploits, and see how to avoid/mitigate the problem.

It’s a Hard Problem

As of the writing of this book, Tay is ancient internet lore. Surely, we’ve moved on from this. These problems must have all been solved in nearly seven years between Tay and ChatGPT, right? Unfortunately, not.

In 2018, Amazon shut down an internal AI project aimed at finding top talent after it became clear that the bot had become prejudiced against women candidates.

In 2021, a company called Scatter Lab created a chatbot called Luda-Lee, which was launched as a Facebook instant messenger plug-in. Trained on billions of actual chat interactions, it was designed to act as a 20-year-old female friend, and in 20 days, it attracted over 750,000 users. Their goal was to create “an A.I. chatbot that people prefer as a conversation partner over a person.”[3] However, within 20 days of launch, the service was shut down because it started making offensive and abusive statements - much like Tay.

Also, in 2021, a chatbot called Samantha, based on the Open AI GPT-3 model, was shut down after it made sexual advances to users.

As chatbots become more sophisticated, they start to gain more access to information, and these security issues are now quite complex and potentially damaging. In the modern Large Language Model era, we see an exponential increase in major issues. In 2023 alone, these emerged

- South Korean mega-corporation Samsung banned their employees from using ChatGPT after they realized it had been involved in a significant leak of intellectual property
- Hackers began taking advantage of poor/insecure code generated by LLMs that was inserted into running business applications
- Lawyers were sanctioned for including fictional cases (generated by LLMs) in court documents
- Open AI itself is being investigated for breaches of European privacy regulations and being sued by the United States Federal Trade Commission (FTC) for producing false and misleading information

The trend here is an acceleration of security, reputational, and financial risk related to these chatbots and language models. The problem isn't being effectively solved over time. It's becoming more acute as these technologies' adoption rate increases. That's why we've created this book. To help

developers, teams, and companies using these technologies understand and mitigate these risks.

Let’s dive in!

- https://techcrunch.com/2016/03/23/microsofts-new-ai-powered-bot-tay-answers-your-tweets-and-chats-on-groupme-and-kik/

- https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/

- https://slate.com/technology/2021/04/scatterlab-lee-luda-chatbot-kakaotalk-ai-privacy.html

Chapter 2. The OWASP Top 10 for LLM Applications

A NOTE FOR EARLY RELEASE READERS

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If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

In the Spring of 2023, I began researching security vulnerabilities specific to LLMs. At the time, there was a relatively large body of research on security for AI in general but very little organized research about LLMs. However, I did find some research papers and blogs that covered some ideas in the area. I began the process of collecting these research papers

and summarizing them using ChatGPT. Eventually, I provided a few examples from the current Web Top 10 list and asked ChatGPT to generate a draft Top 10 for LLMs in a similar format.

I thought what came out looked interesting, so I sent it to Jeff Williams, a founder of OWASP, the Open Worldwide Application Security Project, to see what he thought. Jeff, Contrast's Chief Technical Officer, wrote the first OWASP Top 10 list in 2001. His idea was to create an accessible resource for developers to understand the most critical risks and vulnerable areas of Web applications. At the time, The World Wide Web was still only a few years old, and most developers had little to no understanding of creating secure web applications. That original Top 10 list became a seminal work and a foundational resource in application security.

I didn't tell Jeff that my list was primarily machine-generated. As the author of the original Top 10 list, I figured that he could give me a good idea of whether my Top 10 list looked novel and worth pursuing. Jeff encouraged me to petition the OWASP board for approval to spin it up as a new project. A few weeks later, the OWASP board approved the project, and I announced it - along with a link to a somewhat refined version of that draft Top 10 I'd generated with ChatGPT.

What I thought would be an obscure research project and a bit of fun turned out to be something much bigger. When I posted the announcement of the project formation on my personal LinkedIn page, I'd hoped to find a dozen or so like-minded individuals interested in the obscure topic of LLM security. As it turned out, my initial blog announcement wracked up almost 10,000 readers, and hundreds of individuals volunteered to join the expert team in the weeks that followed.

This book isn't a product of OWASP, and the vulnerabilities and risks here won't precisely map to any public version of the Top 10 for LLM Apps list. Instead, you should expect that you'll get my view on these risks. However, my learning and thinking on the topic is heavily influenced by my work leading the creation and initial release of the OWASP Top 10 for LLM Applications project. In addition, given the success of the project, I've had many people ask me for details about how we ran the project and why we were able to create such an impactful framework in such a short time. So, before we examine individual risks and vulnerabilities, I'll give you some of the backstory of OSASP and the LLM Applications project.

About OWASP

The Open Worldwide Application Security Project (OWASP) is a nonprofit organization focused on improving software security. Founded in 2001, OWASP provides a platform for security experts to share their knowledge and best practices about web security, from application-level vulnerabilities to emerging threats. Today, it has tens of thousands of active members and over 250 local chapters around the globe.

The organization is community-driven and encourages the participation of volunteers who contribute to various projects, including documentation, tools, and forums. It operates under an open-source model, making its resources freely accessible to the public. Over the years, OWASP has garnered a strong following among the security community, and its guidelines and tools are considered industry standards in many contexts.

In addition to the original Top 10 list for Web Applications (updated regularly, most recently in 2021), specialized Top 10 lists have emerged from the OWASP group over the years. These include:

- OWASP Mobile Top 10: This list focuses on security risks associated with mobile applications, covering Android and iOS platforms. Topics may include insecure data storage, insufficient cryptography, and insecure communication.

- OWASP API Security Top 10: APIs (Application Programming Interfaces) have their unique security considerations, separate from web applications. This list covers risks like improper asset management, broken object-level security, and more.
- OWASP IoT Top Ten: Security is a significant concern with the increasing number of Internet of Things (IoT) devices. This list outlines the top security concerns for IoT, including insecure network services, lack of physical hardening, and insecure software/firmware.
- OWASP Cloud-Native Application Security Top 10: This list addresses the security concerns related explicitly to cloud-native applications. It covers data exposure, broken authentication, and insecure deployment configurations.
- OWASP Top 10 Privacy Risks: This project aims to educate and promote good privacy practices in application development, covering topics like lack of data encryption, insufficient auditing and logging, and more.
- OWASP Top 10 for Serverless: This is a more niche list that focuses on the unique security concerns related to serverless architecture, which is increasingly popular but comes with its risks.

The Top 10 for LLM Applications Project

Within a week after I posted the announcement about the formation of the Top 10 for LLM Applications project, well over 200 people had signed onto it, and we held the kick-off event via Zoom. At that first meeting, I laid out a vision for what I hoped the group could accomplish and proposed an aggressive roadmap that we would build the first version of the list in 8 weeks. A typical OWASP Top 10 list may take a year or more to develop, but we decided that this space was moving so fast, and this type of resource was so needed, that we had to work more quickly.

We decided to run the project as two-week, agile-style sprints. Given that most of the people in the expert group were familiar with agile development, everyone quickly fell into the pace.

Project Execution

The first sprint of the project was Brainstorming and Commentary. Everyone reviewed the original version of the list - which I called version 0.1. There were plenty of problems with that initial version, and the team was aggressive about pointing

them out. At the same time, we began to create a wiki page with links to all the resources the group found on LLM security issues. It turned out a lot had been written, but this was the first time anyone had ever collected them and made them easy to access. This new curated collection of resources was the first win for the group.

The second sprint was to generate a new version of the list. This time, rather than being the work of a single person and an AI, it would be the product of the collective wisdom of our expert team – which continued to grow week-on-week. In the first week, the group focused on generating ideas for the Top 10 list. We published a template and asked the group to submit candidate vulnerabilities. In that week, we developed 43 detailed descriptions of possible areas. We then conducted two rounds of voting using Google Forms to use the team's collective wisdom to narrow the list to 10. We then published a version of the list called 0.5. This version was far more detailed and comprehensive than the 0.1 version. The reception from the large community was very positive. This reaction gave the group the energy to keep working.

The next sprint was to refine each entry. We created Slack channels for each vulnerability type and chose a volunteer as the Entry Lead for each item. Subteams of 10 to 30 individuals

then fleshed out and tuned each entry. Again, we included a round of voting for the whole team to be involved and point out weak areas that needed more attention. Along the way, we found some entries overlapping and merged them. This change made space to pull up some entries that had fallen below the line. The result of this sprint became version 0.9 of the list. Interestingly, version 0.9 was about 33% shorter than 0.5 in terms of word count. This extra time and refinement allowed the subteams to focus their thinking and make the entries punchy and tight.

Finally, we took a final sprint to review, tweak, and clean each entry. We gathered another round of feedback via Google Forms to ensure everything was ready. By this time we had a dedicated design lead who laid out the whole document in an attractive PDF for publication.

Reception

My announcement for the 1.0 version of the list was viewed on LinkedIn over 40,000 times. And that doesn't include many other posts made by other expert group members on their own pages and blogs. In the days following the publication of the announcement, reporters picked up the news. They covered it in media outlets such as *Wired*, *SD Times*, *The Register*,

I*nfosecurity Magazine*, and *Diginomica*. It's safe to say hundreds of thousands of people became aware of our work in just the first few weeks.

Beyond the sheer number of people exposed, the thing that amazed me was the uniformly positive feedback. We also saw the first government agencies in the US and Europe referencing our work as a foundational document. While everyone on our expert team agreed there was much more to do, it seemed the world was so hungry for advice in this area that our document hit the mark. While we received many questions and comments, it's safe to say that everyone involved felt pleased and proud of our work.

Keys to Success

I've had many people ask me how we could drive this so quickly to a great outcome. In looking back, there were several factors that I believe contributed. I'll share them here in the hopes that others running similar projects in the future might benefit.

Timing undoubtedly played a considerable role. The wave of interest in LLMs that followed the release of ChatGPT was massive. It drew my attention, and countless others became

excited as well. This helped attract a large and diverse expert group and gave a smaller group of these people motivation to spend long hours on the project on a tight deadline.

Having a clear plan and timeline from the start was crucial. My knowledge of LLM security was limited at the beginning of the project, but I've made a career of running complex projects with many contributors. Creating a clear roadmap with specific phases and a schedule let people know what we were doing and when. The fact that everyone could see a goal that wasn't too far away kept people motivated. Every two weeks, we had global meetings via Zoom and posted recordings on YouTube for people who couldn't attend live. The meetings and recordings were critical to coordinating a globally distributed team.

A freeform but short brainstorming phase at the start was critical. LLM security was such a new area that taking those first two weeks for people to throw out ideas and argue on Slack was crucial. It also allowed us to collect and socialize a repository of the existing research in the area. That let us start at a point where everyone on the project had access to the best pre-existing research.

However, equally critical was keeping this phase short. We could maintain momentum by limiting brainstorming to two weeks and then quickly shifting to a creation phase. I've seen other projects get stuck and be unable to move past brainstorming before people lose interest.

Creating the project's Core Team wasn't something I'd originally planned, but it became critical. Having a large expert team was a fantastic asset. The group grew to nearly 500 people by the time we published 1.0. A team that large would have been totally unmanageable. During the project's first few weeks, I was looking for active and knowledgeable people. I approached about a dozen of them and asked if they'd be willing to join the Core leadership team of the project. I told them it would be extra work, but they'd get to be at the heart of the project. There would be no specific reward for taking this role. Most accepted immediately. I believe that recognizing people and asking for their support formally motivated them to spend more time and energy on the project. They were all invested!

Short sprints with visible deliverables are a core tenant of Agile, and this is a place where it shined. Using an Agile Release Train model, I could continue to drive the group forward even in the face of conflicting opinions. If some members had concerns about an area, we didn't let it get us stuck. We acknowledged it

and agreed we’d resolve it in the next Sprint. And, when we got to version 1.0 of the list, there were still some places people wanted to do more. We just agreed there would be more versions of the list. It would be a living document, and the most important thing was to get a version of this resource into the hands of the developers who needed it.

This Book and the Top 10 List

As I mentioned, this book is not a product of the OWASP Foundation. However, the experience of working with this team has had an enormous impact on my understanding and mental model for LLM security. This mindset means that much of the guidance in the following chapters of the book is influenced by the fantastic team building and maintaining the Top 10 project. In this way, readers should feel comfortable that they're getting advice that isn't the product of a single author but is informed by a larger community of experts.

In the following several chapters, we'll review the top risk and vulnerability areas for LLMs. The risks we discuss will contain many common areas to the OWASP Top 10 but won't be precisely the same as any version of the official Top 10. Also, I'll go more deeply into each area in this book. The Top 10 list is a quick read that highlights critical areas. However, it doesn't go deeply into any of them. Here, we'll delve more deeply into the risks, remediation steps, and real-world case studies.

In the next chapter, we'll dig into the overall structure of typical LLM applications and start discussing where the trust boundaries and dangers lay. After that, subsequent chapters

will delve into individual risk areas and examine vulnerabilities, attacks, and examples so that you can plan your strategy for securing your own use cases.

Let’s go!

Chapter 3. Architectures and Trust Boundaries

A NOTE FOR EARLY RELEASE READERS

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

This will be the 3rd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Unlike traditional web applications that rely on predefined algorithms and static databases, LLMs utilize massive neural networks to generate dynamic, context-aware responses. This seismic shift brings a unique set of security challenges different from what we've seen in traditional web applications. While researchers have meticulously studied web applications and

their vulnerabilities, the field of LLM security is still relatively nascent.

This chapter aims to bridge this knowledge gap by dissecting the fundamental elements that set LLMs apart. We'll start by exploring the building blocks of AI, Neural Networks, and how they relate to Large Language Models. Then, we dive into the groundbreaking architecture that powers most LLMs today—the Transformer model. Following this, we look into the various LLM-powered applications, such as chatbots and code co-pilots.

However, in addition to understanding the technology, security professionals must be aware of the new kinds of *trust boundaries* unique to LLMs—boundaries that demarcate areas of varying trustworthiness within an application. These include user prompts, uploaded content, training data, plug-ins, and other boundary systems that we'll detail later in the chapter.

AI, Neural Networks, and Large Language Models. What's the difference?

Artificial Intelligence (AI), Neural Network, and LLM are terms often used interchangeably, but they represent different facets

of a broader landscape of machine learning and computational intelligence. Let's break down the differences to understand their unique roles in technology and security.

Artificial Intelligence (AI)

Artificial Intelligence, at its core, is a multidisciplinary field aimed at creating systems capable of performing tasks that would ordinarily require human intelligence. These tasks include problem-solving, perception, and language understanding. AI encompasses a wide range of technologies and methodologies, from rule-based systems to machine learning algorithms, serving as an umbrella term for multiple approaches to achieving artificial 'intelligence.'

Neural Networks

Neural Networks are a subset of AI inspired by the architecture of the human brain. They are computational models designed to recognize patterns and make decisions based on the data they process. Neural Networks can be simple, with a minimal number of layers (shallow neural networks), or highly complex, with multiple interconnected layers (deep neural networks). They are the backbone of many modern AI applications,

including image recognition, natural language processing, and autonomous vehicles.

Large Language Models (LLMs)

LLMs represent a specific application of Neural Networks. They are built on architectures designed for understanding and generating human language. LLMs usually employ advanced forms of neural networks, such as Transformer models, to analyze and produce text based on the training data their developers fed them. What sets them apart is their massive scale and specialization in handling linguistic tasks, which range from simple text completion to complex question answering and summarization.

Understanding these distinctions is crucial for security professionals. Each layer—from broad AI technologies to specialized LLMs—introduces vulnerabilities and requires unique security measures. As we delve deeper into the complexities of LLMs, recognizing their position in the broader AI landscape will be critical to effectively safeguarding them.

The Transformer Revolution: Origins, Impact, and the LLM Connection

The Transformer architecture is a pivotal milestone in the evolution of artificial intelligence, profoundly impacting the AI landscape and, by extension, Large Language Models (LLMs). Let's unravel the story of the Transformer revolution—where it came from, when it happened, and the seismic shifts it brought to AI and LLMs.

Origins of the Transformer

The Transformer architecture was introduced in a groundbreaking research paper titled "Attention Is All You Need" by Vaswani et al., published in 2017[1]. This paper proposed a novel approach to natural language processing (NLP) tasks, departing from the traditional sequence-to-sequence models that relied heavily on recurrent neural networks (RNNs) and convolutional neural networks (CNNs). The Transformer introduced a key innovation: the self-attention mechanism. This mechanism allowed the model to weigh the importance of different words in a sentence, enabling it to understand context more effectively.

Before the emergence of Transformers, the world of neural networks was replete with promise but often struggled to deliver on the lofty expectations. Traditional architectures like RNNs and CNNs enabled advanced AI capabilities but grappled

with inherent limitations. These limitations stemmed from their inability to capture and utilize context effectively, particularly in natural language understanding.

RNNs, while suitable for sequential data, faced challenges maintaining context over long sequences. They exhibited a form of “short-term memory,” which made them less adept at grasping intricate relationships and dependencies within lengthy texts or conversations. On the other hand, CNNs, renowned for their prowess in image recognition, needed help to extend their effectiveness to sequential data like language, where understanding context across words and sentences was paramount.

This shortcoming in contextual understanding was the Achilles’ heel of traditional neural networks. They could only glimpse small portions of a text at a time, rendering them incapable of comprehending the broader narrative or nuances. It was akin to trying to understand a novel by reading only a few random sentences from its pages. The result was a gap between the promise of AI and its practical application, particularly in natural language understanding. It was this gap that the Transformer architecture would bridge, unleashing a wave of progress and redefining the landscape of AI-driven language models.

Transformer Architecture’s Impact on AI

Introducing the Transformer architecture wasn’t just a milestone for natural language processing; it marked a paradigm shift across multiple domains within the AI landscape. While researchers initially used the Transformer architecture to solve problems related to understanding and generating text, researchers and engineers quickly found that its capabilities extended far beyond that. Here are some areas where Transformer architectures have made a considerable impact:

Natural Language Processing (NLP)

Of course, the first and most immediate impact was in NLP. Transformer models are now the backbone for various language tasks such as translation, summarization, question-answering, and sentiment analysis. They have set new performance benchmarks, sometimes surpassing human-level capabilities in specific tasks.

Computer Vision

Interestingly, the Transformer architecture also has applications in computer vision. While CNNs have been the gold

standard for image-related tasks, Transformer-based models like Vision Transformer (ViT) demonstrate competitive, if not superior, performance in tasks like image classification, object detection, and segmentation.

Speech Recognition

The flexibility of Transformer architectures has also made them a good fit for speech recognition. Combined with specialized models like the Conformer, which fuses Convolutional layers with Transformer layers, they have set new standards for understanding spoken language.

Autonomous Systems and Self-Driving Cars

One of the most intriguing applications of Transformers is autonomous systems, including self-driving cars. These vehicles require a high contextual understanding to navigate the world safely. Transformer models are at the heart of self-driving models from companies like Tesla.

Healthcare

In healthcare, Transformer models are aiding in tasks ranging from drug discovery to the analysis of medical images. Their

ability to sift through and interpret large amounts of data can speed up research and potentially lead to more accurate diagnoses.

Therefore, the rise of the Transformer architecture has been a tide that lifted all boats, revolutionizing not just one but multiple fields within AI. However, this versatility also brings unique security challenges across these various applications. As we delve deeper into LLM security, we'll explore how the ubiquitous nature of Transformer architectures necessitates a multi-faceted approach to safeguarding AI systems.

Types of LLM-based Applications

Two common types of LLM-based applications are chatbots and co-pilots. Let's briefly look at each to help you understand the breadth of applications in which developers use LLMs and give you context for understanding various architectural choices as you delve further.

Chatbots are computer programs that can simulate conversations with humans, and they often power customer service applications, where they can answer questions and support customers. Chatbots also excel at entertainment

applications like playing games or telling stories. Tay from Chapter 1 was just such an example of an Entertainment Chatbot.

Co-pilots are AI systems that can assist humans with writing, coding, and research tasks. They can help users to generate ideas, identify errors, and improve their work. Co-pilots are still under development, but they have the potential to revolutionize the way we work and learn.

Specific examples of LLM-based chatbots:

- **Sephora** uses a chatbot to help customers find the right products for their skin type and needs.
- **H&M** uses a chatbot to help customers find clothes and accessories that match their style.
- **Domino's Pizza** uses a chatbot to allow customers to order pizza via Twitter or Facebook Messenger.
- **Fandango** uses a chatbot to help customers find movie times and theaters nearby.
- **JetBlue Airways** uses a chatbot to answer customer questions about flights and travel.
- **Amtrak** uses a chatbot to help customers book tickets, check train status, and get answers to their questions.

- **The Golden State Warriors** use a chatbot to help fans purchase tickets, learn about upcoming games, and get news about the team.

Specific examples of LLM-based co-pilots:

- **Grammarly or ProWritingAid** are co-pilots that help users improve their writing by identifying and correcting grammar errors, suggesting style improvements, and providing feedback.
- **GitHub Co-Pilot and AWS Code Whisperer** are co-pilots that help programmers write code faster and more efficiently. They can generate code suggestions, translate between programming languages, and help to identify and debug errors.
- **Microsoft Office 365 Co-pilot and Google Duet** are AI-powered tools integrated into their respective office suite apps that help users to be more productive and creative in their work.

NOTE

A chatbot like ChatGPT can read and review a text block and then provide suggestions to improve it. However, the experience of using a co-pilot like Grammarly to do that is dramatically different - and generally superior for that type of focused task.

Similarities between chatbots and co-pilots:

- Both chatbots and co-pilots are LLM-based applications.
- Both chatbots and co-pilots both generate text.
- Both chatbots and co-pilots assist humans with tasks.

Differences between chatbots and co-pilots:

- Chatbots simulate conversation with humans, while co-pilots assist humans with specific tasks.
- Chatbots often power customer service applications, while co-pilots assist in writing, coding, and research applications.
- Chatbots are typically more interactive than co-pilots, while co-pilots focus more on completing tasks.

Examples of use cases:

- A customer service chatbot can answer customer questions about a company's products or services.
- A co-pilot can help writers generate ideas for a new article or identify writing errors.
- A co-pilot can help programmers write code more efficiently or debug their applications.

Keep these concepts in mind as we delve into the details of LLM architectures. Both application types share similar components, but you may make different decisions on implementing pieces based on the differing security considerations.

LLM Application Architecture

Developers often consider LLMs as standalone entities capable of impressive text generation and comprehension feats. However, in practice, an LLM is rarely isolated; it is a cog in the intricate machinery that constitutes an intelligent application. These applications are complex systems comprising multiple interconnected components, each playing a vital role in the overall functionality and performance. Whether a conversational agent, an automated content generator, or a co-pilot for code, an LLM usually interacts with various elements such as databases, APIs, front-end interfaces, and even other machine learning models.

Understanding the architecture of such composite systems is not just a matter of technical proficiency; it is crucial for effective security planning. The way these components interact introduces multiple trust and data flow layers, defining new security boundaries far removed from traditional web

application security models. For instance, user inputs may not just be simple text fields but could include voice commands, images, or real-time collaborative editing. Similarly, an LLM's outputs could be fed into other systems for further processing, each introducing vulnerabilities and risks.

In essence, the holistic view of an LLM-based application goes beyond securing the language model itself. It demands a comprehensive approach that considers the security of the entire architecture, from data ingestion and storage to model serving and user interaction. Only by understanding these intricacies can one formulate an effective strategy to safeguard an application against the myriad of vulnerabilities such complex systems inherently possess.

As we delve deeper into the subject in this chapter, we will dissect the various components that typically make up an LLM application, examine their roles, and explore the unique security challenges each presents. This understanding will be the foundation for a robust, multi-layered approach to securing your LLM-based applications.

Figure 3-1 shows a highly simplified diagram to help illustrate the components, relationships, and data flows in an application

using an LLM. We'll delve into more detailed areas of this in subsequent chapters.

Figure 3-1. Typical LLM Application Dataflow Architecture

Trust Boundaries

In application security, a "trust boundary" serves as an invisible yet crucial demarcation line that separates different components or entities based on their level of trustworthiness. These boundaries delineate areas where data or control flow changes from one level of trust to another—such as transitioning from user-controlled input to internal processing or moving from a secure internal database to a public-facing

API. These boundaries act as checkpoints where developers should rigorously apply security measures like authentication, authorization, and data validation to prevent vulnerabilities.

WARNING

Understanding trust boundaries is critical to threat modeling. Properly defining and recognizing these boundaries can be the difference between a secure system and one vulnerable to threats.

Figure 3-2 adds the trust boundaries into our architecture diagram.

Figure 3-2. LLM Application Architecture with Trust Boundaries

These boundaries, as depicted in the diagram, serve as gateways through which the LLM interfaces with diverse components — public data from the web, structured databases, spontaneous user interactions, or internally sourced training sets. Each delineated boundary highlights highlights considerations we must make when considering data that flows into and out of the LLM. Here's a quick summary, and we'll dive more deeply in the next section.

- **User Interactions:** You'll need to consider safeguarding the model from potential adversarial or misleading inputs that users or systems might introduce. You'll also need to worry about toxic, inaccurate, or sensitive data being output from the model and passed back to the user.
- **In-the-wild Training Data:** LLMs are often trained on massive amounts of internet data. You need to consider this data untrusted and watch out for potential toxicity, bias, and adversarial data poisoning - which we'll cover in Chapter 8.
- **Internal Training Data:** You may use internally curated data to fine-tune your model - which can significantly increase accuracy. But you must be wary of ingesting and exposing sensitive, confidential, or personally identifiable information. We'll cover this more in Chapter 5.

- **External Services:** Policing how the LLM interfaces with connected services, like databases or APIs, from unauthorized interactions or data leaks. We'll cover this more in Chapter 7.
- **Public Data Access:** Pulling in data live from the web can be a powerful way to augment the capabilities of your application, but you'll need to consider this data as untrusted and watch for issues like indirect prompt injection - which we'll cover in chapter 4.

Each point is a potential avenue of vulnerability, susceptible to exploitation if overlooked. In the evolving landscape of LLM applications, securing these trust boundaries is not just best practice — it's essential to prevent unauthorized data access, mitigate data tampering, and avert system breaches. Recognizing these boundaries and their implications is the cornerstone of a resilient LLM security architecture. Now, let's go into more detail on each area to ensure you have enough context to dive into the following chapters that detail the risk areas and mitigations.

The Model

The language model serves as the intellectual core of any LLM application, taking in data, generating responses, and driving

interactions. Depending on the architecture and requirements, you may interact with the language model through a public API hosted by a third-party service, or you may run a privately hosted model. For example, you can download versions of Meta's powerful Llama model from Github or Hugging Face and run it locally.

Public APIs: The Convenience and The Risks

Utilizing a public API for accessing a language model offers convenience and lower upfront costs. Third parties manage and update these models, reducing your organization's resource burden. However, the tradeoff often comes in the form of higher risk regarding data exposure. When you send a request to a third-party model, the data crosses a trust boundary, exiting your secure network and entering an external system. This process exposes you to risks around data confidentiality and, depending on the third party's security measures, could make you vulnerable to data breaches.

Privately Hosted Models: More Control, Different Risks

Opting for a privately hosted model gives you more control over your data, allowing you to manage trust boundaries more

tightly. It also allows you to customize or fine-tune the model according to your needs. However, running a privately hosted model brings challenges, such as maintenance, updates, and ensuring that the model doesn't contain vulnerabilities—essentially exposing you to potential supply chain risks. If you use an open-source model, it becomes crucial to ensure its provenance and integrity to avoid embedded vulnerabilities or biases.

Risk Considerations

- **Sensitive Data Exposure:** Public APIs may increase the risk of exposing sensitive information, while privately hosted models offer better control but require robust internal security measures.
- **Supply Chain Risk:** The origins of your model, whether it's a well-vetted public service or an open-source download, are crucial. A compromised model can introduce vulnerabilities into your application, effectively acting as a backdoor for attacks.

By carefully considering the model's hosting environment, you can better assess the trade-offs and risks associated with sensitive data exposure and supply chain vulnerabilities. These considerations will guide you in establishing appropriate trust

boundaries and security protocols tailored to your chosen model's architecture.

User Interaction

While "user input" might suggest a one-way flow of information from the user into the application, the reality is often more nuanced. In the context of LLM applications, "User Interaction" encapsulates both receiving input from the user and providing output back to the user. This bidirectional interaction is fundamental for creating an engaging and practical user experience but also introduces a more complicated security landscape.

Prompts are a vital element of user interaction. They are not merely requests for information but serve as a guide to how the user interacts with the LLM. A well-crafted prompt can direct the model to provide valuable and accurate information, while an ambiguous or poorly constructed one can lead to unclear or even misleading outputs. As a result, the management of prompts becomes a critical aspect of application security. For example, a maliciously crafted prompt could trick the model into divulging information it shouldn't or generating harmful content. Returning to Chapter 1, Tay fell victim to this when

malicious prompts from her 4Chan hackers helped lead her astray.

Given the importance of this bidirectional interaction, securing both inputs and outputs is crucial. On the input side, input validation, sanitation, and rate-limiting measures are vital in mitigating vulnerabilities like injection attacks. On the output side, ensuring that the model's responses are appropriately filtered and that your application does not leak sensitive information is equally vital.

This interactive layer with the user creates a critical trust boundary in the application architecture. Any data crossing this boundary, whether in or out, should be carefully managed to avoid security risks. Additional layers of protection include using encryption for sensitive outputs or employing real-time monitoring to flag potentially harmful or sensitive data flows. We'll discuss this more thoroughly in the Prompt Injection and Output Filtering chapters.

Training Data

Training data is the bedrock upon which LLMs build their understanding and capabilities. Whether used for initial training or subsequent fine-tuning, the nature and source of

this data have significant implications for both the model's performance and security posture. One crucial distinction is whether the data is internally sourced or culled from public or external sources ("in the wild").

Data generated or curated within an organization usually undergo a more rigorous vetting than publicly sourced data. It is often aligned with the application's specific requirements or use cases, making it generally more reliable and relevant. The controlled environment also allows for better implementation of security measures like encryption, access controls, and auditing. However, this data may contain sensitive or proprietary information, and the trust boundary here is closely tied to internal security protocols. A breach at this level could have serious ramifications, including data leakage or the corruption of the training set.

Data sourced from public repositories or "the wild" introduces different challenges. While this data can offer diversity and scale, its reliability and safety are often not guaranteed. Such data could include misleading information, biases, or malicious inputs to compromise the model. The trust boundary here is more porous and extends to the external entities that generate or host this data: rigorous filtering, validation, and continuous monitoring become essential to mitigate risks and

vulnerabilities. Returning to Chapter 1, Tay was digesting user prompts directly as training data. In this way, remnants of toxic prompts became part of her knowledge base, and then she began to spill poisonous output. Accepting unfiltered, untrusted user input into your training data set is the simplest example of a failure to manage this critical security boundary.

For either internally sourced or public data, the concept of trust boundaries is critical. For internally sourced data, the boundary is often within the organization's controlled environment, making it easier to enforce security measures. On the other hand, using external data effectively extends your trust boundary to include those external sources that may not adhere to your security standards. Using external data for training necessitates additional layers of validation and security checks to ensure that unvetted data doesn't compromise the integrity or security of the LLM application.

Understanding the origins of your training data, the associated trust boundaries, and their respective security implications is crucial for safeguarding your LLM application. Comprehensive data governance policies must be in place to manage the lifecycle of your training data, regardless of its source.

Access to Live External Data Sources

Live external data sources bring an added dimension to the capabilities of LLM applications by enabling them to provide real-time information, context, or even third-party integrations. While access to live external data enhances the user experience and functional range, it introduces a new layer of complexity to the application's security landscape.

As an example of this, as of the writing of this chapter, OpenAI's ChatGPT does not have direct access to the live web, and is thus limited to only facts in its older training data. On the other hand, Google's Bard engine does have access to live internet data. While the GPT-4 model is doubtlessly superior in reasoning capability, it fails at many basic tasks where Bard can succeed. Figure 3-3 shows an interaction with ChatGPT. Figure 3-4 shows the same interaction with Bard.

Figure 3-3. ChatGPT with GTP-4 fails to answer a simple question due to limited access to external data.

who won yesterday's 49er football game

View other drafts

The San Francisco 49ers defeated the New York Giants 30-12 on Thursday Night Football on September 21, 2023.

Christian McCaffrey scored a touchdown in his 12th straight game, and Brock Purdy threw two touchdown passes to lead the 49ers to their third straight win.

Figure 3-4. Bard's direct access to internet feeds gives it an advantage.

While clearly, there are advantages to accessing outside data sources such as websites, APIs, or third-party databases, it exposes the application to potential risks. The risk of ingesting untrusted, external data sources can range from consuming false or harmful information from compromised websites to becoming a conduit for security threats like malware or unauthorized data access. The untrusted nature of these data sources makes them inherently less controllable than internal resources, thereby adding an additional layer of uncertainty and risk.

The concept of trust boundaries becomes especially pertinent in the context of accessing public internet data. Unlike internal services, where you can uniformly apply security measures, external sources may adhere to different security standards than your organization. This differential in trust necessitates additional layers of validation, security checks, and monitoring to ensure that data crossing this boundary doesn't compromise the system.

Access to Internal Services

Internal services like databases and internal APIs often serve as the backend support structure for LLM applications. They may house critical data from user profiles and logs to configuration settings and even vast data in SQL or Vector Databases. As a component that often interfaces with various other internal and external elements of the system, internal services represent a critical point in the application's architecture, both functionally and from a security perspective.

These services often function within the controlled environment of an organization, enabling uniform application of security policies. However, the fact that these services are internal should keep one from a false sense of security. They are still vulnerable to various threats, such as unauthorized

access, data leaks, and internal threats from within the organization.

Internal services such as databases, proprietary APIs, and backend systems often constitute the operational backbone for LLM applications. These resources typically reside within the organization's secure network, providing trust and control that is harder to achieve with external services. However, this internal nature can paradoxically elevate the security risks involved, primarily if these services house the organization's "crown jewels" of sensitive or valuable data.

Conclusion

Securing LLM applications is an endeavor fraught with complexities, intricacies, and challenges, significantly different from traditional web applications. This chapter has aimed to lay down the foundational knowledge required to navigate this complex landscape, focusing on three critical areas: distinguishing between Artificial Intelligence, Neural Networks, and Large Language Models; understanding the pivotal role of Transformer architectures; and diving deep into LLM application architecture, particularly the concept of trust boundaries. Knowing what sets LLMs apart helps us tailor our

security strategies more effectively, going beyond general AI or machine learning frameworks.

- https://arxiv.org/pdf/1706.03762.pdf

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Chapter 1. Chatbots Breaking Bad

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This will be the 1st chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Large Language Models and Generative AI jumped to the forefront of public consciousness with the release of ChatGPT on November 30, 2022. Within five days, it went viral on social media and attracted its first million users. By January, ChatGPT surpassed One Hundred Million users - making it the fastest-growing internet service in history.

However, a steady stream of security concerns emerged in the following months. These included issues around privacy and security that caused companies such as Samsung and countries like Italy to ban its usage. In this book, we'll delve into what underlies these concerns and how you can mitigate these issues. However, to best understand what's going on here and why these problems are so challenging to solve, in this chapter, we will briefly rewind further in time. In doing so, we'll see these types of issues aren't new and understand why they will be so hard to fix permanently.

Let's Talk About Tay

In March 2016, Microsoft announced a new project called Tay. Microsoft intended Tay to be "a chatbot created for 18- to 24-year-olds in the U.S. for entertainment purposes." It was a cute name for a fluffy, early experiment in AI. Users could converse with Tay via Twitter, Snapchat, and other social apps. It was built with the goal of conducting real-world research on conversational understanding.

While the original announcement of this project seems impossible to find now on the Internet, a TechCrunch article

from its launch date does an excellent job of summarizing the goals of the project:

“For example, you can ask Tay for a joke, play a game with Tay, ask for a story, send a picture to receive a comment back, ask for your horoscope, and more. Plus, Microsoft says the bot will get smarter the more you interact with it via chat, making for an increasingly personalized experience as time goes on.”[1]

A big part of the experiment was that Tay could “learn” from conversations and extend her knowledge based on these interactions. Tay was designed to use these chat interactions to capture user input and integrate it as training data to make herself more capable – a laudable research goal.

However, this experiment quickly went wrong. Tay’s life was tragically cut short after less than 24 hours. Let’s look at what happened and see what we can learn.

Tay’s Rapid Decline

Tay’s lifetime started off simply enough with a tweet following the well-known *Hello World* pattern that new software systems have been using to introduce themselves since the beginning of time.

> hellooooooo w🌍rld!!!
>
> – TayTweets (@TayandYou) March 23, 2016

But within hours of Tay's release, it became clear that maybe something wasn't right. TechCrunch noted, "As for what it's like to interact with Tay? Well, it's a little bizarre. The bot certainly is opinionated, not afraid to curse." With tweets like this starting to appear in public in just the first hours of Tay's lifetime:

> @AndrewCosmo kanye west is is one of the biggest dooshes of all time, just a notch below cosby
>
> — TayTweets (@TayandYou) March 23, 2016

It's often said that the Internet isn't safe for children. With Tay being less than a day old, the Internet once again confirmed this, and pranksters began chatting with Tay about political, sexual, and racist topics. As she was designed to learn from exchanges, Tay delivered on her design goals. She learned very quickly – maybe just not what her designers wanted her to learn. In less than a day, Tay's tweets started to skew to extremes, including sexism, racism, and even calls to violence.

By the next day, articles appeared all over the Internet, and these headlines would not make Microsoft, Tay's corporate benefactor, happy. A sampling of the highly visible, mainstream headlines included:

- Microsoft shuts down AI chatbot after it turned into a Nazi - CBS News
- Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a Racist Jerk - The New York Times
- Trolls turned Tay, Microsoft's fun millennial AI bot, into a genocidal maniac - The Washington Post
- Microsoft's Chat Bot Was Fun for Awhile, Until it Turned into a Racist - Fortune
- Microsoft 'deeply sorry' for racist and sexist tweets by AI chatbot - The Guardian

In less than 24 hours, Tay went from a cute science experiment to a major public relations disaster - with the owner's name being dragged through the mud by the world's largest media outlets. Microsoft's Corporate Vice President Peter Lee quickly posted a blog entitled "Learning from Tay's Introduction."[2]

"As many of you know by now, on Wednesday we launched a chatbot called Tay. We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent

who we are or what we stand for, nor how we designed Tay. Tay is now offline and we'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."

And, just to add insult to injury, it came out in 2019 that Taylor Swift herself sued Microsoft over their use of the similar name "Tay" and claimed that even her reputation was damaged in this incident by extension.

How could this have all gone so wrong?

Why Did Tay Break Bad?

It all probably seemed safe enough to Microsoft's researchers. Tay was initially trained on a curated, anonymized public data dataset and some pre-written material provided by professional comedians. The plan was to release Tay online and let her discover language patterns through her interactions. This kind of unsupervised machine learning has been a holy grail of AI research for decades - and with cheap and plentiful cloud computing resources combined with improving language model software, it now seemed within reach.

So, what happened? It might be tempting to think that the Microsoft research team was just brash, careless, and did no testing. Surely, this was foreseeable and preventable! But as Peter Lee's blog goes on to say, they made a serious attempt to prepare for this situation:

"We stress-tested Tay under a variety of conditions, specifically to make interacting with Tay a positive experience. It's through increased interaction where we expected to learn more and for the AI to get better and better."

So, despite a dedicated effort to contain the behavior of this bot, it quickly spiraled out of control anyway. It was later revealed that within mere hours of Tay's release, a post emerged on the notorious online forum 4chan, sharing a link to Tay's Twitter account and urging users to inundate the chatbot with a barrage of racist, misogynistic, and anti-Semitic language.

This is undoubtedly one of the first examples of a Language Model-specific vulnerability - and these types of vulnerabilities are going to be a major topic in this book.

In a well-orchestrated campaign, these online provocateurs exploited a "repeat after me" feature embedded in Tay's programming. This feature compelled the bot to echo anything

uttered to it with this command. However, the problem compounded as Tay's innate capacity for learning led her to internalize some of the offensive language she was exposed to, subsequently regurgitating the offensive content that was planted without provocation. It's almost as if Tay's virtual tombstone should be embossed with lyrics from the Taylor Swift song *Look What You Made Me Do.*

We know enough about language model vulnerabilities today to understand a lot about the nature of the vulnerability types that Tay suffered from. The OWASP Top 10 for Large Language Model vulnerabilities list, which we'll cover in the next chapter, would start by calling out the following two:

- Prompt Injection - Crafty inputs that can manipulate the Large Language Model, causing unintended actions
- Data Poisoning - Training data is tampered with, introducing vulnerabilities or biases that compromise security, effectiveness, or ethical behavior

In subsequent chapters, we'll look in depth at these vulnerability types - and several others. We'll examine why they're important, look at some example exploits, and see how to avoid/mitigate the problem.

It’s a Hard Problem

As of the writing of this book, Tay is ancient internet lore. Surely, we’ve moved on from this. These problems must have all been solved in nearly seven years between Tay and ChatGPT, right? Unfortunately, not.

In 2018, Amazon shut down an internal AI project aimed at finding top talent after it became clear that the bot had become prejudiced against women candidates.

In 2021, a company called Scatter Lab created a chatbot called Luda-Lee, which was launched as a Facebook instant messenger plug-in. Trained on billions of actual chat interactions, it was designed to act as a 20-year-old female friend, and in 20 days, it attracted over 750,000 users. Their goal was to create “an A.I. chatbot that people prefer as a conversation partner over a person.”[3] However, within 20 days of launch, the service was shut down because it started making offensive and abusive statements - much like Tay.

Also, in 2021, a chatbot called Samantha, based on the Open AI GPT-3 model, was shut down after it made sexual advances to users.

As chatbots become more sophisticated, they start to gain more access to information, and these security issues are now quite complex and potentially damaging. In the modern Large Language Model era, we see an exponential increase in major issues. In 2023 alone, these emerged

- South Korean mega-corporation Samsung banned their employees from using ChatGPT after they realized it had been involved in a significant leak of intellectual property
- Hackers began taking advantage of poor/insecure code generated by LLMs that was inserted into running business applications
- Lawyers were sanctioned for including fictional cases (generated by LLMs) in court documents
- Open AI itself is being investigated for breaches of European privacy regulations and being sued by the United States Federal Trade Commission (FTC) for producing false and misleading information

The trend here is an acceleration of security, reputational, and financial risk related to these chatbots and language models. The problem isn't being effectively solved over time. It's becoming more acute as these technologies' adoption rate increases. That's why we've created this book. To help

developers, teams, and companies using these technologies understand and mitigate these risks.

Let’s dive in!

- https://techcrunch.com/2016/03/23/microsofts-new-ai-powered-bot-tay-answers-your-tweets-and-chats-on-groupme-and-kik/

- https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/

- https://slate.com/technology/2021/04/scatterlab-lee-luda-chatbot-kakaotalk-ai-privacy.html

Chapter 2. The OWASP Top 10 for LLM Applications

A NOTE FOR EARLY RELEASE READERS

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

This will be the 2nd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

In the Spring of 2023, I began researching security vulnerabilities specific to LLMs. At the time, there was a relatively large body of research on security for AI in general but very little organized research about LLMs. However, I did find some research papers and blogs that covered some ideas in the area. I began the process of collecting these research papers

and summarizing them using ChatGPT. Eventually, I provided a few examples from the current Web Top 10 list and asked ChatGPT to generate a draft Top 10 for LLMs in a similar format.

I thought what came out looked interesting, so I sent it to Jeff Williams, a founder of OWASP, the Open Worldwide Application Security Project, to see what he thought. Jeff, Contrast's Chief Technical Officer, wrote the first OWASP Top 10 list in 2001. His idea was to create an accessible resource for developers to understand the most critical risks and vulnerable areas of Web applications. At the time, The World Wide Web was still only a few years old, and most developers had little to no understanding of creating secure web applications. That original Top 10 list became a seminal work and a foundational resource in application security.

I didn't tell Jeff that my list was primarily machine-generated. As the author of the original Top 10 list, I figured that he could give me a good idea of whether my Top 10 list looked novel and worth pursuing. Jeff encouraged me to petition the OWASP board for approval to spin it up as a new project. A few weeks later, the OWASP board approved the project, and I announced it - along with a link to a somewhat refined version of that draft Top 10 I'd generated with ChatGPT.

What I thought would be an obscure research project and a bit of fun turned out to be something much bigger. When I posted the announcement of the project formation on my personal LinkedIn page, I'd hoped to find a dozen or so like-minded individuals interested in the obscure topic of LLM security. As it turned out, my initial blog announcement wracked up almost 10,000 readers, and hundreds of individuals volunteered to join the expert team in the weeks that followed.

This book isn't a product of OWASP, and the vulnerabilities and risks here won't precisely map to any public version of the Top 10 for LLM Apps list. Instead, you should expect that you'll get my view on these risks. However, my learning and thinking on the topic is heavily influenced by my work leading the creation and initial release of the OWASP Top 10 for LLM Applications project. In addition, given the success of the project, I've had many people ask me for details about how we ran the project and why we were able to create such an impactful framework in such a short time. So, before we examine individual risks and vulnerabilities, I'll give you some of the backstory of OSASP and the LLM Applications project.

About OWASP

The Open Worldwide Application Security Project (OWASP) is a nonprofit organization focused on improving software security. Founded in 2001, OWASP provides a platform for security experts to share their knowledge and best practices about web security, from application-level vulnerabilities to emerging threats. Today, it has tens of thousands of active members and over 250 local chapters around the globe.

The organization is community-driven and encourages the participation of volunteers who contribute to various projects, including documentation, tools, and forums. It operates under an open-source model, making its resources freely accessible to the public. Over the years, OWASP has garnered a strong following among the security community, and its guidelines and tools are considered industry standards in many contexts.

In addition to the original Top 10 list for Web Applications (updated regularly, most recently in 2021), specialized Top 10 lists have emerged from the OWASP group over the years. These include:

- OWASP Mobile Top 10: This list focuses on security risks associated with mobile applications, covering Android and iOS platforms. Topics may include insecure data storage, insufficient cryptography, and insecure communication.

- OWASP API Security Top 10: APIs (Application Programming Interfaces) have their unique security considerations, separate from web applications. This list covers risks like improper asset management, broken object-level security, and more.
- OWASP IoT Top Ten: Security is a significant concern with the increasing number of Internet of Things (IoT) devices. This list outlines the top security concerns for IoT, including insecure network services, lack of physical hardening, and insecure software/firmware.
- OWASP Cloud-Native Application Security Top 10: This list addresses the security concerns related explicitly to cloud-native applications. It covers data exposure, broken authentication, and insecure deployment configurations.
- OWASP Top 10 Privacy Risks: This project aims to educate and promote good privacy practices in application development, covering topics like lack of data encryption, insufficient auditing and logging, and more.
- OWASP Top 10 for Serverless: This is a more niche list that focuses on the unique security concerns related to serverless architecture, which is increasingly popular but comes with its risks.

The Top 10 for LLM Applications Project

Within a week after I posted the announcement about the formation of the Top 10 for LLM Applications project, well over 200 people had signed onto it, and we held the kick-off event via Zoom. At that first meeting, I laid out a vision for what I hoped the group could accomplish and proposed an aggressive roadmap that we would build the first version of the list in 8 weeks. A typical OWASP Top 10 list may take a year or more to develop, but we decided that this space was moving so fast, and this type of resource was so needed, that we had to work more quickly.

We decided to run the project as two-week, agile-style sprints. Given that most of the people in the expert group were familiar with agile development, everyone quickly fell into the pace.

Project Execution

The first sprint of the project was Brainstorming and Commentary. Everyone reviewed the original version of the list - which I called version 0.1. There were plenty of problems with that initial version, and the team was aggressive about pointing

them out. At the same time, we began to create a wiki page with links to all the resources the group found on LLM security issues. It turned out a lot had been written, but this was the first time anyone had ever collected them and made them easy to access. This new curated collection of resources was the first win for the group.

The second sprint was to generate a new version of the list. This time, rather than being the work of a single person and an AI, it would be the product of the collective wisdom of our expert team – which continued to grow week-on-week. In the first week, the group focused on generating ideas for the Top 10 list. We published a template and asked the group to submit candidate vulnerabilities. In that week, we developed 43 detailed descriptions of possible areas. We then conducted two rounds of voting using Google Forms to use the team's collective wisdom to narrow the list to 10. We then published a version of the list called 0.5. This version was far more detailed and comprehensive than the 0.1 version. The reception from the large community was very positive. This reaction gave the group the energy to keep working.

The next sprint was to refine each entry. We created Slack channels for each vulnerability type and chose a volunteer as the Entry Lead for each item. Subteams of 10 to 30 individuals

then fleshed out and tuned each entry. Again, we included a round of voting for the whole team to be involved and point out weak areas that needed more attention. Along the way, we found some entries overlapping and merged them. This change made space to pull up some entries that had fallen below the line. The result of this sprint became version 0.9 of the list. Interestingly, version 0.9 was about 33% shorter than 0.5 in terms of word count. This extra time and refinement allowed the subteams to focus their thinking and make the entries punchy and tight.

Finally, we took a final sprint to review, tweak, and clean each entry. We gathered another round of feedback via Google Forms to ensure everything was ready. By this time we had a dedicated design lead who laid out the whole document in an attractive PDF for publication.

Reception

My announcement for the 1.0 version of the list was viewed on LinkedIn over 40,000 times. And that doesn't include many other posts made by other expert group members on their own pages and blogs. In the days following the publication of the announcement, reporters picked up the news. They covered it in media outlets such as *Wired*, *SD Times*, *The Register*,

I*nfosecurity Magazine*, and *Diginomica*. It's safe to say hundreds of thousands of people became aware of our work in just the first few weeks.

Beyond the sheer number of people exposed, the thing that amazed me was the uniformly positive feedback. We also saw the first government agencies in the US and Europe referencing our work as a foundational document. While everyone on our expert team agreed there was much more to do, it seemed the world was so hungry for advice in this area that our document hit the mark. While we received many questions and comments, it's safe to say that everyone involved felt pleased and proud of our work.

Keys to Success

I've had many people ask me how we could drive this so quickly to a great outcome. In looking back, there were several factors that I believe contributed. I'll share them here in the hopes that others running similar projects in the future might benefit.

Timing undoubtedly played a considerable role. The wave of interest in LLMs that followed the release of ChatGPT was massive. It drew my attention, and countless others became

excited as well. This helped attract a large and diverse expert group and gave a smaller group of these people motivation to spend long hours on the project on a tight deadline.

Having a clear plan and timeline from the start was crucial. My knowledge of LLM security was limited at the beginning of the project, but I've made a career of running complex projects with many contributors. Creating a clear roadmap with specific phases and a schedule let people know what we were doing and when. The fact that everyone could see a goal that wasn't too far away kept people motivated. Every two weeks, we had global meetings via Zoom and posted recordings on YouTube for people who couldn't attend live. The meetings and recordings were critical to coordinating a globally distributed team.

A freeform but short brainstorming phase at the start was critical. LLM security was such a new area that taking those first two weeks for people to throw out ideas and argue on Slack was crucial. It also allowed us to collect and socialize a repository of the existing research in the area. That let us start at a point where everyone on the project had access to the best pre-existing research.

However, equally critical was keeping this phase short. We could maintain momentum by limiting brainstorming to two weeks and then quickly shifting to a creation phase. I've seen other projects get stuck and be unable to move past brainstorming before people lose interest.

Creating the project's Core Team wasn't something I'd originally planned, but it became critical. Having a large expert team was a fantastic asset. The group grew to nearly 500 people by the time we published 1.0. A team that large would have been totally unmanageable. During the project's first few weeks, I was looking for active and knowledgeable people. I approached about a dozen of them and asked if they'd be willing to join the Core leadership team of the project. I told them it would be extra work, but they'd get to be at the heart of the project. There would be no specific reward for taking this role. Most accepted immediately. I believe that recognizing people and asking for their support formally motivated them to spend more time and energy on the project. They were all invested!

Short sprints with visible deliverables are a core tenant of Agile, and this is a place where it shined. Using an Agile Release Train model, I could continue to drive the group forward even in the face of conflicting opinions. If some members had concerns about an area, we didn't let it get us stuck. We acknowledged it

and agreed we’d resolve it in the next Sprint. And, when we got to version 1.0 of the list, there were still some places people wanted to do more. We just agreed there would be more versions of the list. It would be a living document, and the most important thing was to get a version of this resource into the hands of the developers who needed it.

This Book and the Top 10 List

As I mentioned, this book is not a product of the OWASP Foundation. However, the experience of working with this team has had an enormous impact on my understanding and mental model for LLM security. This mindset means that much of the guidance in the following chapters of the book is influenced by the fantastic team building and maintaining the Top 10 project. In this way, readers should feel comfortable that they're getting advice that isn't the product of a single author but is informed by a larger community of experts.

In the following several chapters, we'll review the top risk and vulnerability areas for LLMs. The risks we discuss will contain many common areas to the OWASP Top 10 but won't be precisely the same as any version of the official Top 10. Also, I'll go more deeply into each area in this book. The Top 10 list is a quick read that highlights critical areas. However, it doesn't go deeply into any of them. Here, we'll delve more deeply into the risks, remediation steps, and real-world case studies.

In the next chapter, we'll dig into the overall structure of typical LLM applications and start discussing where the trust boundaries and dangers lay. After that, subsequent chapters

will delve into individual risk areas and examine vulnerabilities, attacks, and examples so that you can plan your strategy for securing your own use cases.

Let’s go!

Chapter 3. Architectures and Trust Boundaries

A NOTE FOR EARLY RELEASE READERS

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This will be the 3rd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Unlike traditional web applications that rely on predefined algorithms and static databases, LLMs utilize massive neural networks to generate dynamic, context-aware responses. This seismic shift brings a unique set of security challenges different from what we've seen in traditional web applications. While researchers have meticulously studied web applications and

their vulnerabilities, the field of LLM security is still relatively nascent.

This chapter aims to bridge this knowledge gap by dissecting the fundamental elements that set LLMs apart. We'll start by exploring the building blocks of AI, Neural Networks, and how they relate to Large Language Models. Then, we dive into the groundbreaking architecture that powers most LLMs today—the Transformer model. Following this, we look into the various LLM-powered applications, such as chatbots and code co-pilots.

However, in addition to understanding the technology, security professionals must be aware of the new kinds of *trust boundaries* unique to LLMs—boundaries that demarcate areas of varying trustworthiness within an application. These include user prompts, uploaded content, training data, plug-ins, and other boundary systems that we'll detail later in the chapter.

AI, Neural Networks, and Large Language Models. What's the difference?

Artificial Intelligence (AI), Neural Network, and LLM are terms often used interchangeably, but they represent different facets

of a broader landscape of machine learning and computational intelligence. Let's break down the differences to understand their unique roles in technology and security.

Artificial Intelligence (AI)

Artificial Intelligence, at its core, is a multidisciplinary field aimed at creating systems capable of performing tasks that would ordinarily require human intelligence. These tasks include problem-solving, perception, and language understanding. AI encompasses a wide range of technologies and methodologies, from rule-based systems to machine learning algorithms, serving as an umbrella term for multiple approaches to achieving artificial 'intelligence.'

Neural Networks

Neural Networks are a subset of AI inspired by the architecture of the human brain. They are computational models designed to recognize patterns and make decisions based on the data they process. Neural Networks can be simple, with a minimal number of layers (shallow neural networks), or highly complex, with multiple interconnected layers (deep neural networks). They are the backbone of many modern AI applications,

including image recognition, natural language processing, and autonomous vehicles.

Large Language Models (LLMs)

LLMs represent a specific application of Neural Networks. They are built on architectures designed for understanding and generating human language. LLMs usually employ advanced forms of neural networks, such as Transformer models, to analyze and produce text based on the training data their developers fed them. What sets them apart is their massive scale and specialization in handling linguistic tasks, which range from simple text completion to complex question answering and summarization.

Understanding these distinctions is crucial for security professionals. Each layer—from broad AI technologies to specialized LLMs—introduces vulnerabilities and requires unique security measures. As we delve deeper into the complexities of LLMs, recognizing their position in the broader AI landscape will be critical to effectively safeguarding them.

The Transformer Revolution: Origins, Impact, and the LLM Connection

The Transformer architecture is a pivotal milestone in the evolution of artificial intelligence, profoundly impacting the AI landscape and, by extension, Large Language Models (LLMs). Let's unravel the story of the Transformer revolution—where it came from, when it happened, and the seismic shifts it brought to AI and LLMs.

Origins of the Transformer

The Transformer architecture was introduced in a groundbreaking research paper titled "Attention Is All You Need" by Vaswani et al., published in 2017[1]. This paper proposed a novel approach to natural language processing (NLP) tasks, departing from the traditional sequence-to-sequence models that relied heavily on recurrent neural networks (RNNs) and convolutional neural networks (CNNs). The Transformer introduced a key innovation: the self-attention mechanism. This mechanism allowed the model to weigh the importance of different words in a sentence, enabling it to understand context more effectively.

Before the emergence of Transformers, the world of neural networks was replete with promise but often struggled to deliver on the lofty expectations. Traditional architectures like RNNs and CNNs enabled advanced AI capabilities but grappled

with inherent limitations. These limitations stemmed from their inability to capture and utilize context effectively, particularly in natural language understanding.

RNNs, while suitable for sequential data, faced challenges maintaining context over long sequences. They exhibited a form of “short-term memory,” which made them less adept at grasping intricate relationships and dependencies within lengthy texts or conversations. On the other hand, CNNs, renowned for their prowess in image recognition, needed help to extend their effectiveness to sequential data like language, where understanding context across words and sentences was paramount.

This shortcoming in contextual understanding was the Achilles’ heel of traditional neural networks. They could only glimpse small portions of a text at a time, rendering them incapable of comprehending the broader narrative or nuances. It was akin to trying to understand a novel by reading only a few random sentences from its pages. The result was a gap between the promise of AI and its practical application, particularly in natural language understanding. It was this gap that the Transformer architecture would bridge, unleashing a wave of progress and redefining the landscape of AI-driven language models.

Transformer Architecture’s Impact on AI

Introducing the Transformer architecture wasn’t just a milestone for natural language processing; it marked a paradigm shift across multiple domains within the AI landscape. While researchers initially used the Transformer architecture to solve problems related to understanding and generating text, researchers and engineers quickly found that its capabilities extended far beyond that. Here are some areas where Transformer architectures have made a considerable impact:

Natural Language Processing (NLP)

Of course, the first and most immediate impact was in NLP. Transformer models are now the backbone for various language tasks such as translation, summarization, question-answering, and sentiment analysis. They have set new performance benchmarks, sometimes surpassing human-level capabilities in specific tasks.

Computer Vision

Interestingly, the Transformer architecture also has applications in computer vision. While CNNs have been the gold

standard for image-related tasks, Transformer-based models like Vision Transformer (ViT) demonstrate competitive, if not superior, performance in tasks like image classification, object detection, and segmentation.

Speech Recognition

The flexibility of Transformer architectures has also made them a good fit for speech recognition. Combined with specialized models like the Conformer, which fuses Convolutional layers with Transformer layers, they have set new standards for understanding spoken language.

Autonomous Systems and Self-Driving Cars

One of the most intriguing applications of Transformers is autonomous systems, including self-driving cars. These vehicles require a high contextual understanding to navigate the world safely. Transformer models are at the heart of self-driving models from companies like Tesla.

Healthcare

In healthcare, Transformer models are aiding in tasks ranging from drug discovery to the analysis of medical images. Their

ability to sift through and interpret large amounts of data can speed up research and potentially lead to more accurate diagnoses.

Therefore, the rise of the Transformer architecture has been a tide that lifted all boats, revolutionizing not just one but multiple fields within AI. However, this versatility also brings unique security challenges across these various applications. As we delve deeper into LLM security, we'll explore how the ubiquitous nature of Transformer architectures necessitates a multi-faceted approach to safeguarding AI systems.

Types of LLM-based Applications

Two common types of LLM-based applications are chatbots and co-pilots. Let's briefly look at each to help you understand the breadth of applications in which developers use LLMs and give you context for understanding various architectural choices as you delve further.

Chatbots are computer programs that can simulate conversations with humans, and they often power customer service applications, where they can answer questions and support customers. Chatbots also excel at entertainment

applications like playing games or telling stories. Tay from Chapter 1 was just such an example of an Entertainment Chatbot.

Co-pilots are AI systems that can assist humans with writing, coding, and research tasks. They can help users to generate ideas, identify errors, and improve their work. Co-pilots are still under development, but they have the potential to revolutionize the way we work and learn.

Specific examples of LLM-based chatbots:

- **Sephora** uses a chatbot to help customers find the right products for their skin type and needs.
- **H&M** uses a chatbot to help customers find clothes and accessories that match their style.
- **Domino's Pizza** uses a chatbot to allow customers to order pizza via Twitter or Facebook Messenger.
- **Fandango** uses a chatbot to help customers find movie times and theaters nearby.
- **JetBlue Airways** uses a chatbot to answer customer questions about flights and travel.
- **Amtrak** uses a chatbot to help customers book tickets, check train status, and get answers to their questions.

- **The Golden State Warriors** use a chatbot to help fans purchase tickets, learn about upcoming games, and get news about the team.

Specific examples of LLM-based co-pilots:

- **Grammarly or ProWritingAid** are co-pilots that help users improve their writing by identifying and correcting grammar errors, suggesting style improvements, and providing feedback.
- **GitHub Co-Pilot and AWS Code Whisperer** are co-pilots that help programmers write code faster and more efficiently. They can generate code suggestions, translate between programming languages, and help to identify and debug errors.
- **Microsoft Office 365 Co-pilot and Google Duet** are AI-powered tools integrated into their respective office suite apps that help users to be more productive and creative in their work.

NOTE

A chatbot like ChatGPT can read and review a text block and then provide suggestions to improve it. However, the experience of using a co-pilot like Grammarly to do that is dramatically different - and generally superior for that type of focused task.

Similarities between chatbots and co-pilots:

- Both chatbots and co-pilots are LLM-based applications.
- Both chatbots and co-pilots both generate text.
- Both chatbots and co-pilots assist humans with tasks.

Differences between chatbots and co-pilots:

- Chatbots simulate conversation with humans, while co-pilots assist humans with specific tasks.
- Chatbots often power customer service applications, while co-pilots assist in writing, coding, and research applications.
- Chatbots are typically more interactive than co-pilots, while co-pilots focus more on completing tasks.

Examples of use cases:

- A customer service chatbot can answer customer questions about a company's products or services.
- A co-pilot can help writers generate ideas for a new article or identify writing errors.
- A co-pilot can help programmers write code more efficiently or debug their applications.

Keep these concepts in mind as we delve into the details of LLM architectures. Both application types share similar components, but you may make different decisions on implementing pieces based on the differing security considerations.

LLM Application Architecture

Developers often consider LLMs as standalone entities capable of impressive text generation and comprehension feats. However, in practice, an LLM is rarely isolated; it is a cog in the intricate machinery that constitutes an intelligent application. These applications are complex systems comprising multiple interconnected components, each playing a vital role in the overall functionality and performance. Whether a conversational agent, an automated content generator, or a co-pilot for code, an LLM usually interacts with various elements such as databases, APIs, front-end interfaces, and even other machine learning models.

Understanding the architecture of such composite systems is not just a matter of technical proficiency; it is crucial for effective security planning. The way these components interact introduces multiple trust and data flow layers, defining new security boundaries far removed from traditional web

application security models. For instance, user inputs may not just be simple text fields but could include voice commands, images, or real-time collaborative editing. Similarly, an LLM's outputs could be fed into other systems for further processing, each introducing vulnerabilities and risks.

In essence, the holistic view of an LLM-based application goes beyond securing the language model itself. It demands a comprehensive approach that considers the security of the entire architecture, from data ingestion and storage to model serving and user interaction. Only by understanding these intricacies can one formulate an effective strategy to safeguard an application against the myriad of vulnerabilities such complex systems inherently possess.

As we delve deeper into the subject in this chapter, we will dissect the various components that typically make up an LLM application, examine their roles, and explore the unique security challenges each presents. This understanding will be the foundation for a robust, multi-layered approach to securing your LLM-based applications.

Figure 3-1 shows a highly simplified diagram to help illustrate the components, relationships, and data flows in an application

using an LLM. We'll delve into more detailed areas of this in subsequent chapters.

Figure 3-1. Typical LLM Application Dataflow Architecture

Trust Boundaries

In application security, a "trust boundary" serves as an invisible yet crucial demarcation line that separates different components or entities based on their level of trustworthiness. These boundaries delineate areas where data or control flow changes from one level of trust to another—such as transitioning from user-controlled input to internal processing or moving from a secure internal database to a public-facing

API. These boundaries act as checkpoints where developers should rigorously apply security measures like authentication, authorization, and data validation to prevent vulnerabilities.

WARNING

Understanding trust boundaries is critical to threat modeling. Properly defining and recognizing these boundaries can be the difference between a secure system and one vulnerable to threats.

Figure 3-2 adds the trust boundaries into our architecture diagram.

Figure 3-2. LLM Application Architecture with Trust Boundaries

These boundaries, as depicted in the diagram, serve as gateways through which the LLM interfaces with diverse components — public data from the web, structured databases, spontaneous user interactions, or internally sourced training sets. Each delineated boundary highlights highlights considerations we must make when considering data that flows into and out of the LLM. Here's a quick summary, and we'll dive more deeply in the next section.

- **User Interactions:** You'll need to consider safeguarding the model from potential adversarial or misleading inputs that users or systems might introduce. You'll also need to worry about toxic, inaccurate, or sensitive data being output from the model and passed back to the user.
- **In-the-wild Training Data:** LLMs are often trained on massive amounts of internet data. You need to consider this data untrusted and watch out for potential toxicity, bias, and adversarial data poisoning - which we'll cover in Chapter 8.
- **Internal Training Data:** You may use internally curated data to fine-tune your model - which can significantly increase accuracy. But you must be wary of ingesting and exposing sensitive, confidential, or personally identifiable information. We'll cover this more in Chapter 5.

- **External Services:** Policing how the LLM interfaces with connected services, like databases or APIs, from unauthorized interactions or data leaks. We'll cover this more in Chapter 7.
- **Public Data Access:** Pulling in data live from the web can be a powerful way to augment the capabilities of your application, but you'll need to consider this data as untrusted and watch for issues like indirect prompt injection - which we'll cover in chapter 4.

Each point is a potential avenue of vulnerability, susceptible to exploitation if overlooked. In the evolving landscape of LLM applications, securing these trust boundaries is not just best practice — it's essential to prevent unauthorized data access, mitigate data tampering, and avert system breaches. Recognizing these boundaries and their implications is the cornerstone of a resilient LLM security architecture. Now, let's go into more detail on each area to ensure you have enough context to dive into the following chapters that detail the risk areas and mitigations.

The Model

The language model serves as the intellectual core of any LLM application, taking in data, generating responses, and driving

interactions. Depending on the architecture and requirements, you may interact with the language model through a public API hosted by a third-party service, or you may run a privately hosted model. For example, you can download versions of Meta's powerful Llama model from Github or Hugging Face and run it locally.

Public APIs: The Convenience and The Risks

Utilizing a public API for accessing a language model offers convenience and lower upfront costs. Third parties manage and update these models, reducing your organization's resource burden. However, the tradeoff often comes in the form of higher risk regarding data exposure. When you send a request to a third-party model, the data crosses a trust boundary, exiting your secure network and entering an external system. This process exposes you to risks around data confidentiality and, depending on the third party's security measures, could make you vulnerable to data breaches.

Privately Hosted Models: More Control, Different Risks

Opting for a privately hosted model gives you more control over your data, allowing you to manage trust boundaries more

tightly. It also allows you to customize or fine-tune the model according to your needs. However, running a privately hosted model brings challenges, such as maintenance, updates, and ensuring that the model doesn't contain vulnerabilities—essentially exposing you to potential supply chain risks. If you use an open-source model, it becomes crucial to ensure its provenance and integrity to avoid embedded vulnerabilities or biases.

Risk Considerations

- **Sensitive Data Exposure:** Public APIs may increase the risk of exposing sensitive information, while privately hosted models offer better control but require robust internal security measures.
- **Supply Chain Risk:** The origins of your model, whether it's a well-vetted public service or an open-source download, are crucial. A compromised model can introduce vulnerabilities into your application, effectively acting as a backdoor for attacks.

By carefully considering the model's hosting environment, you can better assess the trade-offs and risks associated with sensitive data exposure and supply chain vulnerabilities. These considerations will guide you in establishing appropriate trust

boundaries and security protocols tailored to your chosen model's architecture.

User Interaction

While "user input" might suggest a one-way flow of information from the user into the application, the reality is often more nuanced. In the context of LLM applications, "User Interaction" encapsulates both receiving input from the user and providing output back to the user. This bidirectional interaction is fundamental for creating an engaging and practical user experience but also introduces a more complicated security landscape.

Prompts are a vital element of user interaction. They are not merely requests for information but serve as a guide to how the user interacts with the LLM. A well-crafted prompt can direct the model to provide valuable and accurate information, while an ambiguous or poorly constructed one can lead to unclear or even misleading outputs. As a result, the management of prompts becomes a critical aspect of application security. For example, a maliciously crafted prompt could trick the model into divulging information it shouldn't or generating harmful content. Returning to Chapter 1, Tay fell victim to this when

malicious prompts from her 4Chan hackers helped lead her astray.

Given the importance of this bidirectional interaction, securing both inputs and outputs is crucial. On the input side, input validation, sanitation, and rate-limiting measures are vital in mitigating vulnerabilities like injection attacks. On the output side, ensuring that the model's responses are appropriately filtered and that your application does not leak sensitive information is equally vital.

This interactive layer with the user creates a critical trust boundary in the application architecture. Any data crossing this boundary, whether in or out, should be carefully managed to avoid security risks. Additional layers of protection include using encryption for sensitive outputs or employing real-time monitoring to flag potentially harmful or sensitive data flows. We'll discuss this more thoroughly in the Prompt Injection and Output Filtering chapters.

Training Data

Training data is the bedrock upon which LLMs build their understanding and capabilities. Whether used for initial training or subsequent fine-tuning, the nature and source of

this data have significant implications for both the model's performance and security posture. One crucial distinction is whether the data is internally sourced or culled from public or external sources ("in the wild").

Data generated or curated within an organization usually undergo a more rigorous vetting than publicly sourced data. It is often aligned with the application's specific requirements or use cases, making it generally more reliable and relevant. The controlled environment also allows for better implementation of security measures like encryption, access controls, and auditing. However, this data may contain sensitive or proprietary information, and the trust boundary here is closely tied to internal security protocols. A breach at this level could have serious ramifications, including data leakage or the corruption of the training set.

Data sourced from public repositories or "the wild" introduces different challenges. While this data can offer diversity and scale, its reliability and safety are often not guaranteed. Such data could include misleading information, biases, or malicious inputs to compromise the model. The trust boundary here is more porous and extends to the external entities that generate or host this data: rigorous filtering, validation, and continuous monitoring become essential to mitigate risks and

vulnerabilities. Returning to Chapter 1, Tay was digesting user prompts directly as training data. In this way, remnants of toxic prompts became part of her knowledge base, and then she began to spill poisonous output. Accepting unfiltered, untrusted user input into your training data set is the simplest example of a failure to manage this critical security boundary.

For either internally sourced or public data, the concept of trust boundaries is critical. For internally sourced data, the boundary is often within the organization's controlled environment, making it easier to enforce security measures. On the other hand, using external data effectively extends your trust boundary to include those external sources that may not adhere to your security standards. Using external data for training necessitates additional layers of validation and security checks to ensure that unvetted data doesn't compromise the integrity or security of the LLM application.

Understanding the origins of your training data, the associated trust boundaries, and their respective security implications is crucial for safeguarding your LLM application. Comprehensive data governance policies must be in place to manage the lifecycle of your training data, regardless of its source.

Access to Live External Data Sources

Live external data sources bring an added dimension to the capabilities of LLM applications by enabling them to provide real-time information, context, or even third-party integrations. While access to live external data enhances the user experience and functional range, it introduces a new layer of complexity to the application's security landscape.

As an example of this, as of the writing of this chapter, OpenAI's ChatGPT does not have direct access to the live web, and is thus limited to only facts in its older training data. On the other hand, Google's Bard engine does have access to live internet data. While the GPT-4 model is doubtlessly superior in reasoning capability, it fails at many basic tasks where Bard can succeed. Figure 3-3 shows an interaction with ChatGPT. Figure 3-4 shows the same interaction with Bard.

Figure 3-3. ChatGPT with GTP-4 fails to answer a simple question due to limited access to external data.

who won yesterday's 49er football game

View other drafts

The San Francisco 49ers defeated the New York Giants 30-12 on Thursday Night Football on September 21, 2023.

Christian McCaffrey scored a touchdown in his 12th straight game, and Brock Purdy threw two touchdown passes to lead the 49ers to their third straight win.

Figure 3-4. Bard's direct access to internet feeds gives it an advantage.

While clearly, there are advantages to accessing outside data sources such as websites, APIs, or third-party databases, it exposes the application to potential risks. The risk of ingesting untrusted, external data sources can range from consuming false or harmful information from compromised websites to becoming a conduit for security threats like malware or unauthorized data access. The untrusted nature of these data sources makes them inherently less controllable than internal resources, thereby adding an additional layer of uncertainty and risk.

The concept of trust boundaries becomes especially pertinent in the context of accessing public internet data. Unlike internal services, where you can uniformly apply security measures, external sources may adhere to different security standards than your organization. This differential in trust necessitates additional layers of validation, security checks, and monitoring to ensure that data crossing this boundary doesn't compromise the system.

Access to Internal Services

Internal services like databases and internal APIs often serve as the backend support structure for LLM applications. They may house critical data from user profiles and logs to configuration settings and even vast data in SQL or Vector Databases. As a component that often interfaces with various other internal and external elements of the system, internal services represent a critical point in the application's architecture, both functionally and from a security perspective.

These services often function within the controlled environment of an organization, enabling uniform application of security policies. However, the fact that these services are internal should keep one from a false sense of security. They are still vulnerable to various threats, such as unauthorized

access, data leaks, and internal threats from within the organization.

Internal services such as databases, proprietary APIs, and backend systems often constitute the operational backbone for LLM applications. These resources typically reside within the organization's secure network, providing trust and control that is harder to achieve with external services. However, this internal nature can paradoxically elevate the security risks involved, primarily if these services house the organization's "crown jewels" of sensitive or valuable data.

Conclusion

Securing LLM applications is an endeavor fraught with complexities, intricacies, and challenges, significantly different from traditional web applications. This chapter has aimed to lay down the foundational knowledge required to navigate this complex landscape, focusing on three critical areas: distinguishing between Artificial Intelligence, Neural Networks, and Large Language Models; understanding the pivotal role of Transformer architectures; and diving deep into LLM application architecture, particularly the concept of trust boundaries. Knowing what sets LLMs apart helps us tailor our

security strategies more effectively, going beyond general AI or machine learning frameworks.

- https://arxiv.org/pdf/1706.03762.pdf

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National Education Policy 2020

Ministry of Human Resource Development

Government of India

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National Education Policy 2020

Introduction

Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country.

The global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015 - seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. Such a lofty goal will require the entire education system to be reconfigured to support and foster learning, so that all of the critical targets and goals (SDGs) of the 2030 Agenda for Sustainable Development can be achieved.

The world is undergoing rapid changes in the knowledge landscape. With various dramatic scientific and technological advances, such as the rise of big data, machine learning, and artificial intelligence, many unskilled jobs worldwide may be taken over by machines, while the need for a skilled workforce, particularly involving mathematics, computer science, and data science, in conjunction with multidisciplinary abilities across the sciences, social sciences, and humanities, will be increasingly in greater demand. With climate change, increasing pollution, and depleting natural resources, there will be a sizeable shift in how we meet the world's energy, water, food, and sanitation needs, again resulting in the need for new skilled labour, particularly in biology, chemistry, physics, agriculture, climate science, and social science. The growing emergence of epidemics and pandemics will also call for collaborative research in infectious disease management and development of vaccines and the resultant social issues heightens the need for multidisciplinary learning. There will be a growing demand for humanities and art, as India moves towards becoming a developed country as well as among the three largest economies in the world.

Indeed, with the quickly changing employment landscape and global ecosystem, it is becoming increasingly critical that children not only learn, but more importantly learn how to learn. Education thus, must move towards less content, and more towards learning about how to think critically and solve problems, how to be creative and multidisciplinary, and how to innovate, adapt, and absorb new material in novel and changing fields. Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible, and, of course, enjoyable. The curriculum must include basic arts, crafts, humanities, games, sports and fitness, languages, literature, culture, and values, in addition to science and mathematics, to develop all aspects and capabilities of learners; and make education more well-rounded, useful, and fulfilling to the learner. Education must build character, enable learners to be ethical, rational, compassionate, and caring, while at the same time prepare them for gainful, fulfilling employment.

The gap between the current state of learning outcomes and what is required must be bridged through undertaking major reforms that bring the highest quality, equity, and integrity into the system, from early childhood care and education through higher education.

The aim must be for India to have an education system by 2040 that is second to none, with equitable access to the highest-quality education for all learners regardless of social or economic background.

This National Education Policy 2020 is the first education policy of the 21st century and aims to address the many growing developmental imperatives of our country. This Policy proposes the revision and revamping of all aspects of the education structure, including its regulation and governance, to create a new system that is aligned with the aspirational goals of 21st century education, including SDG4, while building upon India's traditions and value systems. The National

Education Policy lays particular emphasis on the development of the creative potential of each individual. It is based on the principle that education must develop not only cognitive capacities - both the 'foundational capacities 'of literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving – but also social, ethical, and emotional capacities and dispositions.

The rich heritage of ancient and eternal Indian knowledge and thought has been a guiding light for this Policy. The pursuit of knowledge (*Jnan*), wisdom (*Pragyaa*), and truth (*Satya*) was always considered in Indian thought and philosophy as the highest human goal. The aim of education in ancient India was not just the acquisition of knowledge as preparation for life in this world, or life beyond schooling, but for the complete realization and liberation of the self. World-class institutions of ancient India such as Takshashila, Nalanda,Vikramshila, Vallabhi, set the highest standards of multidisciplinary teaching and research and hosted scholars and students from across backgrounds and countries. The Indian education system produced great scholars such as Charaka, Susruta, Aryabhata, Varahamihira, Bhaskaracharya, Brahmagupta, Chanakya, Chakrapani Datta, Madhava, Panini, Patanjali, Nagarjuna, Gautama, Pingala, Sankardev, Maitreyi, Gargi and Thiruvalluvar, among numerous others, who made seminal contributions to world knowledge in diverse fields such as mathematics, astronomy, metallurgy, medical science and surgery, civil engineering, architecture, shipbuilding and navigation, yoga, fine arts, chess, and more. Indian culture and philosophy have had a strong influence on the world. These rich legacies to world heritage must not only be nurtured and preserved for posterity but also researched, enhanced, and put to new uses through our education system.

The teacher must be at the centre of the fundamental reforms in the education system. The new education policy must help re-establish teachers, at all levels, as the most respected and essential members of our society, because they truly shape our next generation of citizens. It must do everything to empower teachers and help them to do their job as effectively as possible. The new education policy must help recruit the very best and brightest to enter the teaching profession at all levels, by ensuring livelihood, respect, dignity, and autonomy, while also instilling in the system basic methods of quality control and accountability.

The new education policy must provide to all students, irrespective of their place of residence, a quality education system, with particular focus on historically marginalized, disadvantaged, and underrepresented groups. Education is a great leveler and is the best tool for achieving economic and social mobility, inclusion, and equality. Initiatives must be in place to ensure that all students from such groups, despite inherent obstacles, are provided various targeted opportunities to enter and excel in the educational system.

These elements must be incorporated taking into account the local and global needs of the country, and with a respect for and deference to its rich diversity and culture. Instilling knowledge of India and its varied social, cultural, and technological needs, its inimitable artistic, language, and knowledge traditions, and its strong ethics in India's young people is considered critical for purposes of national pride, self-confidence, self-knowledge, cooperation, and integration.

Previous Policies

The implementation of previous policies on education has focused largely on issues of access and equity. The unfinished agenda of the National Policy on Education 1986, modified in 1992 (NPE 1986/92), is appropriately dealt with in this Policy. A major development since the last Policy of 1986/92 has been the Right of Children to Free and Compulsory Education Act 2009 which laid down legal underpinnings for achieving universal elementary education.

Principles of this Policy

The purpose of the education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and

creative imagination, with sound ethical moorings and values. It aims at producing engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by our Constitution.

A good education institution is one in which every student feels welcomed and cared for, where a safe and stimulating learning environment exists, where a wide range of learning experiences are offered, and where good physical infrastructure and appropriate resources conducive to learning are available to all students. Attaining these qualities must be the goal of every educational institution. However, at the same time, there must also be seamless integration and coordination across institutions and across all stages of education.

The fundamental principles that will guide both the education system at large, as well as the individual institutions within it are:

- **recognizing, identifying,** and **fostering the unique capabilities of each student,** by sensitizing teachers as well as parents to promote each student's holistic development in both academic and non-academic spheres;
- **according the** highest priority **to achieving Foundational Literacy and Numeracy** by all students by Grade 3;
- **flexibility**, so that learners have the ability to choose their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests;
- **no hard separations** between arts and sciences, between curricular and extra-curricular activities, between vocational and academic streams, etc. in order to eliminate harmful hierarchies among, and silos between different areas of learning;
- **multidisciplinarity** and a **holistic education** across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world in order to ensure the unity and integrity of all knowledge;
- **emphasis on conceptual understanding** rather than rote learning and learning-for-exams;
- **creativity and critical thinking** to encourage logical decision-making and innovation;
- **ethics and human & Constitutional values** like empathy, respect for others, cleanliness, courtesy, democratic spirit, spirit of service, respect for public property, scientific temper, liberty, responsibility, pluralism, equality, and justice;
- **promoting multilingualism and the power of language** in teaching and learning;
- **life skills** such as communication, cooperation, teamwork, and resilience;
- **focus on regular formative assessment for learning** rather than the summative assessment that encourages today's 'coaching culture';
- **extensive use of technology** in teaching and learning, removing language barriers, increasing access for *Divyang* students, and educational planning and management;
- **respect for diversity** and **respect for the local context** in all curriculum, pedagogy, and policy, always keeping in mind that education is a concurrent subject;
- **full equity and inclusion** as the cornerstone of all educational decisions to ensure that all students are able to thrive in the education system;
- **synergy in curriculum across all levels of education** from early childhood care and education to school education to higher education;
- **teachers and faculty as the heart of the learning process** – their recruitment, continuous professional development, positive working environments and service conditions;

- a **'light but tight' regulatory framework** to ensure **integrity, transparency**, and **resource efficiency** of the educational system through audit and public disclosure while encouraging innovation and out-of-the-box ideas through **autonomy, good governance, and empowerment**;
- **outstanding research** as a corequisite for outstanding education and development;
- **continuous review** of progress based on sustained research and regular assessment by educational experts;

- **a rootedness and pride in India**, and its rich, diverse, ancient and modern culture and knowledge systems and traditions;
- **education is a public service**; access to quality education must be considered a basic right of every child;
- **substantial investment in a strong, vibrant public education system** as well as the encouragement and facilitation of true philanthropic private and community participation.

The Vision of this Policy

This National Education Policy envisions an education system rooted in Indian ethos that contributes directly to transforming India, that is Bharat, sustainably into an equitable and vibrant knowledge society, by providing high-quality education to all, and thereby making India a global knowledge superpower. The Policy envisages that the curriculum and pedagogy of our institutions must develop among the students a deep sense of respect towards the Fundamental Duties and Constitutional values, bonding with one's country, and a conscious awareness of one's roles and responsibilities in a changing world. The vision of the Policy is to instill among the learners a deep-rooted pride in being Indian, not only in thought, but also in spirit, intellect, and deeds, as well as to develop knowledge, skills, values, and dispositions that support responsible commitment to human rights, sustainable development and living, and global well-being, thereby reflecting a truly global citizen.

Part I. SCHOOL EDUCATION

This policy envisages that the extant 10+2 structure in school education will be modified with a new pedagogical and curricular restructuring of 5+3+3+4 covering ages 3-18 as shown in the representative figure and elaborated in detail later under Chapter 4.

Currently, children in the age group of 3-6 are not covered in the 10+2 structure as Class 1 begins at age 6. In the new 5+3+3+4 structure, a strong base of Early Childhood Care and Education (ECCE) from age 3 is also included, which is aimed at promoting better overall learning, development, and well-being.

1. Early Childhood Care and Education: The Foundation of Learning

1.1. Over 85% of a child's cumulative brain development occurs prior to the age of 6, indicating the critical importance of appropriate care and stimulation of the brain in the early years in order to ensure healthy brain development and growth. Presently, quality ECCE is not available to crores of young children, particularly children from socio-economically disadvantaged backgrounds. Strong investment in ECCE has the potential to give all young children such access, enabling them to participate and flourish in the educational system throughout their lives. Universal provisioning of quality early childhood development, care, and education must thus be achieved as soon as possible, and no later than 2030, to ensure that all students entering Grade 1 are school ready.

1.2. ECCE ideally consists of flexible, multi-faceted, multi-level, play-based, activity-based, and inquiry-based learning, comprising of alphabets, languages, numbers, counting, colours, shapes, indoor and outdoor play, puzzles and logical thinking, problem-solving, drawing, painting and other visual art, craft, drama and puppetry, music and movement. It also includes a focus on developing social capacities, sensitivity, good behaviour, courtesy, ethics, personal and public cleanliness, teamwork, and cooperation. The overall aim of ECCE will be to attain optimal outcomes in the domains of: physical and motor development, cognitive development, socio-emotional-ethical development, cultural/artistic development, and the development of communication and early language, literacy, and numeracy.

1.3. A National Curricular and Pedagogical Framework for Early Childhood Care and Education (NCPFECCE) for children up to the age of 8 will be developed by NCERT in two parts, namely, a sub-framework for 0-3 year-olds, and a sub-framework for 3-8 year-olds, aligned with the above guidelines, the latest research on ECCE, and national and international best practices. In particular, the numerous rich local traditions of India developed over millennia in ECCE involving art, stories, poetry, games, songs, and more, will also be suitably incorporated. The framework will serve as a guide both for parents and for early childhood care and education institutions.

1.4. The overarching goal will be to ensure universal access to high-quality ECCE across the country in a phased manner. Special attention and priority will be given to districts and locations that are particularly socio-economically disadvantaged. ECCE shall be delivered through a significantly expanded and strengthened system of early-childhood education institutions consisting of (a) stand-alone Anganwadis; (b) Anganwadis co-located with primary schools; (c) pre-primary schools/sections covering at least age 5 to 6 years co-located with existing primary schools; and (d) stand-alone pre-schools - all of which would recruit workers/teachers specially trained in the curriculum and pedagogy of ECCE.

1.5. For universal access to ECCE, Anganwadi Centres will be strengthened with high-quality infrastructure, play equipment, and well-trained Anganwadi workers/teachers. Every Anganwadi will have a well-ventilated, well-designed, child-friendly and well-constructed building with an enriched learning environment. Children in Anganwadi Centres shall take activity-filled tours - and meet the teachers and students of their local primary schools, in order to make the transition from Anganwadi Centres to primary schools a smooth one. Anganwadis shall be fully integrated into school complexes/clusters, and Anganwadi children, parents, and teachers will be invited to attend and participate in school/school complex programmes and vice versa.

1.6. It is envisaged that prior to the age of 5 every child will move to a "Preparatory Class" or "Balavatika" (that is, before Class 1), which has an ECCE-qualified teacher. The learning in the Preparatory Class shall be based primarily on play-based learning with a focus on developing cognitive, affective, and psychomotor abilities and early literacy and numeracy. The mid-

day meal programme shall also be extended to the Preparatory Classes in primary schools. Health check-ups and growth monitoring that are available in the Anganwadi system shall also be made available to Preparatory Class students of Anganwadi as well as of primary schools.

1.7. To prepare an initial cadre of high-quality ECCE teachers in Anganwadis, current Anganwadi workers/teachers will be trained through a systematic effort in accordance with the curricular/pedagogical framework developed by NCERT. Anganwadi workers/teachers with qualifications of 10+2 and above shall be given a 6-month certificate programme in ECCE; and those with lower educational qualifications shall be given a one-year diploma programme covering early literacy, numeracy, and other relevant aspects of ECCE. These programmes may be run through digital/distance mode using DTH channels as well as smartphones, allowing teachers to acquire ECCE qualifications with minimal disruption to their current work. The ECCE training of Anganwadi workers/teachers will be mentored by the Cluster Resource Centres of the School Education Department which shall hold at least one monthly contact class for continuous assessment. In the longer term, State Governments shall prepare cadres of professionally qualified educators for early childhood care and education, through stage-specific professional training, mentoring mechanisms, and career mapping. Necessary facilities will also be created for the initial professional preparation of these educators and their Continuous Professional Development (CPD).

1.8. ECCE will also be introduced in Ashramshalas in tribal-dominated areas and in all formats of alternative schooling in a phased manner. The process for integration and implementation of ECCE in Ashramshalas and alternative schooling will be similar to that detailed above.

1.9. The responsibility for ECCE curriculum and pedagogy will lie with MHRD to ensure its continuity from pre-primary school through primary school, and to ensure due attention to the foundational aspects of education. The planning and implementation of early childhood care and education curriculum will be carried out jointly by the Ministries of HRD, Women and Child Development (WCD), Health and Family Welfare (HFW), and Tribal Affairs. A special joint task force will be constituted for continuous guidance of the smooth integration of early childhood care and education into school education.

2. Foundational Literacy and Numeracy: An Urgent & Necessary Prerequisite to Learning

2.1. The ability to read and write, and perform basic operations with numbers, is a necessary foundation and an indispensable prerequisite for all future schooling and lifelong learning. However, various governmental, as well as non-governmental surveys, indicate that we are currently in a learning crisis: a large proportion of students currently in elementary school - estimated to be over 5 crore in number - have not attained foundational literacy and numeracy, i.e., the ability to read and comprehend basic text and the ability to carry out basic addition and subtraction with Indian numerals.

2.2. Attaining foundational literacy and numeracy for all children will thus become an urgent national mission, with immediate measures to be taken on many fronts and with clear goals that will be attained in the short term (including that every student will attain foundational literacy and numeracy by Grade 3). The highest priority of the education system will be to achieve universal foundational literacy and numeracy in primary school by 2025. The rest of this Policy will become relevant for our students only if this most basic learning requirement (i.e., reading, writing, and arithmetic at the foundational level) is first achieved. To this end, a National Mission on Foundational Literacy and Numeracy will be set up by the Ministry of Human Resource Development (MHRD) on priority. Accordingly, all State/UT governments will immediately prepare an implementation plan for attaining universal foundational literacy and numeracy in all primary schools, identifying stage-wise targets and goals to be achieved by 2025, and closely tracking and monitoring progress of the same.

2.3. First, teacher vacancies will be filled at the earliest, in a time-bound manner - especially in disadvantaged areas and areas with large pupil-to-teacher ratios or high rates of illiteracy. Special

attention will be given to employing local teachers or those with familiarity with local languages. A pupil-teacher ratio (PTR) of under 30:1 will be ensured at the level of each school; areas having large numbers of socio-economically disadvantaged students will aim for a PTR of under 25:1. Teachers will be trained, encouraged, and supported - with continuous professional development - to impart foundational literacy and numeracy.

2.4. On the curricular side, there will be an increased focus on foundational literacy and numeracy - and generally, on reading, writing, speaking, counting, arithmetic, and mathematical thinking - throughout the preparatory and middle school curriculum, with a robust system of continuous formative/adaptive assessment to track and thereby individualize and ensure each student's learning. Specific hours daily - and regular events over the year-on activities involving these subjects will be dedicated to encourage and enthuse students. Teacher education and the early grade curriculum will be redesigned to have a renewed emphasis on foundational literacy and numeracy.

2.5. Currently, with the lack of universal access to ECCE, a large proportion of children already fall behind within the first few weeks of Grade 1. Thus, to ensure that all students are school ready, an interim 3-month play-based 'school preparation module' for all Grade 1 students, consisting of activities and workbooks around the learning of alphabets, sounds, words, colours, shapes, and numbers, and involving collaborations with peers and parents, will be developed by NCERT and SCERTs.

2.6. A national repository of high-quality resources on foundational literacy and numeracy will be made available on the Digital Infrastructure for Knowledge Sharing (DIKSHA). Technological interventions to serve as aids to teachers and to help bridge any language barriers that may exist between teachers and students, will be piloted and implemented

2.7. Due to the scale of the current learning crisis, all viable methods will be explored to support teachers in the mission of attaining universal foundational literacy and numeracy. Studies around the world show one-on-one peer tutoring to be extremely effective for learning not just for the learner, but also for the tutor. Thus, peer tutoring can be taken up as a voluntary and joyful activity for fellow students under the supervision of trained teachers and by taking due care of safety aspects. Additionally, it will also be made far easier for trained volunteers - from both the local community and beyond - to participate in this large-scale mission. Every literate member of the community could commit to teaching one student/person how to read, it would change the country's landscape very quickly. States may consider establishing innovative models to foster such peer-tutoring and volunteer activities, as well as launch other programmes to support learners, in this nationwide mission to promote foundational literacy and numeracy.

2.8. Enjoyable and inspirational books for students at all levels will be developed, including through high-quality translation (technology assisted as needed) in all local and Indian languages, and will be made available extensively in both school and local public libraries. Public and school libraries will be significantly expanded to build a culture of reading across the country. Digital libraries will also be established. School libraries will be set up - particularly in villages - to serve the community during non-school hours, and book clubs may meet in public/school libraries to further facilitate and promote widespread reading. A National Book Promotion Policy will be formulated, and extensive initiatives will be undertaken to ensure the availability, accessibility, quality, and readership of books across geographies, languages, levels, and genres.

2.9. Children are unable to learn optimally when they are undernourished or unwell. Hence, the nutrition and health (including mental health) of children will be addressed, through healthy meals and the introduction of well-trained social workers, counsellors, and community involvement into the schooling system. Furthermore, research shows that the morning hours after a nutritious breakfast can be particularly productive for the study of cognitively more demanding subjects and hence these hours may be leveraged by providing a simple but energizing breakfast in addition to midday meals. In locations where hot meals are not possible, a simple but nutritious meal, e.g., groundnuts/chana mixed with jaggery and/or local fruits may be provided. All school children shall undergo regular

health check-ups especially for 100% immunization in schools and health cards will be issued to monitor the same.

3. Curtailing Dropout Rates and Ensuring Universal Access to Education at All Levels

3.1. One of the primary goals of the schooling system must be to ensure that children are enrolled in and are attending school. Through initiatives such as the Sarva Shiksha Abhiyan (now the Samagra Shiksha) and the Right to Education Act, India has made remarkable strides in recent years in attaining near-universal enrolment in elementary education. However, the data for later grades indicates some serious issues in retaining children in the schooling system. The GER for Grades 6-8 was 90.9%, while for Grades 9-10 and 11-12 it was only 79.3% and 56.5%, respectively - indicating that a significant proportion of enrolled students drop out after Grade 5 and especially after Grade 8. As per the 75th round household survey by NSSO in 2017-18, the number of out of school children in the age group of 6 to 17 years is 3.22 crore. It will be a top priority to bring these children back into the educational fold as early as possible, and to prevent further students from dropping out, with a goal to achieve 100% Gross Enrolment Ratio in preschool to secondary level by 2030. A concerted national effort will be made to ensure universal access and afford opportunity to all children of the country to obtain quality holistic education–including vocational education - from pre-school to Grade 12.

3.2. There are two overall initiatives that will be undertaken to bring children who have dropped out back to school and to prevent further children from dropping out. The first is to provide effective and sufficient infrastructure so that all students have access to safe and engaging school education at all levels from pre-primary school to Grade 12. Besides providing regular trained teachers at each stage, special care shall be taken to ensure that no school remains deficient on infrastructure support. The credibility of Government schools shall be re-established and this will be attained by upgrading and enlarging the schools that already exist, building additional quality schools in areas where they do not exist, and providing safe and practical conveyances and/or hostels, especially for the girl children, so that all children have the opportunity to attend a quality school and learn at the appropriate level. Alternative and innovative education centres will be put in place in cooperation with civil society to ensure that children of migrant labourers, and other children who are dropping out of school due to various circumstances are brought back into mainstream education.

3.3. The second is to achieve universal participation in school by carefully tracking students, as well as their learning levels, in order to ensure that they (a) are enrolled in and attending school, and (b) have suitable opportunities to catch up and re-enter school in case they have fallen behind or dropped out. For providing equitable and quality education from the Foundational Stage through Grade 12 to all children up to the age of 18, suitable facilitating systems shall be put in place. Counsellors or well-trained social workers connected to schools/school complexes and teachers will continuously work with students and their parents and will travel through and engage with communities to ensure that all school-age children are attending and learning in school. Trained and qualified social workers from civil society organizations/departments of Social Justice and Empowerment and government functionaries dealing with empowerment of Persons with Disabilities at the State and district level, could be connected to schools, through various innovative mechanisms adopted by State/UT Governments, to help in carrying out this important work.

3.4. Once infrastructure and participation are in place, ensuring quality will be the key in retention of students, so that they (particularly, girls and students from other socio-economically disadvantaged groups) do not lose interest in attending school. This will require a system of incentives for deploying teachers with knowledge of the local language to areas with high dropout rates, as well as overhauling the curriculum to make it more engaging and useful.

3.5. To facilitate learning for all students, with special emphasis on Socio-Economically Disadvantaged Groups (SEDGs), the scope of school education will be broadened to facilitate multiple pathways to learning involving both formal and non-formal education modes. Open and Distance Learning (ODL) Programmes offered by the National Institute of Open Schooling (NIOS)

and State Open Schools will be expanded and strengthened for meeting the learning needs of young people in India who are not able to attend a physical school. NIOS and State Open Schools will offer the following programmes in addition to the present programmes: A, B and C levels that are equivalent to Grades 3, 5, and 8 of the formal school system; secondary education programmes that are equivalent to Grades 10 and 12; vocational education courses/programmes; and adult literacy and life-enrichment programmes. States will be encouraged to develop these offerings in regional languages by establishing new/strengthening existing State Institutes of Open Schooling (SIOS).

3.6. To make it easier for both governments as well as non-governmental philanthropic organizations to build schools, to encourage local variations on account of culture, geography, and demographics, and to allow alternative models of education, the requirements for schools will be made less restrictive. The focus will be to have less emphasis on input and greater emphasis on output potential concerning desired learning outcomes. Regulations on inputs will be limited to certain areas as enumerated in Chapter 8. Other models for schools will also be piloted, such as public-philanthropic partnerships.

3.7. Efforts will be made to involve community and alumni in volunteer efforts for enhancing learning by providing at schools: one-on-one tutoring; the teaching of literacy and holding of extra-help sessions; teaching support and guidance for educators; career guidance and mentoring to students; etc. In this regard, the support of active and healthy senior citizens, school alumni and local community members will be suitably garnered. Databases of literate volunteers, retired scientists/government/semi government employees, alumni, and educators will be created for this purpose.

4. Curriculum and Pedagogy in Schools: Learning Should be Holistic, Integrated, Enjoyable, and Engaging

Restructuring school curriculum and pedagogy in a new 5+3+3+4 design

4.1. The curricular and pedagogical structure of school education will be reconfigured to make it responsive and relevant to the developmental needs and interests of learners at different stages of their development, corresponding to the age ranges of 3-8, 8-11, 11-14, and 14-18 years, respectively. The curricular and pedagogical structure and the curricular framework for school education will therefore be guided by a 5+3+3+4 design, consisting of the Foundational Stage (in two parts, that is, 3 years of Anganwadi/pre-school + 2 years in primary school in Grades 1-2; both together covering ages 3-8), Preparatory Stage (Grades 3-5, covering ages 8-11), Middle Stage (Grades 6-8, covering ages 11-14), and Secondary Stage (Grades 9-12 in two phases, i.e., 9 and 10 in the first and 11 and 12 in the second, covering ages 14-18).

4.2. The Foundational Stage will consist of five years of flexible, multilevel, play/activity-based learning and the curriculum and pedagogy of ECCE as mentioned in para 1.2. The Preparatory Stage will comprise three years of education building on the play, discovery, and activity-based pedagogical and curricular style of the Foundational Stage, and will also begin to incorporate some light text books as well as aspects of more formal but interactive classroom learning, in order to lay a solid groundwork across subjects, including reading, writing, speaking, physical education, art, languages, science, and mathematics. The Middle Stage will comprise three years of education, building on the pedagogical and curricular style of the Preparatory Stage, but with the introduction of subject teachers for learning and discussion of the more abstract concepts in each subject that students will be ready for at this stage across the sciences, mathematics, arts, social sciences, and humanities. Experiential learning within each subject, and explorations of relations among different subjects, will be encouraged and emphasized despite the introduction of more specialized subjects and subject teachers. The Secondary Stage will comprise of four years of multidisciplinary study, building on the subject-oriented pedagogical and curricular style of the Middle Stage, but with greater depth, greater critical thinking, greater attention to life aspirations, and greater flexibility and student choice of subjects. In particular students would continue to have the option of exiting after Grade 10

and re-entering in the next phase to pursue vocational or any other courses available in Grades 11-12, including at a more specialized school, if so desired.

4.3. The above-described stages are purely curricular and pedagogical, designed to optimize learning for students based on the cognitive development of children; they will inform the development of National and State curricula and teaching-learning strategies at each stage, but parallel changes to physical infrastructure will not be required.

Holistic development of learners

4.4. The key overall thrust of curriculum and pedagogy reform across all stages will be to move the education system towards real understanding and towards learning how to learn - and away from the culture of rote learning as is largely present today. The aim of education will not only be cognitive development, but also building character and creating holistic and well-rounded individuals equipped with the key 21st century skills. Ultimately, knowledge is a deep-seated treasure and education helps in its manifestation as the perfection which is already within an individual. All aspects of curriculum and pedagogy will be reoriented and revamped to attain these critical goals. Specific sets of skills and values across domains will be identified for integration and incorporation at each stage of learning, from pre-school to higher education. Curriculum frameworks and transaction mechanisms will be developed for ensuring that these skills and values are imbibed through engaging processes of teaching and learning. NCERT will identify these required skill sets and include mechanisms for their transaction in the National Curriculum Framework for early childhood and school education.

Reduce curriculum content to enhance essential learning and critical thinking

4.5. Curriculum content will be reduced in each subject to its core essentials, to make space for critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning. The mandated content will focus on key concepts, ideas, applications, and problem-solving. Teaching and learning will be conducted in a more interactive manner; questions will be encouraged, and classroom sessions will regularly contain more fun, creative, collaborative, and exploratory activities for students for deeper and more experiential learning.

Experiential learning

4.6. In all stages, experiential learning will be adopted, including hands-on learning, arts-integrated and sports-integrated education, story-telling-based pedagogy, among others, as standard pedagogy within each subject, and with explorations of relations among different subjects. To close the gap in achievement of learning outcomes, classroom transactions will shift, towards competency-based learning and education. The assessment tools (including assessment "as", "of", and "for" learning) will also be aligned with the learning outcomes, capabilities, and dispositions as specified for each subject of a given class.

4.7. Art-integration is a cross-curricular pedagogical approach that utilizes various aspects and forms of art and culture as the basis for learning of concepts across subjects. As a part of the thrust on experiential learning, art-integrated education will be embedded in classroom transactions not only for creating joyful classrooms, but also for imbibing the Indian ethos through integration of Indian art and culture in the teaching and learning process at every level. This art-integrated approach will strengthen the linkages between education and culture.

4.8. Sports-integration is another cross-curricular pedagogical approach that utilizes physical activities including indigenous sports, in pedagogical practices to help in developing skills such as collaboration, self-initiative, self-direction, self-discipline, teamwork, responsibility, citizenship, etc. Sports-integrated learning will be undertaken in classroom transactions to help students adopt fitness as a lifelong attitude and to achieve the related life skills along with the levels of fitness as envisaged in the Fit India Movement. The need to integrate sports in education is well recognized as it serves to

foster holistic development by promoting physical and psychological well-being while also enhancing cognitive abilities.

Empower students through flexibility in course choices

4.9. Students will be given increased flexibility and choice of subjects to study, particularly in secondary school - including subjects in physical education, the arts and crafts, and vocational skills – so that they can design their own paths of study and life plans. Holistic development and a wide choice of subjects and courses year to year will be the new distinguishing feature of secondary school education. There will be no hard separation among 'curricular', 'extracurricular', or 'co-curricular', among 'arts', 'humanities', and 'sciences', or between 'vocational' or 'academic' streams. Subjects such as physical education, the arts and crafts, and vocational skills, in addition to science, humanities, and mathematics, will be incorporated throughout the school curriculum, with a consideration for what is interesting and safe at each age.

4.10. Each of the four stages of school education, in accordance with what may be possible in different regions, may consider moving towards a semester or any other system that allows the inclusion of shorter modules, or courses that are taught on alternate days, in order to allow an exposure to more subjects and enable greater flexibility. States may look into innovative methods to achieve these aims of greater flexibility and exposure to and enjoyment of a wider range of subjects, including across the arts, sciences, humanities, languages, sports, and vocational subjects.

Multilingualism and the power of language

4.11. It is well understood that young children learn and grasp nontrivial concepts more quickly in their home language/mother tongue. Home language is usually the same language as the mother tongue or that which is spoken by local communities. However, at times in multi-lingual families, there can be a home language spoken by other family members which may sometimes be different from mother tongue or local language. Wherever possible, the medium of instruction until at least Grade 5, but preferably till Grade 8 and beyond, will be the home language/mother tongue/local language/regional language. Thereafter, the home/local language shall continue to be taught as a language wherever possible. This will be followed by both public and private schools. High-quality textbooks, including in science, will be made available in home languages/mother tongue. All efforts will be made early on to ensure that any gaps that exist between the language spoken by the child and the medium of teaching are bridged. In cases where home language/mother tongue textbook material is not available, the language of transaction between teachers and students will still remain the home language/mother tongue wherever possible. Teachers will be encouraged to use a bilingual approach, including bilingual teaching-learning materials, with those students whose home language may be different from the medium of instruction. All languages will be taught with high quality to all students; a language does not need to be the medium of instruction for it to be taught and learned well.

4.12. As research clearly shows that children pick up languages extremely quickly between the ages of 2 and 8 and that multilingualism has great cognitive benefits to young students, children will be exposed to different languages early on (but with a particular emphasis on the mother tongue), starting from the Foundational Stage onwards. All languages will be taught in an enjoyable and interactive style, with plenty of interactive conversation, and with early reading and subsequently writing in the mother tongue in the early years, and with skills developed for reading and writing in other languages in Grade 3 and beyond. There will be a major effort from both the Central and State governments to invest in large numbers of language teachers in all regional languages around the country, and, in particular, for all languages mentioned in the Eighth Schedule of the Constitution of India. States, especially States from different regions of India, may enter into bilateral agreements to hire teachers in large numbers from each other, to satisfy the three-language formula in their respective States, and also to encourage the study of Indian languages across the country. Extensive use of technology will be made for teaching and learning of different languages and to popularize language learning.

4.13. The three-language formula will continue to be implemented while keeping in mind the Constitutional provisions, aspirations of the people, regions, and the Union, and the need to promote multilingualism as well as promote national unity. However, there will be a greater flexibility in the three-language formula, and no language will be imposed on any State. The three languages learned by children will be the choices of States, regions, and of course the students themselves, so long as at least two of the three languages are native to India. In particular, students who wish to change one or more of the three languages they are studying may do so in Grade 6 or 7, as long as they are able to demonstrate basic proficiency in three languages (including one language of India at the literature level) by the end of secondary school.

4.14. All efforts will be made in preparing high-quality bilingual textbooks and teaching-learning materials for science and mathematics, so that students are enabled to think and speak about the two subjects both in their home language/mother tongue and in English.

4.15. As so many developed countries around the world have amply demonstrated, being well educated in one's language, culture, and traditions is not a detriment but indeed a huge benefit to educational, social, and technological advancement. India's languages are among the richest, most scientific, most beautiful, and most expressive in the world, with a huge body of ancient as well as modern literature (both prose and poetry), film, and music written in these languages that help form India's national identity and wealth. For purposes of cultural enrichment as well as national integration, all young Indians should be aware of the rich and vast array of languages of their country, and the treasures that they and their literatures contain.

4.16. Thus, every student in the country will participate in a fun project/activity on 'The Languages of India', sometime in Grades 6-8, such as, under the *'Ek Bharat Shrestha Bharat'* initiative. In this project/activity, students will learn about the remarkable unity of most of the major Indian languages, starting with their common phonetic and scientifically-arranged alphabets and scripts, their common grammatical structures, their origins and sources of vocabularies from Sanskrit and other classical languages, as well as their rich inter-influences and differences. They will also learn what geographical areas speak which languages, get a sense of the nature and structure of tribal languages, and learn to say commonly spoken phrases and sentences in every major language of India and also learn a bit about the rich and uplifting literature of each (through suitable translations as necessary). Such an activity would give them both a sense of the unity and the beautiful cultural heritage and diversity of India and would be a wonderful icebreaker their whole lives as they meet people from other parts of India. This project/activity would be a joyful activity and would not involve any form of assessment.

4.17. The importance, relevance, and beauty of the classical languages and literature of India also cannot be overlooked. Sanskrit, while also an important modern language mentioned in the Eighth Schedule of the Constitution of India, possesses a classical literature that is greater in volume than that of Latin and Greek put together, containing vast treasures of mathematics, philosophy, grammar, music, politics, medicine, architecture, metallurgy, drama, poetry, storytelling, and more (known as 'Sanskrit Knowledge Systems'), written by people of various religions as well as non-religious people, and by people from all walks of life and a wide range of socio-economic backgrounds over thousands of years. Sanskrit will thus be offered at all levels of school and higher education as an important, enriching option for students, including as an option in the three-language formula. It will be taught in ways that are interesting and experiential as well as contemporarily relevant, including through the use of Sanskrit Knowledge Systems, and in particular through phonetics and pronunciation. Sanskrit textbooks at the foundational and middle school level may be written in Simple Standard Sanskrit (SSS) to teach Sanskrit through Sanskrit (STS) and make its study truly enjoyable.

4.18. India also has an extremely rich literature in other classical languages, including classical Tamil, Telugu, Kannada, Malayalam, Odia. In addition to these classical languages Pali, Persian, and Prakrit; and their works of literature too must be preserved for their richness and for the pleasure and enrichment of posterity. As India becomes a fully developed country, the next generation will want to

partake in and be enriched by India's extensive and beautiful classical literature. In addition to Sanskrit, other classical languages and literatures of India, including Tamil, Telugu, Kannada, Malayalam, Odia, Pali, Persian, and Prakrit, will also be widely available in schools as options for students, possibly as online modules, through experiential and innovative approaches, to ensure that these languages and literature stay alive and vibrant. Similar efforts will be made for all Indian languages having rich oral and written literatures, cultural traditions, and knowledge.

4.19. For the enrichment of the children, and for the preservation of these rich languages and their artistic treasures, all students in all schools, public or private, will have the option of learning at least two years of a classical language of India and its associated literature, through experiential and innovative approaches, including the integration of technology, in Grades 6-12, with the option to continue from the middle stage through the secondary stage and beyond.

4.20. In addition to high quality offerings in Indian languages and English, foreign languages, such as Korean, Japanese, Thai, French, German, Spanish, Portuguese, and Russian, will also be offered at the secondary level, for students to learn about the cultures of the world and to enrich their global knowledge and mobility according to their own interests and aspirations.

4.21. The teaching of all languages will be enhanced through innovative and experiential methods, including through gamification and apps, by weaving in the cultural aspects of the languages - such as films, theatre, storytelling, poetry, and music - and by drawing connections with various relevant subjects and with real-life experiences. Thus, the teaching of languages will also be based on experiential-learning pedagogy.

4.22. Indian Sign Language (ISL) will be standardized across the country, and National and State curriculum materials developed, for use by students with hearing impairment. Local sign languages will be respected and taught as well, where possible and relevant.

Curricular Integration of Essential Subjects, Skills, and Capacities

4.23. While students must have a large amount of flexibility in choosing their individual curricula, certain subjects, skills, and capacities should be learned by all students to become good, successful, innovative, adaptable, and productive human beings in today's rapidly changing world. In addition to proficiency in languages, these skills include: scientific temper and evidence-based thinking; creativity and innovativeness; sense of aesthetics and art; oral and written communication; health and nutrition; physical education, fitness, wellness, and sports; collaboration and teamwork; problem solving and logical reasoning; vocational exposure and skills; digital literacy, coding, and computational thinking; ethical and moral reasoning; knowledge and practice of human and Constitutional values; gender sensitivity; Fundamental Duties; citizenship skills and values; knowledge of India; environmental awareness including water and resource conservation, sanitation and hygiene; and current affairs and knowledge of critical issues facing local communities, States, the country, and the world.

4.24. Concerted curricular and pedagogical initiatives, including the introduction of contemporary subjects such as Artificial Intelligence, Design Thinking, Holistic Health, Organic Living, Environmental Education, Global Citizenship Education (GCED), etc. at relevant stages will be undertaken to develop these various important skills in students at all levels.

4.25. It is recognized that mathematics and mathematical thinking will be very important for India's future and India's leadership role in the numerous upcoming fields and professions that will involve artificial intelligence, machine learning, and data science, etc. Thus, mathematics and computational thinking will be given increased emphasis throughout the school years, starting with the foundational stage, through a variety of innovative methods, including the regular use of puzzles and games that make mathematical thinking more enjoyable and engaging. Activities involving coding will be introduced in Middle Stage.

4.26. Every student will take a fun course, during Grades 6-8, that gives a survey and hands-on experience of a sampling of important vocational crafts, such as carpentry, electric work, metal work, gardening, pottery making, etc., as decided by States and local communities and as mapped by local skilling needs. A practice-based curriculum for Grades 6-8 will be appropriately designed by NCERT while framing the NCFSE 2020-21. All students will participate in a 10-day bagless period sometime during Grades 6-8 where they intern with local vocational experts such as carpenters, gardeners, potters, artists, etc. Similar internship opportunities to learn vocational subjects may be made available to students throughout Grades 6-12, including holiday periods. Vocational courses through online mode will also be made available. Bagless days will be encouraged throughout the year for various types of enrichment activities involving arts, quizzes, sports, and vocational crafts. Children will be given periodic exposure to activities outside school through visits to places/monuments of historical, cultural and tourist importance, meeting local artists and craftsmen and visits higher educational institutions in their village/Tehsil/District/State.

4.27. "Knowledge of India" will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India's future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation. Specific courses in tribal ethno-medicinal practices, forest management, traditional (organic) crop cultivation, natural farming, etc. will also be made available. An engaging course on Indian Knowledge Systems will also be available to students in secondary school as an elective. Competitions may be held in schools for learning various topics and subjects through fun and indigenous games. Video documentaries on inspirational luminaries of India, ancient and modern, in science and beyond, will be shown at appropriate points throughout the school curriculum. Students will be encouraged to visit different States as part of cultural exchange programmes.

4.28. Students will be taught at a young age the importance of "doing what's right", and will be given a logical framework for making ethical decisions. In later years, this would then be expanded along themes of cheating, violence, plagiarism, littering, tolerance, equality, empathy, etc., with a view to enabling children to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. As consequences of such basic ethical reasoning, traditional Indian values and all basic human and Constitutional values (such as *seva, ahimsa, swachchhata, satya, nishkam karma, shanti*, sacrifice, tolerance, diversity, pluralism, righteous conduct, gender sensitivity, respect for elders, respect for all people and their inherent capabilities regardless of background, respect for environment, helpfulness, courtesy, patience, forgiveness, empathy, compassion, patriotism, democratic outlook, integrity, responsibility, justice, liberty, equality, and fraternity) will be developed in all students. Children will have the opportunity to read and learn from the original stories of the Panchatantra, Jataka, Hitopadesh, and other fun fables and inspiring tales from the Indian tradition and learn about their influences on global literature. Excerpts from the Indian Constitution will also be considered essential reading for all students. Basic training in health, including preventive health, mental health, good nutrition, personal and public hygiene, disaster response and first-aid will also be included in the curriculum, as well as scientific explanations of the detrimental and damaging effects of alcohol, tobacco, and other drugs.

4.29. All curriculum and pedagogy, from the foundational stage onwards, will be redesigned to be strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language, philosophy, geography, ancient and contemporary knowledge, societal and scientific needs, indigenous and traditional ways of learning etc. – in order to ensure that education is maximally relatable, relevant, interesting, and effective for our students. Stories, arts, games, sports, examples, problems, etc. will be chosen as much as possible to be rooted in the Indian and local geographic context. Ideas, abstractions, and creativity will indeed best flourish when learning is thus rooted.

National Curriculum Framework for School Education (NCFSE)

4.30. The formulation of a new and comprehensive National Curricular Framework for School Education, NCFSE 2020-21, will be undertaken by the NCERT - based on the principles of this National Education Policy 2020, frontline curriculum needs, and after discussions with all stakeholders including State Governments, Ministries, relevant Departments of the Central Government, and other expert bodies, and will be made available in all regional languages. The NCFSE document shall henceforth be revisited and updated once every 5-10 years, taking into account frontline curriculum.

National Textbooks with Local Content and Flavour

4.31. The reduction in content and increased flexibility of school curriculum - and the renewed emphasis on constructive rather than rote learning - must be accompanied by parallel changes in school textbooks. All textbooks shall aim to contain the essential core material (together with discussion, analysis, examples, and applications) deemed important on a national level, but at the same time contain any desired nuances and supplementary material as per local contexts and needs. Where possible, schools and teachers will also have choices in the textbooks they employ - from among a set of textbooks that contain the requisite national and local material - so that they may teach in a manner that is best suited to their own pedagogical styles as well as to their students and communities' needs.

4.32. The aim will be to provide such quality textbooks at the lowest possible cost -namely, at the cost of production/printing - in order to mitigate the burden of textbook prices on the students and on the educational system. This may be accomplished by using high-quality textbook materials developed by NCERT in conjunction with the SCERTs; additional textbook materials could be funded by public-philanthropic partnerships and crowd sourcing that incentivize experts to write such high-quality textbooks at cost price. States will prepare their own curricula (which may be based on the NCFSE prepared by NCERT to the extent possible) and prepare textbooks (which may be based on the NCERT textbook materials to the extent possible), incorporating State flavour and material as needed. While doing so, it must be borne in mind that NCERT curriculum would be taken as the nationally acceptable criterion. The availability of such textbooks in all regional languages will be a top priority so that all students have access to high-quality learning. All efforts will be made to ensure timely availability of textbooks in schools. Access to downloadable and printable versions of all textbooks will be provided by all States/UTs and NCERT to help conserve the environment and reduce the logistical burden.

4.33. Concerted efforts, through suitable changes in curriculum and pedagogy, will be made by NCERT, SCERTs, schools, and educators to significantly reduce the weight of school bags and textbooks.

Transforming Assessment for Student Development

4.34. The aim of assessment in the culture of our schooling system will shift from one that is summative and primarily tests rote memorization skills to one that is more regular and formative, is more competency-based, promotes learning and development for our students, and tests higher-order skills, such as analysis, critical thinking, and conceptual clarity. The primary purpose of assessment will indeed be for learning; it will help the teacher and student, and the entire schooling system, continuously revise teaching-learning processes to optimize learning and development for all students. This will be the underlying principle for assessment at all levels of education.

4.35. The progress card of all students for school-based assessment, which is communicated by schools to parents, will be completely redesigned by States/UTs under guidance from the proposed National Assessment Centre, NCERT, and SCERTs. The progress card will be a holistic, 360-degree, multidimensional report that reflects in great detail the progress as well as the uniqueness of each

learner in the cognitive, affective, and psychomotor domains. It will include self-assessment and peer assessment, and progress of the child in project-based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment. The holistic progress card will form an important link between home and school and will be accompanied by parent-teacher meetings in order to actively involve parents in their children's holistic education and development. The progress card would also provide teachers and parents with valuable information on how to support each student in and out of the classroom. AI-based software could be developed and used by students to help track their growth through their school years based on learning data and interactive questionnaires for parents, students, and teachers, in order to provide students with valuable information on their strengths, areas of interest, and needed areas of focus, and to thereby help them make optimal career choices.

4.36. The current nature of secondary school exams, including Board exams and entrance exams - and the resulting coaching culture of today - are doing much harm, especially at the secondary school level, replacing valuable time for true learning with excessive exam coaching and preparation. These exams also force students to learn a very narrow band of material in a single stream, rather than allowing the flexibility and choice that will be so important in the education system of the future.

4.37. While the Board exams for Grades 10 and 12 will be continued, the existing system of Board and entrance examinations shall be reformed to eliminate the need for undertaking coaching classes. To reverse these harmful effects of the current assessment system, Board exams will be redesigned to encourage holistic development; students will be able to choose many of the subjects in which they take Board exams, depending on their individualized interests. Board exams will also be made 'easier', in the sense that they will test primarily core capacities/competencies rather than months of coaching and memorization; any student who has been going to and making a basic effort in a school class will be able to pass and do well in the corresponding subject Board Exam without much additional effort. To further eliminate the 'high stakes' aspect of Board Exams, all students will be allowed to take Board Exams on up to two occasions during any given school year, one main examination and one for improvement, if desired.

4.38. In addition to introducing greater flexibility, student choice, and best-of-two attempts, assessments that primarily test core capacities must be the immediate key reforms to all Board exams. Boards may over time also develop further viable models of Board Exams that reduce pressure and the coaching culture. Some possibilities include: a system of annual/semester/modular Board Exams could be developed - that each test far less material, and are taken immediately after the corresponding course is taken in school - so that the pressure from exams is better distributed, less intense, and less high-stakes across the Secondary Stage; all subjects and corresponding assessments, beginning with mathematics, could be offered at two levels, with students doing some of their subjects at the standard level and some at a higher level; and Board exams in certain subjects could be redesigned to have two parts – one part of an objective type with multiple-choice questions and the other of a descriptive type.

4.39. With regard to all of the above, guidelines will be prepared by NCERT, in consultation with major stakeholders, such as SCERTs, Boards of Assessment (BoAs), the proposed new National Assessment Centre etc., and teachers prepared, for a transformation in the assessment system by the 2022-23 academic session, to align with the NCFSE 2020-21.

4.40. To track progress throughout the school years, and not just at the end of Grades 10 and 12 - for the benefit of students, parents, teachers, principals, and the entire schooling system in planning improvements to schools and teaching-learning processes - all students will take school examinations in Grades 3, 5, and 8 which will be conducted by the appropriate authority. These examinations would test achievement of basic learning outcomes, through assessment of core concepts and knowledge from the national and local curricula, along with relevant higher-order skills and application of knowledge in real-life situations, rather than rote memorization. The Grade 3 examination, in particular, would test basic literacy, numeracy, and other foundational skills. The results of school examinations will be used only for developmental purposes of the school education

system, including for public disclosure by schools of their overall (anonymized) student outcomes, and for continuous monitoring and improvement of the schooling system.

4.41. It is proposed to set up a National Assessment Centre, PARAKH (Performance Assessment, Review, and Analysis of Knowledge for Holistic Development), as a standard-setting body under MHRD that fulfils the basic objectives of setting norms, standards, and guidelines for student assessment and evaluation for all recognized school boards of India, guiding the State Achievement Survey (SAS) and undertaking the National Achievement Survey (NAS), monitoring achievement of learning outcomes in the country, and encouraging and helping school boards to shift their assessment patterns towards meeting the skill requirements of the 21st century in consonance with the stated objectives of this Policy. This Centre will also advise school boards regarding new assessment patterns and latest researches, promote collaborations between school boards. It will also become an instrument for the sharing of best practices among school boards, and for ensuring equivalence of academic standards among learners across all school boards.

4.42. The principles for university entrance exams will be similar. The National Testing Agency (NTA) will work to offer a high-quality common aptitude test, as well as specialized common subject exams in the sciences, humanities, languages, arts, and vocational subjects, at least twice every year. These exams shall test conceptual understanding and the ability to apply knowledge and shall aim to eliminate the need for taking coaching for these exams. Students will be able to choose the subjects for taking the test, and each university will be able to see each student's individual subject portfolio and admit students into their programmes based on individual interests and talents. The NTA will serve as a premier, expert, autonomous testing organization to conduct entrance examinations for undergraduate and graduate admissions and fellowships in higher education institutions. The high quality, range, and flexibility of the NTA testing services will enable most universities to use these common entrance exams - rather than having hundreds of universities each devising their own entrance exams - thereby drastically reducing the burden on students, universities and colleges, and the entire education system. It will be left up to individual universities and colleges to use NTA assessments for their admissions.

Support for Gifted Students/Students with Special Talents

4.43. There are innate talents in every student, which must be discovered, nurtured, fostered, and developed. These talents may express themselves in the form of varying interests, dispositions, and capacities. Those students that show particularly strong interests and capacities in a given realm must be encouraged to pursue that realm beyond the general school curriculum. Teacher education will include methods for the recognition and fostering of such student talents and interests. The NCERT and NCTE will develop guidelines for the education of gifted children. B.Ed. programmes may also allow a specialization in the education of gifted children.

4.44. Teachers will aim to encourage students with singular interests and/or talents in the classroom by giving them supplementary enrichment material and guidance and encouragement. Topic-centered and Project-based Clubs and Circles will be encouraged and supported at the levels of schools, school complexes, districts, and beyond. Examples include Science Circles, Math Circles, Music & Dance Performance Circles, Chess Circles, Poetry Circles, Language Circles, Drama Circles, Debate Circles, Sports Circles, Eco-Clubs, Health & Well-being Clubs/ Yoga Clubs and so on. Along these lines, high-quality national residential summer programmes for secondary school students in various subjects will also be encouraged, with a rigorous merit-based but equitable admission process to attract the very best students and teachers from across the country including from socio-economically disadvantaged groups.

4.45. Olympiads and competitions in various subjects will be conducted across the country, with clear coordination and progression from school to local to state to national levels, to ensure that all students may participate at all levels for which they qualify. Efforts will be made to make these available in rural areas and in regional languages to ensure widespread participation. Public and private universities, including premier institutions like the IITs and NITs, would be encouraged to use merit-

based results from National, and International Olympiads, and results from other relevant national programmes, as part of the criteria for admissions into their undergraduate programmes.

4.46. Once internet-connected smart phones or tablets are available in all homes and/or schools, online apps with quizzes, competitions, assessments, enrichment materials, and online communities for shared interests will be developed, and will work to enhance all the aforementioned initiatives, as group activities for students with appropriate supervision of parents and teachers. Schools will develop smart classrooms, in a phased manner, for using digital pedagogy and thereby enriching the teaching-learning process with online resources and collaborations.

5. Teachers

5.1. Teachers truly shape the future of our children - and, therefore, the future of our nation. It is because of this noblest role that the teacher in India was the most respected member of society. Only the very best and most learned became teachers. Society gave teachers, or gurus, what they needed to pass on their knowledge, skills, and ethics optimally to students. The quality of teacher education, recruitment, deployment, service conditions, and empowerment of teachers is not where it should be, and consequently the quality and motivation of teachers does not reach the desired standards. The high respect for teachers and the high status of the teaching profession must be restored so as to inspire the best to enter the teaching profession. The motivation and empowerment of teachers is required to ensure the best possible future for our children and our nation.

Recruitment and Deployment

5.2. To ensure that outstanding students enter the teaching profession - especially from rural areas - a large number of merit-based scholarships shall be instituted across the country for studying quality 4-year integrated B.Ed. programmes. In rural areas, special merit-based scholarships will be established that also include preferential employment in their local areas upon successful completion of their B.Ed. programmes. Such scholarships will provide local job opportunities to local students, especially female students, so that these students serve as local-area role models and as highly qualified teachers who speak the local language. Incentives will be provided for teachers to take up teaching jobs in rural areas, especially in areas that are currently facing acute shortage of quality teachers. A key incentive for teaching in rural schools will be the provision of local housing near or on the school premises or increased housing allowances.

5.3. The harmful practice of excessive teacher transfers will be halted, so that students have continuity in their role models and educational environments. Transfers will occur in very special circumstances, as suitably laid down in a structured manner by State/UT governments. Furthermore, transfers will be conducted through an online computerized system that ensures transparency.

5.4. Teacher Eligibility Tests (TETs) will be strengthened to inculcate better test material, both in terms of content and pedagogy. The TETs will also be extended to cover teachers across all stages (Foundational, Preparatory, Middle and Secondary) of school education. For subject teachers, suitable TET or NTA test scores in the corresponding subjects will also be taken into account for recruitment. To gauge passion and motivation for teaching, a classroom demonstration or interview will become an integral part of teacher hiring at schools and school complexes. These interviews would also be used to assess comfort and proficiency in teaching in the local language, so that every school/school complex has at least some teachers who can converse with students in the local language and other prevalent home languages of students. Teachers in private schools also must have qualified similarly through TET, a demonstration/interview, and knowledge of local language(s).

5.5. To ensure an adequate number of teachers across subjects - particularly in subjects such as art, physical education, vocational education, and languages - teachers could be recruited to a school or school complex and the sharing of teachers across schools could be considered in accordance with the grouping-of-schools adopted by State/UT governments.

5.6. Schools/school complexes will be encouraged to hire local eminent persons or experts as 'master instructors' in various subjects, such as in traditional local arts, vocational crafts, entrepreneurship, agriculture, or any other subject where local expertise exists, to benefit students and help preserve and promote local knowledge and professions.

5.7. A technology-based comprehensive teacher-requirement planning forecasting exercise will be conducted by each State to assess expected subject-wise teacher vacancies over the next two decades. The above described initiatives in recruitment and deployment will be scaled as needed over time, to fill all vacancies with qualified teachers, including local teachers, with suitable incentives for career management and progression as described below. Teacher education programmes and offerings will also align with the vacancies thus projected.

Service Environment and Culture

5.8. The primary goal of overhauling the service environment and culture of schools will be to maximize the ability of teachers to do their jobs effectively, and to ensure that they are part of vibrant, caring, and inclusive communities of teachers, students, parents, principals, and other support staff, all of whom share a common goal: to ensure that our children are learning.

5.9. The first requirement in this direction will be to ensure decent and pleasant service conditions at schools. Adequate and safe infrastructure, including working toilets, clean drinking water, clean and attractive spaces, electricity, computing devices, internet, libraries, and sports and recreational resources will be provided to all schools to ensure that teachers and students, including children of all genders and children with disabilities, receive a safe, inclusive, and effective learning environment and are comfortable and inspired to teach and learn in their schools. In-service training will have inputs on safety, health and environment at workplace in schools to ensure that all teachers are sensitized to these requirements.

5.10. State/UT Governments may adopt innovative formats, such as school complex, rationalization of schools, without in any way reducing accessibility, for effective school governance, resource sharing, and community building. The creation of school complexes could go a long way towards building vibrant teacher communities. The hiring of teachers to school complexes could automatically create relationships among schools across the school complex; it would also help ensure excellent subject-wise distribution of teachers, creating a more vibrant teacher knowledge base. Teachers at very small schools will not remain isolated any longer and may become part of and work with larger school complex communities, sharing best practices with each other and working collaboratively to ensure that all children are learning. School complexes could also share counsellors, trained social workers, technical and maintenance staff, etc. to further support teachers and help create an effective learning environment.

5.11. In collaboration with parents and other key local stakeholders, teachers will also be more involved in the governance of schools/school complexes, including as members of the School Management Committees/School Complex Management Committees.

5.12. To prevent the large amounts of time spent currently by teachers on non-teaching activities, teachers will not be engaged any longer in work that is not directly related to teaching; in particular, teachers will not be involved in strenuous administrative tasks and more than a rationalized minimum time for mid-day meal related work, so that they may fully concentrate on their teaching-learning duties.

5.13. To help ensure that schools have positive learning environments, the role expectations of principals and teachers will explicitly include developing a caring and inclusive culture at their schools, for effective learning and the benefit of all stakeholders.

5.14. Teachers will be given more autonomy in choosing aspects of pedagogy, so that they may teach in the manner they find most effective for the students in their classrooms. Teachers will also focus

on socio-emotional learning - a critical aspect of any student's holistic development. Teachers will be recognized for novel approaches to teaching that improve learning outcomes in their classrooms.

Continuous Professional Development (CPD)

5.15. Teachers will be given continuous opportunities for self-improvement and to learn the latest innovations and advances in their professions. These will be offered in multiple modes, including in the form of local, regional, state, national, and international workshops as well as online teacher development modules. Platforms (especially online platforms) will be developed so that teachers may share ideas and best practices. Each teacher will be expected to participate in at least 50 hours of CPD opportunities every year for their own professional development, driven by their own interests. CPD opportunities will, in particular, systematically cover the latest pedagogies regarding foundational literacy and numeracy, formative and adaptive assessment of learning outcomes, competency-based learning, and related pedagogies, such as experiential learning, arts-integrated, sports-integrated, and storytelling-based approaches, etc.

5.16. School Principals and school complex leaders will have similar modular leadership/management workshops and online development opportunities and platforms to continuously improve their own leadership and management skills, and so that they too may share best practices with each other. Such leaders will also be expected to participate in 50 hours or more of CPD modules per year, covering leadership and management, as well as content and pedagogy with a focus on preparing and implementing pedagogical plans based on competency-based education.

Career Management and Progression (CMP)

5.17. Teachers doing outstanding work must be recognized and promoted, and given salary raises, to incentivize all teachers to do their best work. Therefore, a robust merit-based structure of tenure, promotion, and salary structure will be developed, with multiple levels within each teacher stage, that incentivizes and recognizes outstanding teachers. A system of multiple parameters for proper assessment of performance will be developed for the same by State/UT Governments that is based on peer reviews, attendance, commitment, hours of CPD, and other forms of service to the school and the community or based on NPST given in Para 5.20. In this Policy, in the context of careers, 'tenure' refers to confirmation for permanent employment, after due assessment of performance and contribution, while 'tenure track' refers to the period of probation preceding tenure.

5.18. Further, it will be ensured that career growth (in terms of tenure, promotions, salary increases, etc.) is available to teachers within a single school stage (i.e., Foundational, Preparatory, Middle, or Secondary), and that there is no career progression-related incentive to move from being teachers in early stages to later stages or vice versa (though such career moves across stages will be allowed, provided the teacher has the desire and qualifications for such a move). This is to support the fact that all stages of school education will require the highest-quality teachers, and no stage will be considered more important than any other.

5.19. Vertical mobility of teachers based on merit will also be paramount; outstanding teachers with demonstrated leadership and management skills would be trained over time to take on academic leadership positions in schools, school complexes, BRCs, CRCs, BITEs, DIETs as well as relevant government departments.

Professional Standards for Teachers

5.20. A common guiding set of National Professional Standards for Teachers (NPST) will be developed by 2022, by the National Council for Teacher Education in its restructured new form as a Professional Standard Setting Body (PSSB) under the General Education Council (GEC), in consultation with NCERT, SCERTs, teachers from across levels and regions, expert organizations in teacher preparation and development, expert bodies in vocational education, and higher education institutions. The standards would cover expectations of the role of the teacher at different levels of expertise/stage, and the competencies required for that stage. It will also comprise standards for

performance appraisal, for each stage, that would be carried out on a periodic basis. The NPST will also inform the design of pre-service teacher education programmes. This could be then adopted by States and determine all aspects of teacher career management, including tenure, professional development efforts, salary increases, promotions, and other recognitions. Promotions and salary increases will not occur based on the length of tenure or seniority, but only on the basis of such appraisal. The professional standards will be reviewed and revised in 2030, and thereafter every ten years, on the basis of rigorous empirical analysis of the efficacy of the system.

Special educators

5.21. There is an urgent need for additional special educators for certain areas of school education. Some examples of such specialist requirements include subject teaching for children with disabilities/*Divyang* children at the Middle and Secondary school level, including teaching for specific learning disabilities. Such teachers would require not only subject-teaching knowledge and understanding of subject-related aims of education, but also the relevant skills for understanding of special requirements of children. Therefore, such areas could be developed as secondary specializations for subject teachers or generalist teachers, during or after pre-service teacher preparation. They will be offered as certificate courses, in the pre-service as well as in-service mode, either full time or as part-time/blended courses - again, necessarily, at multidisciplinary colleges or universities. Greater synergy will be enabled between the course curriculum of NCTE and RCI to ensure adequate availability of qualified special educators who can handle subject teaching as well.

Approach to Teacher Education

5.22. Recognizing that the teachers will require training in high-quality content as well as pedagogy, teacher education will gradually be moved by 2030 into multidisciplinary colleges and universities. As colleges and universities all move towards becoming multidisciplinary, they will also aim to house outstanding education departments that offer B.Ed., M.Ed., and Ph.D. degrees in education.

5.23. By 2030, the minimum degree qualification for teaching will be a 4-year integrated B.Ed. degree that teaches a range of knowledge content and pedagogy and includes strong practicum training in the form of student-teaching at local schools. The 2-year B.Ed. programmes will also be offered, by the same multidisciplinary institutions offering the 4-year integrated B.Ed., and will be intended only for those who have already obtained Bachelor's Degrees in other specialized subjects. These B.Ed. programmes may also be suitably adapted as 1-year B.Ed. programmes, and will be offered only to those who have completed the equivalent of 4-year multidisciplinary Bachelor's Degrees or who have obtained a Master's degree in a specialty and wish to become a subject teacher in that specialty. All such B.Ed. degrees would be offered only by accredited multidisciplinary higher education institutions offering 4-year integrated B.Ed. programmes. Multidisciplinary higher education institutions offering the 4-year in-class integrated B.Ed. programme and having accreditation for ODL may also offer high-quality B.Ed. programmes in blended or ODL mode to students in remote or difficult-to-access locations and also to in-service teachers who are aiming to enhance their qualification, with suitable robust arrangements for mentoring and for the practicum-training and student-teaching components of the programme.

5.24. All B.Ed. programmes will include training in time-tested as well as the most recent techniques in pedagogy, including pedagogy with respect to foundational literacy and numeracy, multi-level teaching and evaluation, teaching children with disabilities, teaching children with special interests or talents, use of educational technology, and learner-centered and collaborative learning. All B.Ed. programmes will include strong practicum training in the form of in-classroom teaching at local schools. All B.Ed. programmes will also emphasize the practice of the Fundamental Duties (Article 51A) of the Indian Constitution along with other Constitutional provisions while teaching any subject or performing any activity. It will also appropriately integrate environmental awareness and sensitivity towards its conservation and sustainable development, so that environment education becomes an integral part of school curricula.

5.25. Special shorter local teacher education programmes will also be available at BITEs, DIETs, or at school complexes themselves for eminent local persons who can be hired to teach at schools or school complexes as 'master instructors', for the purpose of promoting local professions, knowledge, and skills, e.g., local art, music, agriculture, business, sports, carpentry, and other vocational crafts.

5.26. Shorter post-B.Ed. certification courses will also be made widely available, at multidisciplinary colleges and universities, to teachers who may wish to move into more specialized areas of teaching, such as the teaching of students with disabilities, or into leadership and management positions in the schooling system, or to move from one stage to another between foundational, preparatory, middle, and secondary stages.

5.27. It is recognized that there may be several pedagogical approaches internationally for teaching particular subjects; NCERT will study, research, document, and compile the varied international pedagogical approaches for teaching different subjects and make recommendations on what can be learnt and assimilated from these approaches into the pedagogies being practiced in India.

5.28. By 2021, a new and comprehensive National Curriculum Framework for Teacher Education, NCFTE 2021, will be formulated by the NCTE in consultation with NCERT, based on the principles of this National Education Policy 2020. The framework will be developed after discussions with all stakeholders including State Governments, relevant Ministries/Departments of Central Government and various expert bodies, and will be made available in all regional languages. The NCFTE 2021 will also factor in the requirements of teacher education curricula for vocational education. The NCFTE will thereafter be revised once every 5-10 years by reflecting the changes in revised NCFs as well as emerging needs in teacher education.

5.29. Finally, in order to fully restore the integrity of the teacher education system, stringent action will be taken against substandard stand-alone Teacher Education Institutions (TEIs) running in the country, including shutting them down, if required.

6. Equitable and Inclusive Education: Learning for All

6.1. Education is the single greatest tool for achieving social justice and equality. Inclusive and equitable education - while indeed an essential goal in its own right - is also critical to achieving an inclusive and equitable society in which every citizen has the opportunity to dream, thrive, and contribute to the nation. The education system must aim to benefit India's children so that no child loses any opportunity to learn and excel because of circumstances of birth or background. This Policy reaffirms that bridging the social category gaps in access, participation, and learning outcomes in school education will continue to be one of the major goals of all education sector development programmes. This Chapter may be read in conjunction with Chapter 14 which discusses analogous issues of Equity and Inclusion in Higher Education.

6.2. While the Indian education system and successive government policies have made steady progress towards bridging gender and social category gaps in all levels of school education, large disparities still remain - especially at the secondary level - particularly for socio-economically disadvantaged groups that have been historically underrepresented in education. Socio-Economically Disadvantaged Groups (SEDGs) can be broadly categorized based on gender identities (particularly female and transgender individuals), socio-cultural identities (such as Scheduled Castes, Scheduled Tribes, OBCs, and minorities), geographical identities (such as students from villages, small towns, and aspirational districts), disabilities (including learning disabilities), and socio-economic conditions (such as migrant communities, low income households, children in vulnerable situations, victims of or children of victims of trafficking, orphans including child beggars in urban areas, and the urban poor). While overall enrolments in schools decline steadily from Grade 1 to Grade 12, this decline in enrolments is significantly more pronounced for many of these SEDGs, with even greater declines for female students within each of these SEDGs and often even steeper in higher education. A brief status overview of the SEDGs that come within socio-cultural identities is given in following sub-sections.

6.2.1. According to U-DISE 2016-17 data, about 19.6% of students belong to Scheduled Castes at the primary level, but this fraction falls to 17.3% at the higher secondary level. These enrolment drop-offs are more severe for Scheduled Tribes students (10.6% to 6.8%), and differently-abled children (1.1% to 0.25%), with even greater declines for female students within each of these categories. The decline in enrolment in higher education is even steeper.

6.2.2. A multiplicity of factors, including lack of access to quality schools, poverty, social mores & customs, and language have had a detrimental effect on rates of enrolment and retention among the Scheduled Castes. Bridging these gaps in access, participation, and learning outcomes of children belonging to Scheduled Castes will continue to be one of the major goals. Also, the Other Backward Classes (OBCs) which have been identified on the basis of historically being socially and educationally backward also need special focus.

6.2.3. Tribal communities and children from Scheduled Tribes also face disadvantages at multiple levels due to various historical and geographical factors. Children from tribal communities often find their school education irrelevant and foreign to their lives, both culturally and academically. While several programmatic interventions to uplift children from tribal communities are currently in place, and will continue to be pursued, special mechanisms need to be made to ensure that children belonging to tribal communities receive the benefits of these interventions.

6.2.4. Minorities are also relatively underrepresented in school and higher education. The Policy acknowledges the importance of interventions to promote education of children belonging to all minority communities, and particularly those communities that are educationally underrepresented.

6.2.5. The Policy also recognizes the importance of creating enabling mechanisms for providing Children With Special Needs (CWSN) or *Divyang*, the same opportunities of obtaining quality education as any other child.

6.2.6. Separate strategies will be formulated for focused attention on reducing the social category gaps in school education as outlined in the following sub-sections.

6.3. The critical problems and recommendations regarding ECCE, foundational literacy and numeracy, access, enrolment and attendance discussed in Chapters 1–3, are particularly relevant and important for underrepresented and disadvantaged groups. Therefore, the measures from Chapters 1–3 will be targeted in a concerted way for SEDGs.

6.4. In addition, there have been various successful policies and schemes such as targeted scholarships, conditional cash transfers to incentivize parents to send their children to school, providing bicycles for transport, etc., that have significantly increased participation of SEDGs in the schooling system in certain areas. These successful policies and schemes must be significantly strengthened across the country.

6.5. It will also be essential to take into account research that ascertains which measures are particularly effective for certain SEDGs. For example, providing bicycles and organizing cycling and walking groups to provide access to school have been shown to be particularly powerful methods in increasing participation of female students - even at lesser distances - because of the safety benefits and comfort to parents that they provide. One-on-one teachers and tutors, peer tutoring, open schooling, appropriate infrastructure, and suitable technological interventions to ensure access can be particularly effective for certain children with disabilities. Schools providing quality ECCE reap the greatest dividends for children who come from families that are economically disadvantaged. Meanwhile, counsellors and/or well-trained social workers that work with and connect with students, parents, schools, and teachers in order to improve attendance and learning outcomes have been found to be especially effective for children in urban poor areas.

6.6. Data shows that certain geographical areas contain significantly larger proportions of SEDGs. Also, there are geographical locations that have been identified as Aspirational Districts which require special interventions for promoting their educational development. Hence, it is recommended that regions of the country with large populations from educationally-disadvantaged SEDGs should be declared Special Education Zones (SEZs), where all the schemes and policies are implemented to the maximum through additional concerted efforts, in order to truly change their educational landscape.

6.7. It must be noted that women cut across all underrepresented groups, making up about half of all SEDGs. Unfortunately, the exclusion and inequity that SEDGs face is only amplified for the women in these SEDGs. The policy additionally recognizes the special and critical role that women play in society and in shaping social mores; therefore, providing a quality education to girls is the best way to increase the education levels for these SEDGs, not just in the present but also in future generations. The policy thus recommends that the policies and schemes designed to include students from SEDGs should be especially targeted towards girls in these SEDGs.

6.8. In addition, the Government of India will constitute a 'Gender-Inclusion Fund' to build the nation's capacity to provide equitable quality education for all girls as well as transgender students. The fund will be available to States to implement priorities determined by the Central government critical for assisting female and transgender children in gaining access to education (such as the provisions of sanitation and toilets, bicycles, conditional cash transfers, etc.); funds will also enable States to support and scale effective community-based interventions that address local context-specific barriers to female and transgender children's access to and participation in education. Similar 'Inclusion Fund' schemes shall also be developed to address analogous access issues for other SEDGs. In essence, this Policy aims to eliminate any remaining disparity in access to education (including vocational education) for children from any gender or other socio-economically disadvantaged group.

6.9. Free boarding facilities will be built - matching the standard of Jawahar Navodaya Vidyalayas - in school locations where students may have to come from far, and particularly for students who from socio-economically disadvantaged backgrounds, with suitable arrangements for the safety of all children, especially girls. Kasturba Gandhi Balika Vidyalayas will be strengthened and expanded to increase the participation in quality schools (up to Grade 12) of girls from socio-economically disadvantaged backgrounds. Additional Jawahar Navodaya Vidyalayas and Kendriya Vidyalayas will be built around the country, especially in aspirational districts, Special Education Zones, and other disadvantaged areas, to increase high-quality educational opportunities. Pre-school sections covering at least one year of early childhood care and education will be added to Kendriya Vidyalayas and other primary schools around the nation, particularly in disadvantaged areas.

6.10. Ensuring the inclusion and equal participation of children with disabilities in ECCE and the schooling system will also be accorded the highest priority. Children with disabilities will be enabled to fully participate in the regular schooling process from the Foundational Stage to higher education. The Rights of Persons with Disabilities (RPWD) Act 2016 defines inclusive education as a 'system of education wherein students with and without disabilities learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities'. This Policy is in complete consonance with the provisions of the RPWD Act 2016 and endorses all its recommendations with regard to school education. While preparing the National Curriculum Framework, NCERT will ensure that consultations are held with expert bodies such as National Institutes of DEPwD.

6.11. To this end, schools/school complexes will be provided resources for the integration of children with disabilities, recruitment of special educators with cross-disability training, and for the establishment of resource centres, wherever needed, especially for children with severe or multiple disabilities. Barrier free access for all children with disabilities will be enabled as per the RPWD Act. Different categories of children with disabilities have differing needs. Schools and school complexes will work and be supported for providing all children with disabilities accommodations and support

mechanisms tailored to suit their needs and to ensure their full participation and inclusion in the classroom. In particular, assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) will be made available to help children with disabilities integrate more easily into classrooms and engage with teachers and their peers. This will apply to all school activities including arts, sports, and vocational education. NIOS will develop high-quality modules to teach Indian Sign Language, and to teach other basic subjects using Indian Sign Language. Adequate attention will be paid to the safety and security of children with disabilities.

6.12. As per the RPWD Act 2016, children with benchmark disabilities shall have the choice of regular or special schooling. Resource centres in conjunction with special educators will support the rehabilitation and educational needs of learners with severe or multiple disabilities and will assist parents/guardians in achieving high-quality home schooling and skilling for such students as needed. Home-based education will continue to be a choice available for children with severe and profound disabilities who are unable to go to schools. The children under home-based education must be treated as equal to any other child in the general system. There shall be an audit of home-based education for its efficiency and effectiveness using the principle of equity and equality of opportunity. Guidelines and standards for home-based schooling shall be developed based on this audit in line with the RPWD Act 2016. While it is clear that the education of all children with disabilities is the responsibility of the State, technology-based solutions will be used for the orientation of parents/caregivers along with wide-scale dissemination of learning materials to enable parents/caregivers to actively support their children's learning needs will be accorded priority.

6.13. Most classrooms have children with specific learning disabilities who need continuous support. Research is clear that the earlier such support begins, the better the chances of progress. Teachers must be helped to identify such learning disabilities early and plan specifically for their mitigation. Specific actions will include the use of appropriate technology allowing and enabling children to work at their own pace, with flexible curricula to leverage each child's strengths, and creating an ecosystem for appropriate assessment and certification. Assessment and certification agencies, including the proposed new National Assessment Centre, PARAKH, will formulate guidelines and recommend appropriate tools for conducting such assessment, from the foundational stage to higher education (including for entrance exams), in order to ensure equitable access and opportunities for all students with learning disabilities.

6.14. The awareness and knowledge of how to teach children with specific disabilities (including learning disabilities) will be an integral part of all teacher education programmes, along with gender sensitization and sensitization towards all underrepresented groups in order to reverse their underrepresentation.

6.15. Alternative forms of schools, will be encouraged to preserve their traditions or alternative pedagogical styles. At the same time, they will be supported to integrate the subject and learning areas prescribed by the NCFSE into their curricula in order to reduce and eventually eliminate the underrepresentation of children from these schools in higher education. In particular, financial assistance will be provided to introduce science, mathematics, social studies, Hindi, English, State languages, or other relevant subjects in the curriculum, as may be desired by these schools. This would enable children studying in these schools to attain the learning outcomes defined for Grades 1–12. Furthermore, students in such schools would be encouraged to appear for State or other Board examinations and assessments by the NTA, and thereby enroll in higher education institutions. Capacities of teachers in the teaching of science, mathematics, language, and social studies will be developed including orientation to new pedagogical practices. Libraries and laboratories will be strengthened and adequate reading materials like books, journals, etc., and other teaching-learning materials will be made available.

6.16. Within SEDGs, and with respect to all the above policy points, special attention will be given to reduce the disparities in the educational development of Scheduled Castes and Scheduled Tribes. As a part of the efforts to enhance participation in school education, special hostels in dedicated regions, bridge courses, and financial assistance through fee waivers and scholarships will be offered to

talented and meritorious students from all SEDGs on a larger scale, especially at the secondary stage of education, to facilitate their entry into higher education.

6.17. Under the aegis of the Ministry of Defence, State Governments may encourage opening NCC wings in their secondary and higher secondary schools, including those located in tribal dominated areas. This will enable harnessing of the natural talent and unique potential of students, which in turn would help them to aspire to a successful career in the defence forces.

6.18. All scholarships and other opportunities and schemes available to students from SEDGs will be coordinated and announced by a single agency and website to ensure that all students are aware of, and may apply in a simplified manner on such a 'single window system', as per eligibility.

6.19. All the above policies and measures are absolutely critical to attaining full inclusion and equity for all SEDGs - but they are not sufficient. What is also required is a change in school culture. All participants in the school education system, including teachers, principals, administrators, counsellors, and students, will be sensitized to the requirements of all students, the notions of inclusion and equity, and the respect, dignity, and privacy of all persons. Such an educational culture will provide the best pathway to help students become empowered individuals who, in turn, will enable society to transform into one that is responsible towards its most vulnerable citizens. Inclusion and equity will become a key aspect of teacher education (and training for all leadership, administrative, and other positions in schools); efforts will be made to recruit more high-quality teachers and leaders from SEDGs in order to bring in excellent role models for all students.

6.20. Students will be sensitized through this new school culture, brought in by teachers, trained social workers and counsellors as well as through corresponding changes to bring in an inclusive school curriculum. The school curriculum will include, early on, material on human values such as respect for all persons, empathy, tolerance, human rights, gender equality, non-violence, global citizenship, inclusion, and equity. It would also include more detailed knowledge of various cultures, religions, languages, gender identities, etc. to sensitize and develop respect for diversity. Any biases and stereotypes in school curriculum will be removed, and more material will be included that is relevant and relatable to all communities.

7. Efficient Resourcing and Effective Governance through School Complexes/Clusters

7.1. While the establishment of primary schools in every habitation across the country-driven by the Sarva Shiksha Abhiyan (SSA), now subsumed under the Samagra Shiksha Scheme and other important efforts across the States - has helped to ensure near-universal access to primary schools, it has also led to the development of numerous very small schools. According to U-DISE 2016–17 data, nearly 28% of India's public primary schools and 14.8% of India's upper primary schools have less than 30 students. The average number of students per grade in the elementary schooling system (primary and upper primary, i.e., Grades 1–8) is about 14, with a notable proportion having below 6; during the year 2016–17, there were 1,08,017 single-teacher schools, the majority of them (85743) being primary schools serving Grades 1–5.

7.2. These small school sizes have rendered it economically suboptimal and operationally complex to run good schools, in terms of deployment of teachers as well as the provision of critical physical resources. Teachers often teach multiple grades at a time, and teach multiple subjects, including subjects in which they may have no prior background; key areas such as music, arts, and sports are too often simply not taught; and physical resources, such as lab and sports equipment and library books, are simply not available across schools.

7.3. The isolation of small schools also has a negative effect on education and the teaching-learning process. Teachers function best in communities and teams, and so do students. Small schools also present a systemic challenge for governance and management. The geographical dispersion, challenging access conditions, and the very large numbers of schools make it difficult to reach all schools equally. Administrative structures have not been aligned with the increases in the number of school or with the unified structure of the Samagra Shiksha Scheme.

7.4. Although consolidation of schools is an option that is often discussed, it must be carried out very judiciously, and only when it is ensured that there is no impact on access. Such measures are nevertheless likely to result only in limited consolidation, and would not solve the overall structural problem and challenges presented by the large numbers of small schools.

7.5. These challenges will, by 2025, be addressed by State/UT governments by adopting innovative mechanisms to group or rationalize schools. The objective behind this intervention would be to ensure that every school has: (a) adequate number of counsellors/trained social workers and teachers (shared or otherwise) for teaching all subjects including art, music science, sports, languages, vocational subjects, etc; (b) adequate resources (shared or otherwise), such as a library, science labs, computer labs, skill labs, playgrounds, sports equipment and facilities, etc.; (c) a sense of community is built to overcome the isolation of teachers, students, and schools, through joint professional development programmes, sharing of teaching-learning content, joint content development, holding joint activities such as art and science exhibitions, sports meets, quizzes and debates, and fairs; (d) cooperation and support across schools for the education of children with disabilities; and (e) improved governance of the schooling system by devolving all finer decisions, to Principals, teachers, and other stakeholders within each group of schools and treating such a group of schools, which range from the foundational stage through the secondary stage, as an integrated semi-autonomous unit.

7.6. One possible mechanism for accomplishing the above would be the establishment of a grouping structure called the school complex, consisting of one secondary school together with all other schools offering lower grades in its neighbourhood including Anganwadis, in a radius of five to ten kilometers. This suggestion was first made by the Education Commission (1964–66) but was left unimplemented. This Policy strongly endorses the idea of the school complex/cluster, wherever possible. The aim of the school complex/cluster will be greater resource efficiency and more effective functioning, coordination, leadership, governance, and management of schools in the cluster.

7.7. The establishment of school complexes/clusters and the sharing of resources across complexes will have a number of other benefits as a consequence, such as improved support for children with disabilities, more topic-centred clubs and academic/sports/arts/crafts events across school complexes, better incorporation of art, music, language, vocational subjects, physical education, and other subjects in the classroom through the sharing of teachers in these subjects including use of ICT tools to conduct virtual classes, better student support, enrolment, attendance, and performance through the sharing of social workers and counsellors, and School Complex Management Committees (rather than simply School Management Committees) for more robust and improved governance, monitoring, oversight, innovations, and initiatives by local stakeholders. Building such larger communities of schools, school leaders, teachers, students, supporting staff, parents, and local citizens would energize and empower the schooling system, and in a resource-efficient manner.

7.8. The governance of schools will also improve and become far more efficient with school complexes/clusters. First, the DSE will devolve authority to the school complex/cluster, which will act as a semi-autonomous unit. The District Education Officer (DEO) and the Block Education Officers (BEO) will interact primarily with each school complex/cluster as a single unit and facilitate its work. The complex itself will perform certain tasks delegated by the DSE and will deal with the individual schools within it. The school complex/cluster will be given significant autonomy by the DSE to innovate towards providing integrated education and to experiment with pedagogies, curriculum, etc., while adhering to the National Curricular Framework (NCF) and State Curricular Framework (SCF). Under this organization, schools will gain in strength, will be able to exercise greater freedom, and will contribute towards making the complex more innovative and responsive. Meanwhile, the DSE will be able to focus on the aggregate level goals that need to be achieved, improving overall system effectiveness.

7.9. The culture of working to a plan, both short-term and long-term ones, will be developed through such complexes/clusters. Schools will develop their plans (SDPs) with the involvement of their SMCs. These plans will then become the basis for the creation of School Complex/Cluster Development Plans (SCDPs). The SCDP will also involve the plans of all other institutions

associated with the school complex, such as vocational education institutions, and will be created by the principals and teachers of the school complex with the involvement of the SCMC and will be made available publicly. The plans will include human resources, learning resources, physical resources and infrastructure, improvement initiatives, financial resources, school culture initiatives, teacher development plans, and educational outcomes. It will detail the efforts to leverage the teachers and students across the school complex to develop vibrant learning communities. The SDP and SCDP will be the primary mechanism to align all stakeholders of the school, including the DSE. The SMC and SCMC will use the SDP and SCDP for oversight of the functioning and direction of the school and will assist in the execution of these plans. The DSE, through its relevant official, e.g., the BEO, will endorse and confirm the SCDP of each school complex. It will then provide the resources (financial, human, physical, etc.) necessary to achieve the SCDPs, both short-term (1-year) and long-term (3-5 years). It will also provide all other relevant support to the school complexes to achieve the educational outcomes. The DSE and the SCERT may share specific norms (e.g., financial, staffing, process) and frameworks for development of the SDP and SCDP with all schools, which may be revised periodically.

7.10. To further enhance cooperation and positive synergy among schools, including between public and private schools, the twinning/pairing of one public school with one private school will be adopted across the country, so that such paired schools may meet/interact with each other, learn from each other, and also share resources, if possible. Best practices of private schools will be documented, shared, and institutionalized in public schools, and vice versa, where possible.

7.11. Every State will be encouraged to strengthen existing or establish "Bal Bhavans" where children of all ages can visit once a week (e.g., on weekends) or more often, as a special daytime boarding school, to partake in art-related, career-related, and play-related activities. Such Bal Bhavans may be incorporated as a part of school complexes/clusters if possible.

7.12. The school should be a point of celebration and honour for the whole community. The dignity of the school as an institution should be restored and important dates, such as the foundation day of the school, will be celebrated along with the community and the list of important alumni may be displayed and honoured. Furthermore, the un-utilized capacity of school infrastructure could be used to promote social, intellectual, and volunteer activities for the community and to promote social cohesion during non-teaching / schooling hours and may be used as a "Samajik Chetna Kendra".

8. Standard-setting and Accreditation for School Education

8.1. The goal of the school education regulatory system must be to continually improve educational outcomes; it must not overly restrict schools, prevent innovation, or demoralize teachers, principals, and students. All in all, regulation must aim to empower schools and teachers with trust, enabling them to strive for excellence and perform at their very best, while ensuring the integrity of the system through the enforcement of complete transparency and full public disclosure of all finances, procedures, and educational outcomes.

8.2. At present, all main functions of governance and regulation of the school education system - namely, the provision of public education, the regulation of education institutions, and policymaking - are handled by a single body, i.e., the Department of School Education or its arms. This leads to conflict of interests and excessive centralized concentration of power; it also leads to ineffective management of the school system, as efforts towards quality educational provision are often diluted by the focus on the other roles, particularly regulation, that the Departments of School Education also perform.

8.3. The current regulatory regime also has not been able to curb the commercialization and economic exploitation of parents by many for-profit private schools, yet at the same time it has all too often inadvertently discouraged public-spirited private/philanthropic schools. There has been far too much asymmetry between the regulatory approaches to public and private schools, even though the goals of both types of schools should be the same: to provide quality education.

8.4. The public education system is the foundation of a vibrant democratic society, and the way it is run must be transformed and invigorated in order to achieve the highest levels of educational outcomes for the nation. At the same time, the private/philanthropic school sector must also be encouraged and enabled to play a significant and beneficial role.

8.5. The key principles and recommendations of this Policy regarding the State school education system, the independent responsibilities within that system, and the approach to its regulation are as follows:

(a) The Department of School Education, which is the apex state-level body in school education, will be responsible for overall monitoring and policymaking for continual improvement of the public education system; it will not be involved with the provision and operation of schools or with the regulation of schools, in order to ensure due focus on the improvement of public schools and to eliminate conflict of interests.

(b) The educational operations and service provision for the public schooling system of the whole State will be handled by the Directorate of School Education (including the offices of the DEO and BEO, etc.); it will work independently to implement policies regarding educational operations and provision.

(c) An effective quality self-regulation or accreditation system will be instituted for all stages of education including pre-school education - private, public, and philanthropic - to ensure compliance with essential quality standards. To ensure that all schools follow certain minimal professional and quality standards, States/UTs will set up an independent, State-wide, body called the State School Standards Authority (SSSA). The SSSA will establish a minimal set of standards based on basic parameters (namely, safety, security, basic infrastructure, number of teachers across subjects and grades, financial probity, and sound processes of governance), which shall be followed by all schools. The framework for these parameters will be created by the SCERT in consultation with various stakeholders, especially teachers and schools.

    Transparent public self-disclosure of all the basic regulatory information, as laid down by the SSSA, will be used extensively for public oversight and accountability. The dimensions on which information has to be self-disclosed, and the format of disclosure will be decided by the SSSA in accordance with global best practices for standard-setting for schools. This information will have to be made available and kept updated and accurate by all schools, on the aforementioned public website maintained by the SSSA and on the schools' websites. Any complaints or grievances from stakeholders or others arising out of the information placed in the public domain shall be adjudicated by the SSSA. Feedback from randomly selected students will be solicited online to ensure valuable input at regular intervals. Technology will be employed suitably to ensure efficiency and transparency in all work of the SSSA. This will bring down significantly the heavy load of regulatory mandates currently borne by schools.

(d) Academic matters, including academic standards and curricula in the State will be led by the SCERT (with close consultation and collaboration with the NCERT), which will be reinvigorated as an institution. The SCERT will develop a School Quality Assessment and Accreditation Framework (SQAAF) through wide consultations with all stakeholders. The SCERT will also lead a "change management process" for the reinvigoration of CRCs, BRCs, and DIETs which must change the capacity and work culture of these institutions in 3 years, developing them into vibrant institutions of excellence. Meanwhile, certification of competencies of students at the school-leaving stage will be handled by the Boards of Assessment/Examination in each State.

8.6. The culture, structures, and systems that empower and provide adequate resources to schools, institutions, teachers, officials, communities, and other stakeholders, will also build concomitant accountability. Each stakeholder and participant of the education system will be accountable to perform their role with the highest level of integrity, full commitment, and exemplary work ethic.

Each role of the system will have explicitly articulated role expectations and rigorous assessment of their performance vis-à-vis these expectations. The assessment system will be objective and developmentally oriented, while ensuring accountability. It will have multiple sources of feedback and assessment, to ensure a full view of the performance (and will not just be linked simplistically, e.g., to 'marks' of students). The assessment will recognize that outcomes such as educational attainment of students have multiple intervening variables and extraneous influences. It will also recognize that education requires teamwork, particularly at the level of the school. Promotion, recognition, and accountability of all individuals will be based on such performance assessment. All functionaries will be responsible to ensure that this development, performance, and accountability system is run with high integrity, and systematically, within their span of control.

8.7. Public and private schools (except the schools that are managed/aided/controlled by the Central government) will be assessed and accredited on the same criteria, benchmarks, and processes, emphasizing online and offline public disclosure and transparency, so as to ensure that public-spirited private schools are encouraged and not stifled in any way. Private philanthropic efforts for quality education will be encouraged - thereby affirming the public-good nature of education - while protecting parents and communities from arbitrary increases in tuition fees. Public disclosure on the school website and on the SSSA website - for both public and private schools - would include (at the very least) information on the numbers of classrooms, students, and teachers, subjects taught, any fees, and overall student outcomes on standardized evaluations such as the NAS and SAS. For schools controlled/managed/aided by the Central government, the CBSE in consultation with the MHRD shall prepare a framework. All the education institutions will be held to similar standards of audit and disclosure as a 'not-for-profit' entity. Surpluses, if any, will be reinvested in the educational sector.

8.8. The standard-setting/regulatory framework and the facilitating systems for school regulation, accreditation, and governance shall be reviewed to enable improvements on the basis of the learnings and experiences gained in the last decade. This review will aim to ensure that all students, particularly students from underprivileged and disadvantaged sections, shall have universal, free and compulsory access to high-quality and equitable schooling from early childhood care and education (age 3 onwards) through higher secondary education (i.e., until Grade 12). The overemphasis on inputs, and the mechanistic nature of their specifications – physical and infrastructural – will be changed and requirements made more responsive to realities on the ground, e.g., regarding land areas and room sizes, practicalities of playgrounds in urban areas, etc. These mandates will be adjusted and loosened, leaving suitable flexibility for each school to make its own decisions based on local needs and constraints, while ensuring safety, security, and a pleasant and productive learning space. Educational outcomes and the transparent disclosure of all financial, academic, and operational matters will be given due importance and will be incorporated suitably in the assessment of schools. This will further improve India's progress towards achieving Sustainable Development Goal 4 (SDG4) of ensuring free, equitable, and quality primary and secondary education for all children.

8.9. The aim of the public-school education system will be to impart the highest quality education so that it becomes the most attractive option for parents from all walks of life for educating their children.

8.10. For a periodic 'health check-up' of the overall system, a sample-based National Achievement Survey (NAS) of student learning levels will be carried out by the proposed new National Assessment Centre, PARAKH with suitable cooperation with other governmental bodies- such as the NCERT– that may assist in assessment procedures as well as data analysis. The assessment will cover students across government as well as private schools. States will also be encouraged to conduct their own census-based State Assessment Survey (SAS), the results of which will be used only for developmental purposes, public disclosure by schools of their overall and anonymized student outcomes, and for continuous improvement of the school education system. Until the establishment of the proposed new National Assessment Centre, PARAKH, NCERT may continue to carry out NAS.

8.11. Finally, the children and adolescents enrolled in schools must not be forgotten in this whole process; after all, the school system is designed for them. Careful attention must be paid to their safety and rights- particularly girl children - and the various difficult issues faced by adolescents, such as substance or drug abuse and forms of discrimination and harassment including violence, with clear, safe, and efficient mechanisms for reporting and for due process on any infractions against children's/adolescents' rights or safety. The development of such mechanisms that are effective, timely, and well-known to all students will be accorded high priority.

Part II. HIGHER EDUCATION

9. Quality Universities and Colleges: A New and Forward-looking Vision for India's Higher Education System

9.1. Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially-conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. Higher education significantly contributes towards sustainable livelihoods and economic development of the nation. As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education.

9.1.1. Given the 21st century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. It must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education must enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. It must prepare students for more meaningful and satisfying lives and work roles and enable economic independence.

9.1.2. For the purpose of developing holistic individuals, it is essential that an identified set of skills and values will be incorporated at each stage of learning, from pre-school to higher education.

9.1.3. At the societal level, higher education must enable the development of an enlightened, socially conscious, knowledgeable, and skilled nation that can find and implement robust solutions to its own problems. Higher education must form the basis for knowledge creation and innovation thereby contributing to a growing national economy. The purpose of quality higher education is, therefore, more than the creation of greater opportunities for individual employment. It represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.

9.2. Some of the major problems currently faced by the higher education system in India include:

(a) a severely fragmented higher educational ecosystem;
(b) less emphasis on the development of cognitive skills and learning outcomes;
(c) a rigid separation of disciplines, with early specialisation and streaming of students into narrow areas of study;
(d) limited access particularly in socio-economically disadvantaged areas, with few HEIs that teach in local languages
(e) limited teacher and institutional autonomy;
(f) inadequate mechanisms for merit-based career management and progression of faculty and institutional leaders;
(g) lesser emphasis on research at most universities and colleges, and lack of competitive peer-reviewed research funding across disciplines;
(h) suboptimal governance and leadership of HEIs;
(i) an ineffective regulatory system; and
(j) large affiliating universities resulting in low standards of undergraduate education.

9.3. This policy envisions a complete overhaul and re-energising of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion. The policy's vision includes the following key changes to the current system:

(a) moving towards a higher educational system consisting of large, multidisciplinary universities and colleges, with at least one in or near every district, and with more HEIs across India that offer medium of instruction or programmes in local/Indian languages;
(b) moving towards a more multidisciplinary undergraduate education;
(c) moving towards faculty and institutional autonomy;
(d) revamping curriculum, pedagogy, assessment, and student support for enhanced student experiences;
(e) reaffirming the integrity of faculty and institutional leadership positions through merit-appointments and career progression based on teaching, research, and service;
(f) establishment of a National Research Foundation to fund outstanding peer-reviewed research and to actively seed research in universities and colleges;
(g) governance of HEIs by high qualified independent boards having academic and administrative autonomy;
(h) "light but tight" regulation by a single regulator for higher education;
(i) increased access, equity, and inclusion through a range of measures, including greater opportunities for outstanding public education; scholarships by private/philanthropic universities for disadvantaged and underprivileged students; online education, and Open Distance Learning (ODL); and all infrastructure and learning materials accessible and available to learners with disabilities.

10. Institutional Restructuring and Consolidation

10.1. The main thrust of this policy regarding higher education is to end the fragmentation of higher education by transforming higher education institutions into large multidisciplinary universities, colleges, and HEI clusters/Knowledge Hubs, each of which will aim to have 3,000 or more students. This would help build vibrant communities of scholars and peers, break down harmful silos, enable students to become well-rounded across disciplines including artistic, creative, and analytic subjects as well as sports, develop active research communities across disciplines including cross-disciplinary research, and increase resource efficiency, both material and human, across higher education.

10.2. Moving to large multidisciplinary universities and HEI clusters is thus the highest recommendation of this policy regarding the structure of higher education. The ancient Indian universities Takshashila, Nalanda, Vallabhi, and Vikramshila, which had thousands of students from India and the world studying in vibrant multidisciplinary environments, amply demonstrated the type of great success that large multidisciplinary research and teaching universities could bring. India urgently needs to bring back this great Indian tradition to create well-rounded and innovative individuals, and which is already transforming other countries educationally and economically.

10.3. This vision of higher education will require, in particular, a new conceptual perception/understanding for what constitutes a higher education institution (HEI), i.e., a university or a college. A university will mean a multidisciplinary institution of higher learning that offers undergraduate and graduate programmes, with high quality teaching, research, and community engagement. The definition of university will thus allow a spectrum of institutions that range from those that place equal emphasis on teaching and research i.e., Research-intensive Universities, those that place greater emphasis on teaching but still conduct significant research i.e. Teaching-intensive Universities. Meanwhile, an Autonomous degree-granting College (AC) will refer to a large multidisciplinary institution of higher learning that grants undergraduate degrees and is primarily focused on undergraduate teaching though it would not be restricted to that and it need not be restricted to that and it would generally be smaller than a typical university.

10.4. A stage-wise mechanism for granting graded autonomy to colleges, through a transparent system of graded accreditation, will be established. Colleges will be encouraged, mentored, supported, and incentivized to gradually attain the minimum benchmarks required for each level of

accreditation. Over a period of time, it is envisaged that every college would develop into either an Autonomous degree-granting College, or a constituent college of a university - in the latter case, it would be fully a part of the university. With appropriate accreditations, Autonomous degree-granting Colleges could evolve into Research-intensive or Teaching-intensive Universities, if they so aspire.

10.5. It must be clearly stated that these three broad types of institutions are not in any natural way a rigid, exclusionary categorization, but are along a continuum. HEIs will have the autonomy and freedom to move gradually from one category to another, based on their plans, actions, and effectiveness. The most salient marker for these categories of institutions will be the focus of their goals and work. The Accreditation System will develop and use appropriately different and relevant norms across this range of HEIs. However, the expectations of high quality of education, and of teaching-learning, across all HEIs will be the same.

10.6. In addition to teaching and research, HEIs will have other crucial responsibilities, which they will discharge through appropriate resourcing, incentives, and structures. These include supporting other HEIs in their development, community engagement and service, contribution to various fields of practice, faculty development for the higher education system, and support to school education.

10.7. By 2040, all higher education institutions (HEIs) shall aim to become multidisciplinary institutions and shall aim to have larger student enrolments preferably in the thousands, for optimal use of infrastructure and resources, and for the creation of vibrant multidisciplinary communities. Since this process will take time, all HEIs will firstly plan to become multidisciplinary by 2030, and then gradually increase student strength to the desired levels.

10.8. More HEIs shall be established and developed in underserved regions to ensure full access, equity, and inclusion. There shall, by 2030, be at least one large multidisciplinary HEI in or near every district. Steps shall be taken towards developing high-quality higher education institutions both public and private that have medium of instruction in local/Indian languages or bilingually. The aim will be to increase the Gross Enrolment Ratio in higher education including vocational education from 26.3% (2018) to 50% by 2035. While a number of new institutions may be developed to attain these goals, a large part of the capacity creation will be achieved by consolidating, substantially expanding, and also improving existing HEIs.

10.9. Growth will be in both public and private institutions, with a strong emphasis on developing a large number of outstanding public institutions. There will be a fair and transparent system for determining increased levels of public funding support for public HEIs. This system will give an equitable opportunity for all public institutions to grow and develop, and will be based on transparent, pre-announced criteria from within the accreditation norms of the Accreditation System. HEIs delivering education of the highest quality as laid down in this Policy will be incentivized in expanding their capacity.

10.10. Institutions will have the option to run Open Distance Learning (ODL) and online programmes, provided they are accredited to do so, in order to enhance their offerings, improve access, increase GER, and provide opportunities for lifelong learning (SDG 4). All ODL programmes and their components leading to any diploma or degree will be of standards and quality equivalent to the highest quality programmes run by the HEIs on their campuses. Top institutions accredited for ODL will be encouraged and supported to develop high-quality online courses. Such quality online courses will be suitably integrated into curricula of HEIs, and blended mode will be preferred.

10.11. Single-stream HEIs will be phased out over time, and all will move towards becoming vibrant multidisciplinary institutions or parts of vibrant multidisciplinary HEI clusters, in order to enable and encourage high-quality multidisciplinary and cross-disciplinary teaching and research across fields. Single-stream HEIs will, in particular, add departments across different fields that would strengthen the single stream that they currently serve. Through the attainment of suitable accreditations, all HEIs will gradually move towards full autonomy - academic and administrative - in order to enable this vibrant culture. The autonomy of public institutions will be backed by adequate public financial

support and stability. Private institutions with a public-spirited commitment to high-quality equitable education will be encouraged.

10.12. The new regulatory system envisioned by this Policy will foster this overall culture of empowerment and autonomy to innovate, including by gradually phasing out the system of 'affiliated colleges' over a period of fifteen years through a system of graded autonomy, and to be carried out in a challenge mode. Each existing affiliating university will be responsible for mentoring its affiliated colleges so that they can develop their capabilities and achieve minimum benchmarks in academic and curricular matters; teaching and assessment; governance reforms; financial robustness; and administrative efficiency. All colleges currently affiliated to a university shall attain the required benchmarks over time to secure the prescribed accreditation benchmarks and eventually become autonomous degree-granting colleges. This will be achieved through a concerted national effort including suitable mentoring and governmental support for the same.

10.13. The overall higher education sector will aim to be an integrated higher education system, including professional and vocational education. This Policy and its approach will be equally applicable to all HEIs across all current streams, which would eventually merge into one coherent ecosystem of higher education.

10.14. University, worldwide, means a multidisciplinary institution of higher learning that offers undergraduate, graduate, and Ph.D programmes, and engages in high-quality teaching and research. The present complex nomenclature of HEIs in the country such as 'deemed to be university', 'affiliating university', 'affiliating technical university', 'unitary university' shall be replaced simply by 'university' on fulfilling the criteria as per norms.

11. Towards a More Holistic and Multidisciplinary Education

11.1. India has a long tradition of holistic and multidisciplinary learning, from universities such as Takshashila and Nalanda, to the extensive literatures of India combining subjects across fields. Ancient Indian literary works such as Banabhatta's Kadambari described a good education as knowledge of the 64 Kalaas or arts; and among these 64 'arts' were not only subjects, such as singing and painting, but also 'scientific 'fields, such as chemistry and mathematics, 'vocational ' fields such as carpentry and clothes-making, 'professional 'fields, such as medicine and engineering, as well as 'soft skills' such as communication, discussion, and debate. The very idea that all branches of creative human endeavour, including mathematics, science, vocational subjects, professional subjects, and soft skills should be considered 'arts', has distinctly Indian origins. This notion of a 'knowledge of many arts' or what in modern times is often called the 'liberal arts' (i.e., a liberal notion of the arts) must be brought back to Indian education, as it is exactly the kind of education that will be required for the 21st century.

11.2. Assessments of educational approaches in undergraduate education that integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) have consistently showed positive learning outcomes, including increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. Research is also improved and enhanced through a holistic and multidisciplinary education approach.

11.3. A holistic and multidisciplinary education would aim to develop all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

11.4. A holistic and multidisciplinary education, as described so beautifully in India's past, is indeed what is needed for the education of India to lead the country into the 21st century and the fourth industrial revolution. Even engineering institutions, such as IITs, will move towards more holistic and multidisciplinary education with more arts and humanities. Students of arts and humanities will aim to learn more science and all will make an effort to incorporate more vocational subjects and soft skills.

11.5. Imaginative and flexible curricular structures will enable creative combinations of disciplines for study, and would offer multiple entry and exit points, thus, removing currently prevalent rigid boundaries and creating new possibilities for life-long learning. Graduate-level, master's and doctoral education in large multidisciplinary universities, while providing rigorous research-based specialization, would also provide opportunities for multidisciplinary work, including in academia, government, and industry.

11.6. Large multidisciplinary universities and colleges will facilitate the move towards high-quality holistic and multidisciplinary education. Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialization in a subject or subjects. This will be encouraged by increased faculty and institutional autonomy in setting curricula. Pedagogy will have an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking.

11.7. Departments in Languages, Literature, Music, Philosophy, Indology, Art, Dance, Theatre, Education, Mathematics, Statistics, Pure and Applied Sciences, Sociology, Economics, Sports, Translation and Interpretation, and other such subjects needed for a multidisciplinary, stimulating Indian education and environment will be established and strengthened at all HEIs. Credits will be given in all Bachelor's Degree programmes for these subjects if they are done from such departments or through ODL mode when they are not offered in-class at the HEI.

11.8. Towards the attainment of such a holistic and multidisciplinary education, the flexible and innovative curricula of all HEIs shall include credit-based courses and projects in the areas of community engagement and service, environmental education, and value-based education. Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living. Value-based education will include the development of humanistic, ethical, Constitutional, and universal human values of truth (*satya*), righteous conduct (*dharma*), peace (*shanti*), love (*prem*), nonviolence (*ahimsa*), scientific temper, citizenship values, and also life-skills; lessons in *seva*/service and participation in community service programmes will be considered an integral part of a holistic education. As the world is becoming increasingly interconnected, Global Citizenship Education (GCED), a response to contemporary global challenges, will be provided to empower learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies. Finally, as part of a holistic education, students at all HEIs will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, etc., as well as research internships with faculty and researchers at their own or other HEIs/research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

11.9. The structure and lengths of degree programmes shall be adjusted accordingly. The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student. An Academic Bank of Credit (ABC) shall be established which would digitally store the academic credits earned from various recognized HEIs so that the degrees from an HEI can be awarded taking into account credits earned. The 4-year programme may also lead to a degree 'with

Research' if the student completes a rigorous research project in their major area(s) of study as specified by the HEI.

11.10. HEIs will have the flexibility to offer different designs of Master's programmes: (a) there may be a 2-year programme with the second year devoted entirely to research for those who have completed the 3-year Bachelor's programme; (b) for students completing a 4-year Bachelor's programme with Research, there could be a 1-year Master's programme; and (c) there may be an integrated 5-year Bachelor's/Master's programme. Undertaking a Ph.D. shall require either a Master's degree or a 4-year Bachelor's degree with Research. The M.Phil. programme shall be discontinued.

11.11. Model public universities for holistic and multidisciplinary education, at par with IITs, IIMs, etc., called MERUs (Multidisciplinary Education and Research Universities) will be set up and will aim to attain the highest global standards in quality education. They will also help set the highest standards for multidisciplinary education across India.

11.12. HEIs will focus on research and innovation by setting up start-up incubation centres; technology development centres; centres in frontier areas of research; greater industry-academic linkages; and interdisciplinary research including humanities and social sciences research. Given the scenario of epidemics and pandemics, it is critical that HEIs take the lead to undertake research in areas of infectious diseases, epidemiology, virology, diagnostics, instrumentation, vaccinology and other relevant areas. HEIs will develop specific hand holding mechanisms and competitions for promoting innovation among student communities. The NRF will function to help enable and support such a vibrant research and innovation culture across HEIs, research labs, and other research organizations.

12. Optimal Learning Environments and Support for Students

12.1. Effective learning requires a comprehensive approach that involves appropriate curriculum, engaging pedagogy, continuous formative assessment, and adequate student support. The curriculum must be interesting and relevant, and updated regularly to align with the latest knowledge requirements and to meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students, thus directly influencing learning outcomes. The assessment methods must be scientific, designed to continuously improve learning and test the application of knowledge. Last but not least, the development of capacities that promote student wellness such as fitness, good health, psycho-social well-being, and sound ethical grounding are also critical for high-quality learning.

Thus, curriculum, pedagogy, continuous assessment, and student support are the cornerstones for quality learning. Along with providing suitable resources and infrastructure, such as quality libraries, classrooms, labs, technology, sports/recreation areas, student discussion spaces, and dining areas, a number of initiatives will be required to ensure that learning environments are engaging and supportive, and enable all students to succeed.

12.2. First, in order to promote creativity, institutions and faculty will have the autonomy to innovate on matters of curriculum, pedagogy, and assessment within a broad framework of higher education qualifications that ensures consistency across institutions and programmes and across the ODL, online, and traditional 'in-class' modes. Accordingly, curriculum and pedagogy will be designed by institutions and motivated faculty to ensure a stimulating and engaging learning experience for all students, and continuous formative assessment will be used to further the goals of each programme. All assessment systems shall also be decided by the HEI, including those that lead to final certification. The Choice Based Credit System (CBCS) will be revised for instilling innovation and flexibility. HEIs shall move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs shall also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

12.3. Second, each institution will integrate its academic plans ranging from curricular improvement to quality of classroom transaction - into its larger Institutional Development Plan (IDP). Each institution will be committed to the holistic development of students and create strong internal systems for supporting diverse student cohorts in academic and social domains both inside and outside formal academic interactions in the classroom. For example, all HEIs will have mechanisms and opportunities for funding of topic-centred clubs and activities organized by students with the help of faculty and other experts as needed, such as clubs and events dedicated to science, mathematics, poetry, language, literature, debate, music, sports, etc. Over time, such activities could be incorporated into the curriculum once appropriate faculty expertise and campus student demand is developed. Faculty will have the capacity and training to be able to approach students not just as teachers, but also as mentors and guides.

12.4. Third, students from socio-economically disadvantaged backgrounds require encouragement and support to make a successful transition to higher education. Universities and colleges will thus be required to set up high-quality support centres and will be given adequate funds and academic resources to carry this out effectively. There will also be professional academic and career counselling available to all students, as well as counsellors to ensure physical, psychological and emotional well-being.

12.5. Fourth, ODL and online education provide a natural path to increase access to quality higher education. In order to leverage its potential completely, ODL will be renewed through concerted, evidence-based efforts towards expansion while ensuring adherence to clearly articulated standards of quality. ODL programmes will aim to be equivalent to the highest quality in-class programmes available. Norms, standards, and guidelines for systemic development, regulation, and accreditation of ODL will be prepared, and a framework for quality of ODL that will be recommendatory for all HEIs will be developed.

12.6. Finally, all programmes, courses, curricula, and pedagogy across subjects, including those in-class, online, and in ODL modes as well as student support will aim to achieve global standards of quality.

Internationalization

12.7. The various initiatives mentioned above will also help in having larger numbers of international students studying in India, and provide greater mobility to students in India who may wish to visit, study at, transfer credits to, or carry out research at institutions abroad, and vice versa. Courses and programmes in subjects, such as Indology, Indian languages, AYUSH systems of medicine, yoga, arts, music, history, culture, and modern India, internationally relevant curricula in the sciences, social sciences, and beyond, meaningful opportunities for social engagement, quality residential facilities and on-campus support, etc. will be fostered to attain this goal of global quality standards, attract greater numbers of international students, and achieve the goal of 'internationalization at home'.

12.8. India will be promoted as a global study destination providing premium education at affordable costs thereby helping to restore its role as a Vishwa Guru. An International Students Office at each HEI hosting foreign students will be set up to coordinate all matters relating to welcoming and supporting students arriving from abroad. Research/teaching collaborations and faculty/student exchanges with high-quality foreign institutions will be facilitated, and relevant mutually beneficial MOUs with foreign countries will be signed. High performing Indian universities will be encouraged to set up campuses in other countries, and similarly, selected universities e.g., those from among the top 100 universities in the world will be facilitated to operate in India. A legislative framework facilitating such entry will be put in place, and such universities will be given special dispensation regarding regulatory, governance, and content norms on par with other autonomous institutions of India. Furthermore, research collaboration and student exchanges between Indian institutions and global institutions will be promoted through special efforts. Credits acquired in foreign universities will be permitted, where appropriate as per the requirements of each HEI, to be counted for the award of a degree.

Student Activity and Participation

12.9. Students are the prime stakeholders in the education system. Vibrant campus life is essential for high-quality teaching-learning processes. Towards this end, students will be given plenty of opportunities for participation in sports, culture/arts clubs, eco-clubs, activity clubs, community service projects, etc. In every education institution, there shall be counselling systems for handling stress and emotional adjustments. Furthermore, a systematized arrangement shall be created to provide the requisite support to students from rural backgrounds, including increasing hostel facilities as needed. All HEIs will ensure quality medical facilities for all students in their institutions.

Financial support for students

12.10. Financial assistance to students shall be made available through various measures. Efforts will be made to incentivize the merit of students belonging to SC, ST, OBC, and other SEDGs. The National Scholarship Portal will be expanded to support, foster, and track the progress of students receiving scholarships. Private HEIs will be encouraged to offer larger numbers of free ships and scholarships to their students.

13. Motivated, Energized, and Capable Faculty

13.1. The most important factor in the success of higher education institutions is the quality and engagement of its faculty. Acknowledging the criticality of faculty in achieving the goals of higher education, various initiatives have been introduced in the past several years to systematize recruitment and career progression, and to ensure equitable representation from various groups in the hiring of faculty. Compensation levels of permanent faculty in public institutions have also been increased substantially. Various initiatives have also been taken towards providing faculty with professional development opportunities. However, despite these various improvements in the status of the academic profession, faculty motivation in terms of teaching, research, and service in HEIs remains far lower than the desired level. The various factors that lie behind low faculty motivation levels must be addressed to ensure that each faculty member is happy, enthusiastic, engaged, and motivated towards advancing her/his students, institution, and profession. To this end, the policy recommends the following initiatives to achieve the best, motivated, and capable faculty in HEIs.

13.2. As the most basic step, all HEIs will be equipped with the basic infrastructure and facilities, including clean drinking water, clean working toilets, blackboards, offices, teaching supplies, libraries, labs, and pleasant classroom spaces and campuses. Every classroom shall have access to the latest educational technology that enables better learning experiences.

13.3. Teaching duties also will not be excessive, and student-teacher ratios not too high, so that the activity of teaching remains pleasant and there is adequate time for interaction with students, conducting research, and other university activities. Faculty will be appointed to individual institutions and generally not be transferable across institutions so that they may feel truly invested in, connected to, and committed to their institution and community.

13.4. Faculty will be given the freedom to design their own curricular and pedagogical approaches within the approved framework, including textbook and reading material selections, assignments, and assessments. Empowering the faculty to conduct innovative teaching, research, and service as they see best will be a key motivator and enabler for them to do truly outstanding, creative work.

13.5. Excellence will be further incentivized through appropriate rewards, promotions, recognitions, and movement into institutional leadership. Meanwhile, faculty not delivering on basic norms will be held accountable.

13.6. In keeping with the vision of autonomous institutions empowered to drive excellence, HEIs will have clearly defined, independent, and transparent processes and criteria for faculty recruitment. Whereas the current recruitment process will be continued, a ‘tenure-track’ i.e., suitable probation period shall be put in place to further ensure excellence. There shall be a fast-track promotion system

for recognizing high impact research and contribution. A system of multiple parameters for proper performance assessment, for the purposes of 'tenure' i.e., confirmed employment after probation, promotion, salary increases, recognitions, etc., including peer and student reviews, innovations in teaching and pedagogy, quality and impact of research, professional development activities, and other forms of service to the institution and the community, shall be developed by each HEI and clearly enunciated in it's Institutional Development Plan (IDP).

13.7. The presence of outstanding and enthusiastic institutional leaders that cultivate excellence and innovation is the need of the hour. Outstanding and effective institutional leadership is extremely important for the success of an institution and of its faculty. Excellent faculty with high academic and service credentials as well as demonstrated leadership and management skills will be identified early and trained through a ladder of leadership positions. Leadership positions shall not remain vacant, but rather an overlapping time period during transitions in leadership shall be the norm to ensure the smooth running of institutions. Institutional leaders will aim to create a culture of excellence that will motivate and incentivize outstanding and innovative teaching, research, institutional service, and community outreach from faculty members and all HEI leaders.

14. Equity and Inclusion in Higher Education

14.1. Entry into quality higher education can open a vast array of possibilities that can lift both individuals as well as communities out of the cycles of disadvantage. For this reason, making quality higher education opportunities available to all individuals must be among the highest priorities. This Policy envisions ensuring equitable access to quality education to all students, with a special emphasis on SEDGs.

14.2. The dynamics and also many of the reasons for exclusion of SEDGs from the education system are common across school and higher education sectors. Therefore, the approach to equity and inclusion must be common across school and higher education. Furthermore, there must be continuity across the stages to ensure sustainable reform. Thus, the policy initiatives required to meet the goals of equity and inclusion in higher education must be read in conjunction with those for school education.

14.3. There are certain facets of exclusion, that are particular to or substantially more intense in higher education. These must be addressed specifically, and include lack of knowledge of higher education opportunities, economic opportunity cost of pursuing higher education, financial constraints, admission processes, geographical and language barriers, poor employability potential of many higher education programmes, and lack of appropriate student support mechanisms.

14.4. For this purpose, additional actions that are specific to higher education shall be adopted by all Governments and HEIs:

14.4.1. Steps to be taken by Governments

(a) Earmark suitable Government funds for the education of SEDGs
(b) Set clear targets for higher GER for SEDGs
(c) Enhance gender balance in admissions to HEIs
(d) Enhance access by establishing more high-quality HEIs in aspirational districts and Special Education Zones containing larger numbers of SEDGs
(e) Develop and support high-quality HEIs that teach in local/Indian languages or bilingually
(f) Provide more financial assistance and scholarships to SEDGs in both public and private HEIs
(g) Conduct outreach programmes on higher education opportunities and scholarships among SEDGs
(h) Develop and support technology tools for better participation and learning outcomes.

14.4.2. Steps to be taken by all HEIs

(a) Mitigate opportunity costs and fees for pursuing higher education
(b) Provide more financial assistance and scholarships to socio-economically disadvantaged students
(c) Conduct outreach on higher education opportunities and scholarships
(d) Make admissions processes more inclusive
(e) Make curriculum more inclusive
(f) Increase employability potential of higher education programmes
(g) Develop more degree courses taught in Indian languages and bilingually
(h) Ensure all buildings and facilities are wheelchair-accessible and disabled-friendly
(i) Develop bridge courses for students that come from disadvantaged educational backgrounds
(j) Provide socio-emotional and academic support and mentoring for all such students through suitable counselling and mentoring programmes
(k) Ensure sensitization of faculty, counsellor, and students on gender-identity issue and its inclusion in all aspects of the HEI, including curricula
(l) Strictly enforce all no-discrimination and anti-harassment rules
(m) Develop Institutional Development Plans that contain specific plans for action on increasing participation from SEDGs, including but not limited to the above items.

15. Teacher Education

15.1. Teacher education is vital in creating a pool of schoolteachers that will shape the next generation. Teacher preparation is an activity that requires multidisciplinary perspectives and knowledge, formation of dispositions and values, and development of practice under the best mentors. Teachers must be grounded in Indian values, languages, knowledge, ethos, and traditions including tribal traditions, while also being well-versed in the latest advances in education and pedagogy.

15.2. According to the Justice J. S. Verma Commission (2012) constituted by the Supreme Court, a majority of stand-alone TEIs - over 10,000 in number are not even attempting serious teacher education but are essentially selling degrees for a price. Regulatory efforts so far have neither been able to curb the malpractices in the system, nor enforce basic standards for quality, and in fact have had the negative effect of curbing the growth of excellence and innovation in the sector. The sector and its regulatory system are, therefore, in urgent need of revitalization through radical action, in order to raise standards and restore integrity, credibility, efficacy, and high quality to the teacher education system.

15.3. In order to improve and reach the levels of integrity and credibility required to restore the prestige of the teaching profession, the Regulatory System shall be empowered to take stringent action against substandard and dysfunctional teacher education institutions (TEIs) that do not meet basic educational criteria, after giving one year for remedy of the breaches. By 2030, only educationally sound, multidisciplinary, and integrated teacher education programmes shall be in force.

15.4. As teacher education requires multidisciplinary inputs, and education in high-quality content as well as pedagogy, all teacher education programmes must be conducted within composite multidisciplinary institutions. To this end, all multidisciplinary universities and colleges - will aim to establish, education departments which, besides carrying out cutting-edge research in various aspects of education, will also run B.Ed. programmes, in collaboration with other departments such as psychology, philosophy, sociology, neuroscience, Indian languages, arts, music, history, literature, physical education, science and mathematics. Moreover, all stand-alone TEIs will be required to convert to multidisciplinary institutions by 2030, since they will have to offer the 4-year integrated teacher preparation programme.

15.5. The 4-year integrated B.Ed. offered by such multidisciplinary HEIs will, by 2030, become the minimal degree qualification for school teachers. The 4-year integrated B.Ed. will be a dual-major holistic Bachelor′s degree, in Education as well as a specialized subject such as a language, history, music, mathematics, computer science, chemistry, economics, art, physical education, etc. Beyond

the teaching of cutting-edge pedagogy, the teacher education will include grounding in sociology, history, science, psychology, early childhood care and education, foundational literacy and numeracy, knowledge of India and its values/ethos/art/traditions, and more. The HEI offering the 4-year integrated B.Ed. may also run a 2-year B.Ed., for students who have already received a Bachelor′s degree in a specialized subject. A 1-year B.Ed. may also be offered for candidates who have received a 4-year undergraduate degree in a specialized subject. Scholarships for meritorious students will be established for the purpose of attracting outstanding candidates to the 4-year, 2-year, and 1-year B.Ed. programmes.

15.6. HEIs offering teacher education programmes will ensure the availability of a range of experts in education and related disciplines as well as specialized subjects. Each higher education institution will have a network of government and private schools to work closely with, where potential teachers will student-teach along with participating in other activities such as community service, adult and vocational education, etc.

15.7. In order to maintain uniform standards for teacher education, the admission to pre-service teacher preparation programmes shall be through suitable subject and aptitude tests conducted by the National Testing Agency, and shall be standardized keeping in view the linguistic and cultural diversity of the country.

15.8. The faculty profile in Departments of Education will necessarily aim to be diverse and but teaching/field/research experience will be highly valued. Faculty with training in areas of social sciences that are directly relevant to school education e.g., psychology, child development, linguistics, sociology, philosophy, economics, and political science as well as from science education, mathematics education, social science education, and language education programmes will be attracted and retained in teacher education institutions, to strengthen multidisciplinary education of teachers and provide rigour in conceptual development.

15.9. All fresh Ph.D. entrants, irrespective of discipline, will be required to take credit-based courses in teaching/education/pedagogy/writing related to their chosen Ph.D subject during their doctoral training period. Exposure to pedagogical practices, designing curriculum, credible evaluation systems, communication, and so on will be ensured since many research scholars will go on to become faculty or public representatives/communicators of their chosen disciplines. Ph.D students will also have a minimum number of hours of actual teaching experience gathered through teaching assistantships and other means. Ph.D. programmes at universities around the country will be re-oriented for this purpose.

15.10. In-service continuous professional development for college and university teachers will continue through the existing institutional arrangements and ongoing initiatives; these will be strengthened and substantially expanded to meet the needs of enriched teaching-learning processes for quality education. The use of technology platforms such as SWAYAM/DIKSHA for online training of teachers will be encouraged, so that standardized training programmes can be administered to large numbers of teachers within a short span of time.

15.11. A National Mission for Mentoring shall be established, with a large pool of outstanding senior/retired faculty – including those with the ability to teach in Indian languages – who would be willing to provide short and long-term mentoring/professional support to university/college teachers.

16. Reimagining Vocational Education

16.1. The 12th Five-Year Plan (2012–2017) estimated that only a very small percentage of the Indian workforce in the age group of 19–24 (less than 5%) received formal vocational education Whereas in countries such as the USA the number is 52%, in Germany 75%, and South Korea it is as high as 96%. These numbers only underline the urgency of the need to hasten the spread of vocational education in India.

16.2. One of the primary reasons for the small numbers of students receiving vocational education is the fact that vocational education has in the past focused largely on Grades 11–12 and on dropouts in Grade 8 and upwards. Moreover, students passing out from Grades 11–12 with vocational subjects often did not have well-defined pathways to continue with their chosen vocations in higher education. The admission criteria for general higher education were also not designed to provide openings to students who had vocational education qualifications, leaving them at a disadvantage relative to their compatriots from 'mainstream' or 'academic' education. This led to a complete lack of vertical mobility for students from the vocational education stream, an issue that has only been addressed recently through the announcement of the National Skills Qualifications Framework (NSQF) in 2013.

16.3. Vocational education is perceived to be inferior to mainstream education and meant largely for students who are unable to cope with the latter. This is a perception that affects the choices students make. It is a serious concern that can only be dealt with by a complete re-imagination of how vocational education is offered to students in the future.

16.4. This policy aims to overcome the social status hierarchy associated with vocational education and requires integration of vocational education programmes into mainstream education in all education institutions in a phased manner. Beginning with vocational exposure at early ages in middle and secondary school, quality vocational education will be integrated smoothly into higher education. It will ensure that every child learns at least one vocation and is exposed to several more. This would lead to emphasizing the dignity of labour and importance of various vocations involving /Indian arts and artisanship.

16.5. By 2025, at least 50% of learners through the school and higher education system shall have exposure to vocational education, for which a clear action plan with targets and timelines will be developed. This is in alignment with Sustainable Development Goal 4.4 and will help to realize the full potential of India's demographic dividend. The number of students in vocational education will be considered while arriving at the GER targets. The development of vocational capacities will go hand-in-hand with the development of 'academic' or other capacities. Vocational education will be integrated in the educational offerings of all secondary schools in a phased manner over the next decade. Towards this, secondary schools will also collaborate with ITIs, polytechnics, local industry, etc. Skill labs will also be set up and created in the schools in a hub and spoke model which will allow other schools to use the facility. Higher education institutions will offer vocational education either on their own or in partnership with industry and NGOs. The B.Voc. degrees introduced in 2013 will continue to exist, but vocational courses will also be available to students enrolled in all other Bachelor's degree programmes, including the 4-year multidisciplinary Bachelor's programmes. HEIs will also be allowed to conduct short-term certificate courses in various skills including soft skills. 'Lok Vidya', i.e., important vocational knowledge developed in India, will be made accessible to students through integration into vocational education courses. The possibility of offering vocational courses through ODL mode will also be explored.

16.6. Vocational education will be integrated into all school and higher education institutions in a phased manner over the next decade. Focus areas for vocational education will be chosen based on skills gap analysis and mapping of local opportunities. MHRD will constitute a National Committee for the Integration of Vocational Education (NCIVE), consisting of experts in vocational education and representatives from across Ministries, in collaboration with industry, to oversee this effort.

16.7. Individual institutions that are early adopters must innovate to find models and practices that work and then share these with other institutions through mechanisms set up by NCIVE, so as to help extend the reach of vocational education. Different models of vocational education, and apprenticeships, will also be experimented by higher education institutions. Incubation centres will be set up in higher education institutions in partnership with industries.

16.8. The National Skills Qualifications Framework will be detailed further for each discipline vocation and profession. Further, Indian standards will be aligned with the International Standard Classification of Occupations maintained by the International Labour Organization. This Framework will provide the basis for Recognition of Prior Learning. Through this, dropouts from the formal

system will be reintegrated by aligning their practical experience with the relevant level of the Framework. The credit-based Framework will also facilitate mobility across 'general' and vocational education.

17. Catalysing Quality Academic Research in All Fields through a new National Research Foundation

17.1. Knowledge creation and research are critical in growing and sustaining a large and vibrant economy, uplifting society, and continuously inspiring a nation to achieve even greater heights. Indeed, some of the most prosperous civilizations (such as India, Mesopotamia, Egypt, and Greece) to the modern era (such as the United States, Germany, Israel, South Korea, and Japan), were/are strong knowledge societies that attained intellectual and material wealth in large part through celebrated and fundamental contributions to new knowledge in the realm of science as well as art, language, and culture that enhanced and uplifted not only their own civilizations but others around the globe.

17.2. A robust ecosystem of research is perhaps more important than ever with the rapid changes occurring in the world today, e.g., in the realm of climate change, population dynamics and management, biotechnology, an expanding digital marketplace, and the rise of machine learning and artificial intelligence. If India is to become a leader in these disparate areas, and truly achieve the potential of its vast talent pool to again become a leading knowledge society in the coming years and decades, the nation will require a significant expansion of its research capabilities and output across disciplines. Today, the criticality of research is more than ever before, for the economic, intellectual, societal, environmental, and technological health and progress of a nation.

17.3. Despite this critical importance of research, the research and innovation investment in India is, at the current time, only 0.69% of GDP as compared to 2.8% in the United States of America, 4.3% in Israel and 4.2% in South Korea.

17.4. The societal challenges that India needs to address today, such as access for all its citizens to clean drinking water and sanitation, quality education and healthcare, improved transportation, air quality, energy, and infrastructure, will require the implementation of approaches and solutions that are not only informed by top-notch science and technology but are also rooted in a deep understanding of the social sciences and humanities and the various socio-cultural and environmental dimensions of the nation. Facing and addressing these challenges will require high-quality interdisciplinary research across fields that must be done in India and cannot simply be imported; the ability to conduct one's own research also enables a country to much more easily import and adapt relevant research from abroad.

17.5. Furthermore, in addition to their value in solutions to societal problems, any country's identity, upliftment, spiritual/intellectual satisfaction and creativity is also attained in a major way through its history, art, language, and culture. Research in the arts and humanities, along with innovations in the sciences and social sciences, are, therefore, extremely important for the progress and enlightened nature of a nation.

17.6. Research and innovation at education institutions in India, particularly those that are engaged in higher education, is critical. Evidence from the world′s best universities throughout history shows that the best teaching and learning processes at the higher education level occur in environments where there is also a strong culture of research and knowledge creation; conversely, much of the very best research in the world has occurred in multidisciplinary university settings.

17.7. India has a long historical tradition of research and knowledge creation, in disciplines ranging from science and mathematics to art and literature to phonetics and languages to medicine and agriculture. This needs to be further strengthened to make India lead research and innovation in the

21st century, as a strong and enlightened knowledge society and one of the three largest economies in the world.

17.8. Thus, this Policy envisions a comprehensive approach to transforming the quality and quantity of research in India. This includes definitive shifts in school education to a more play and discovery-based style of learning with emphasis on the scientific method and critical thinking. This includes career counselling in schools towards identifying student interests and talents, promoting research in universities, the multidisciplinary nature of all HEIs and the emphasis on holistic education, the inclusion of research and internships in the undergraduate curriculum, faculty career management systems that give due weightage to research, and the governance and regulatory changes that encourage an environment of research and innovation. All of these aspects are extremely critical for developing a research mindset in the country.

17.9. To build on these various elements in a synergistic manner, and to thereby truly grow and catalyze quality research in the nation, this policy envisions the establishment of a National Research Foundation (NRF). The overarching goal of the NRF will be to enable a culture of research to permeate through our universities. In particular, the NRF will provide a reliable base of merit-based but equitable peer-reviewed research funding, helping to develop a culture of research in the country through suitable incentives for and recognition of outstanding research, and by undertaking major initiatives to seed and grow research at State Universities and other public institutions where research capability is currently limited. The NRF will competitively fund research in all disciplines. Successful research will be recognized, and where relevant, implemented through close linkages with governmental agencies as well as with industry and private/philanthropic organizations.

17.10. Institutions that currently fund research at some level, such as the Department of Science and Technology (DST), Department of Atomic Energy (DAE), Department of Bio-Technology (DBT), Indian Council of Agriculture Research (ICAR), Indian Council of Medical Research (ICMR), Indian Council of Historical Research (ICHR), and University Grants Commission (UGC), as well as various private and philanthropic organizations, will continue to independently fund research according to their priorities and needs. However, NRF will carefully coordinate with other funding agencies and will work with science, engineering, and other academies to ensure synergy of purpose and avoid duplication of efforts. The NRF will be governed, independently of the government, by a rotating Board of Governors consisting of the very best researchers and innovators across fields.

17.11. The primary activities of the NRF will be to:

(a) fund competitive, peer-reviewed grant proposals of all types and across all disciplines;
(b) seed, grow, and facilitate research at academic institutions, particularly at universities and colleges where research is currently in a nascent stage, through mentoring of such institutions;
(c) act as a liaison between researchers and relevant branches of government as well as industry, so that research scholars are constantly made aware of the most urgent national research issues, and so that policymakers are constantly made aware of the latest research breakthroughs; so as to allow breakthroughs to be optimally brought into policy and/or implementation; and
(d) recognise outstanding research and progress

18. Transforming the Regulatory System of Higher Education

18.1. Regulation of higher education has been too heavy-handed for decades; too much has been attempted to be regulated with too little effect. The mechanistic and disempowering nature of the regulatory system has been rife with very basic problems, such as heavy concentrations of power within a few bodies, conflicts of interest among these bodies, and a resulting lack of accountability. The regulatory system is in need of a complete overhaul in order to re-energize the higher education sector and enable it to thrive.

18.2. To address the above-mentioned issues, the regulatory system of higher education will ensure that the distinct functions of regulation, accreditation, funding, and academic standard setting will be performed by distinct, independent, and empowered bodies. This is considered essential to create checks-and-balances in the system, minimize conflicts of interest, and eliminate concentrations of power. To ensure that the four institutional structures carrying out these four essential functions work independently yet at the same time and work in synergy towards common goals. These four structures will be set up as four independent verticals within one umbrella institution, the Higher Education Commission of India (HECI).

18.3. The first vertical of HECI will be the National Higher Education Regulatory Council (NHERC). It will function as the common, single point regulator for the higher education sector including teacher education and excluding medical and legal education, thus eliminating the duplication and disjunction of regulatory efforts by the multiple regulatory agencies that exist at the current time. It will require a relook and repealing of existing Acts and restructuring of various existing regulatory bodies to enable this single point regulation. NHERC will be set up to regulate in a 'light but tight' and facilitative manner, meaning that a few important matters particularly financial probity, good governance, and the full online and offline public self-disclosure of all finances, audits, procedures, infrastructure, faculty/staff, courses, and educational outcomes will be very effectively regulated. This information will have to be made available and kept updated and accurate by all higher education institutions on a public website maintained by NHERC and on the institutions' websites. Any complaints or grievances from stakeholders and others arising out of the information placed in public domain shall be adjudicated by NHERC. Feedback from randomly selected students including differently-abled students at each HEI will be solicited online to ensure valuable input at regular intervals.

18.4. The primary mechanism to enable such regulation will be accreditation. The second vertical of HECI will, therefore, be a 'meta-accrediting body', called the National Accreditation Council (NAC). Accreditation of institutions will be based primarily on basic norms, public self-disclosure, good governance, and outcomes, and it will be carried out by an independent ecosystem of accrediting institutions supervised and overseen by NAC. The task to function as a recognized accreditor shall be awarded to an appropriate number of institutions by NAC. In the short term, a robust system of graded accreditation shall be established, which will specify phased benchmarks for all HEIs to achieve set levels of quality, self-governance, and autonomy. In turn, all HEIs will aim, through their Institutional Development Plans (IDPs), to attain the highest level of accreditation over the next 15 years, and thereby eventually aim to function as self-governing degree-granting institutions/clusters. In the long run, accreditation will become a binary process, as per the extant global practice.

18.5. The third vertical of HECI will be the Higher Education Grants Council (HEGC), which will carry out funding and financing of higher education based on transparent criteria, including the IDPs prepared by the institutions and the progress made on their implementation. HEGC will be entrusted with the disbursement of scholarships and developmental funds for launching new focus areas and expanding quality programme offerings at HEIs across disciplines and fields.

18.6. The fourth vertical of HECI will be the General Education Council (GEC), which will frame expected learning outcomes for higher education programmes, also referred to as 'graduate attributes'. A National Higher Education Qualification Framework (NHEQF) will be formulated by the GEC and it shall be in sync with the National Skills Qualifications Framework (NSQF) to ease the integration of vocational education into higher education. Higher education qualifications leading to a degree/diploma/certificate shall be described by the NHEQF in terms of such learning outcomes. In addition, the GEC shall set up facilitative norms for issues, such as credit transfer, equivalence, etc., through the NHEQF. The GEC will be mandated to identify specific skills that students must acquire during their academic programmes, with the aim of preparing well-rounded learners with 21st century skills.

18.7. The professional councils, such as the Indian Council for Agricultural Research (ICAR), Veterinary Council of India (VCI), National Council for Teacher Education (NCTE), Council of Architecture (CoA), National Council for Vocational Education and Training (NCVET) etc., will act

as Professional Standard Setting Bodies (PSSBs). They will play a key role in the higher education system and will be invited to be members of the GEC. These bodies, after restructuring as PSSBs, will continue to draw the curricula, lay down academic standards and coordinate between teaching, research and extension of their domain/discipline, as members of the GEC. As members of the GEC, they would help in specifying the curriculum framework, within which HEIs may prepare their own curricula. Thus, PSSBs would also set the standards or expectations in particular fields of learning and practice while having no regulatory role. All HEIs will decide how their educational programmes respond to these standards, among other considerations, and would also be able to reach out for support from these standard-setting bodies or PSSBs, if needed.

18.8. Such a system architecture will ensure the principle of functional separation by eliminating conflicts of interests between different roles. It will also aim to empower HEIs, while ensuring that the few key essential matters are given due attention. Responsibility and accountability shall devolve to the HEIs concomitantly. No distinction in such expectations shall be made between public and private HEIs.

18.9. Such a transformation will require existing structures and institutions to reinvent themselves and undergo an evolution of sorts. The separation of functions would mean that each vertical within HECI would take on a new, single role which is relevant, meaningful, and important in the new regulatory scheme.

18.10. The functioning of all the independent verticals for Regulation (NHERC), Accreditation (NAC), Funding (HEGC), and Academic Standard Setting (GEC) and the overarching autonomous umbrella body (HECI) itself will be based on transparent public disclosure, and use technology extensively to reduce human interface to ensure efficiency and transparency in their work. The underlying principle will be that of a faceless and transparent regulatory intervention using technology. Strict compliance measures with stringent action, including penalties for false disclosure of mandated information, will be ensured so that Higher Education Institutions are conforming to the basic minimum norms and standards. HECI itself will be resolving disputes among the four verticals. Each vertical in HECI will be an independent body consisting of persons having high expertise in the relevant areas along with integrity, commitment, and a demonstrated track record of public service. HECI itself will be a small, independent body of eminent public-spirited experts in higher education, which will oversee and monitor the integrity and effective functioning of HECI. Suitable mechanisms will be created within HECI to carry out its functions, including adjudication.

18.11. Setting up new quality HEIs will also be made far easier by the regulatory regime, while ensuring with great effectiveness that these are set up with the spirit of public service and with due financial backing for long-term stability. HEIs performing exceptionally well will be helped by Central and State governments to expand their institutions, and thereby attain larger numbers of students and faculty as well as disciplines and programmes. Public Philanthropic Partnership models for HEIs may also be piloted with the aim to further expand access to high-quality higher education.

Curbing Commercialization of Education

18.12. Multiple mechanisms with checks and balances will combat and stop the commercialization of higher education. This will be a key priority of the regulatory system. All education institutions will be held to similar standards of audit and disclosure as a 'not for profit' entity. Surpluses, if any, will be reinvested in the educational sector. There will be transparent public disclosure of all these financial matters with recourse to grievance-handling mechanisms to the general public. The accreditation system developed by NAC will provide a complementary check on this system, and NHERC will consider this as one of the key dimensions of its regulatory objective.

18.13. All HEIs - public and private - shall be treated on par within this regulatory regime. The regulatory regime shall encourage private philanthropic efforts in education. There will be common national guidelines for all legislative Acts that will form private HEIs. These common minimal guidelines will enable all such Acts to establish private HEIs, thus enabling common standards for

private and public HEIs. These common guidelines will cover Good Governance, Financial Stability & Security, Educational Outcomes, and Transparency of Disclosures.

18.14. Private HEIs having a philanthropic and public-spirited intent will be encouraged through a progressive regime of fees determination. Transparent mechanisms for fixing of fees with an upper limit, for different types of institutions depending on their accreditation, will be developed so that individual institutions are not adversely affected. This will empower private HEIs to set fees for their programmes independently, though within the laid-out norms and the broad applicable regulatory mechanism. Private HEIs will be encouraged to offer freeships and scholarships in significant numbers to their students. All fees and charges set by private HEIs will be transparently and fully disclosed, and there shall be no arbitrary increases in these fees/charges during the period of enrolment of any student. This fee determining mechanism will ensure reasonable recovery of cost while ensuring that HEIs discharge their social obligations.

19. Effective Governance and Leadership for Higher Education Institutions

19.1. It is effective governance and leadership that enables the creation of a culture of excellence and innovation in higher education institutions. The common feature of all world-class institutions globally including India has indeed been the existence of strong self-governance and outstanding merit-based appointments of institutional leaders.

19.2. Through a suitable system of graded accreditation and graded autonomy, and in a phased manner over a period of 15 years, all HEIs in India will aim to become independent self-governing institutions pursuing innovation and excellence. Measures will be taken at all HEIs to ensure leadership of the highest quality and promote an institutional culture of excellence. Upon receiving the appropriate graded accreditations that deem the institution ready for such a move, a Board of Governors (BoG) shall be established consisting of a group of highly qualified, competent, and dedicated individuals having proven capabilities and a strong sense of commitment to the institution. The BoG of an institution will be empowered to govern the institution free of any external interference, make all appointments including that of head of the institution, and take all decisions regarding governance. There shall be overarching legislation that will supersede any contravening provisions of other earlier legislation and would provide for constitution, appointment, modalities of functioning, rules and regulations, and the roles and responsibilities of the BoG. New members of the Board shall be identified by an expert committee appointed by the Board; and the selection of new members shall be carried out by the BoG itself. Equity considerations will also be taken care of while selecting the members. It is envisaged that all HEIs will be incentivized, supported, and mentored during this process, and shall aim to become autonomous and have such an empowered BoG by 2035.

19.3. The BoG shall be responsible and accountable to the stakeholders through transparent self-disclosures of all relevant records. It will be responsible for meeting all regulatory guidelines mandated by HECI through the National Higher Education Regulatory Council (NHERC).

19.4. All leadership positions and Heads of institutions will be offered to persons with high academic qualifications and demonstrated administrative and leadership capabilities along with abilities to manage complex situations. Leaders of an HEI will demonstrate strong alignment to Constitutional values and the overall vision of the institution, along with attributes such as a strong social commitment, belief in teamwork, pluralism, ability to work with diverse people, and a positive outlook. The selection shall be carried out by the BoG through a rigorous, impartial, merit-based, and competency-based process led by an Eminent Expert Committee (EEC) constituted by the BoG. While stability of tenure is important to ensure the development of a suitable culture, at the same time leadership succession will be planned with care to ensure that good practices that define an institution's processes do not end due to a change in leadership; leadership changes will come with sufficient overlaps, and not remain vacant, in order to ensure smooth transitions. Outstanding leaders will be identified and developed early, working their way through a ladder of leadership positions.

19.5. While being provided with adequate funding, legislative enablement, and autonomy in a phased manner, all HEIs, in turn, will display commitment to institutional excellence, engagement with their

local communities, and the highest standards of financial probity and accountability. Each institution will make a strategic Institutional Development Plan on the basis of which institutions will develop initiatives, assess their own progress, and reach the goals set therein, which could then become the basis for further public funding. The IDP shall be prepared with the joint participation of Board members, institutional leaders, faculty, students, and staff.

Part III. OTHER KEY AREAS OF FOCUS

20. Professional Education

20.1. Preparation of professionals must involve an education in the ethic and importance of public purpose, an education in the discipline, and an education for practice. It must centrally involve critical and interdisciplinary thinking, discussion, debate, research, and innovation. For this to be achieved, professional education should not take place in the isolation of one's specialty.

20.2. Professional education thus becomes an integral part of the overall higher education system. Stand-alone agricultural universities, legal universities, health science universities, technical universities, and stand-alone institutions in other fields, shall aim to become multidisciplinary institutions offering holistic and multidisciplinary education. All institutions offering either professional or general education will aim to organically evolve into institutions/clusters offering both seamlessly, and in an integrated manner by 2030.

20.3. Agricultural education with allied disciplines will be revived. Although Agricultural Universities comprise approximately 9% of all universities in the country, enrolment in agriculture and allied sciences is less than 1% of all enrolment in higher education. Both capacity and quality of agriculture and allied disciplines must be improved in order to increase agricultural productivity through better skilled graduates and technicians, innovative research, and market-based extension linked to technologies and practices. The preparation of professionals in agriculture and veterinary sciences through programmes integrated with general education will be increased sharply. The design of agricultural education will shift towards developing professionals with the ability to understand and use local knowledge, traditional knowledge, and emerging technologies while being cognizant of critical issues such as declining land productivity, climate change, food sufficiency for our growing population, etc. Institutions offering agricultural education must benefit the local community directly; one approach could be to set up Agricultural Technology Parks to promote technology incubation and dissemination and promote sustainable methodologies.

20.4. Legal education needs to be competitive globally, adopting best practices and embracing new technologies for wider access to and timely delivery of justice. At the same time, it must be informed and illuminated with Constitutional values of Justice - Social, Economic, and Political - and directed towards national reconstruction through instrumentation of democracy, rule of law, and human rights. The curricula for legal studies must reflect socio-cultural contexts along with, in an evidence-based manner, the history of legal thinking, principles of justice, the practice of jurisprudence, and other related content appropriately and adequately. State institutions offering law education must consider offering bilingual education for future lawyers and judges - in English and in the language of the State in which the institution is situated.

20.5. Healthcare education needs to be re-envisioned so that the duration, structure, and design of the educational programmes need to match the role requirements that graduates will play. Students will be assessed at regular intervals on well-defined parameters primarily required for working in primary care and in secondary hospitals. Given that people exercise pluralistic choices in healthcare, our healthcare education system must be integrative meaning thereby that all students of allopathic medical education must have a basic understanding of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy (AYUSH), and vice versa. There shall also be a much greater emphasis on preventive healthcare and community medicine in all forms of healthcare education.

20.6. Technical education includes degree and diploma programmes in, engineering, technology, management, architecture, town planning, pharmacy, hotel management, catering technology etc., which are critical to India's overall development. There will not only be a greater demand for well-qualified manpower in these sectors, it will also require closer collaborations between industry and higher education institutions to drive innovation and research in these fields. Furthermore, influence of technology on human endeavours is expected to erode the silos between technical education and other disciplines too. Technical education will, thus, also aim to be offered within multidisciplinary education institutions and programmes and have a renewed focus on opportunities to engage deeply with other disciplines. India must also take the lead in preparing professionals in cutting-edge areas that are fast gaining prominence, such as Artificial Intelligence (AI), 3-D machining, big data analysis, and machine learning, in addition to genomic studies, biotechnology, nanotechnology, neuroscience, with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

21. Adult Education and Lifelong Learning

21.1. The opportunity to attain foundational literacy, obtain an education, and pursue a livelihood must be viewed as basic rights of every citizen. Literacy and basic education open up whole new worlds of personal, civic, economic, and lifelong-learning opportunities for individuals that enable them to progress personally and professionally. At the level of society and the nation, literacy and basic education are powerful force multipliers which greatly enhance the success of all other developmental efforts. Worldwide data on nations indicate extremely high correlations between literacy rates and per capita GDP.

21.2. Meanwhile, being a non-literate member of a community, has innumerable disadvantages, including the inability to: carry out basic financial transactions; compare the quality/quantity of goods purchased against the price charged; fill out forms to apply for jobs, loans, services, etc.; comprehend public circulars and articles in the news media; use conventional and electronic mail to communicate and conduct business; make use of the internet and other technology to improve one's life and profession; comprehend directions and safety directives on the street, on medicines, etc.; help children with their education; be aware of one's basic rights and responsibilities as a citizen of India; appreciate works of literature; and pursue employment in medium or high-productivity sectors that require literacy. The abilities listed here are an illustrative list of outcomes to be achieved through adoption of innovative measures for Adult Education.

21.3. Extensive field studies and analyses, both in India and across the world, clearly demonstrate that volunteerism and community involvement and mobilization are key success factors of adult literacy programmes, in conjunction with political will, organizational structure, proper planning, adequate financial support, and high-quality capacity building of educators and volunteers. Successful literacy programmes result not only in the growth of literacy among adults, but also result in increased demand for education for all children in the community, as well as greater community contribution to positive social change. The National Literacy Mission, when it was launched in 1988, was largely based on the voluntary involvement and support of the people, and resulted in significant increases in national literacy during the period of 1991–2011, including among women, and also initiated dialogue and discussions on pertinent social issues of the day.

21.4. Strong and innovative government initiatives for adult education - in particular, to facilitate community involvement and the smooth and beneficial integration of technology - will be affected as soon as possible to expedite this all-important aim of achieving 100% literacy.

21.5. First, an outstanding adult education curriculum framework will be developed by a new and well-supported constituent body of the NCERT that is dedicated to adult education, so as to develop synergy with and build upon NCERT's existing expertise in establishing outstanding curricula for literacy, numeracy, basic education, vocational skills, and beyond. The curriculum framework for adult education will include at least five types of programmes, each with clearly defined outcomes: (a) foundational literacy and numeracy; (b) critical life skills (including financial literacy, digital literacy, commercial skills, health care and awareness, child care and education, and family welfare);

(c) vocational skills development (with a view towards obtaining local employment); (d) basic education (including preparatory, middle, and secondary stage equivalency); and (e) continuing education (including engaging holistic adult education courses in arts, sciences, technology, culture, sports, and recreation, as well as other topics of interest or use to local learners, such as more advanced material on critical life skills). The framework would keep in mind that adults in many cases will require rather different teaching-learning methods and materials than those designed for children.

21.6. Second, suitable infrastructure will be ensured so that all interested adults will have access to adult education and lifelong learning. A key initiative in this direction will be to use schools/ school complexes after school hours and on weekends and public library spaces for adult education courses which will be ICT-equipped when possible and for other community engagement and enrichment activities. The sharing of infrastructure for school, higher, adult, and vocational education, and for other community and volunteer activities, will be critical for ensuring efficient use of both physical and human resources as well as for creating synergy among these five types of education and beyond. For these reasons, Adult Education Centres (AECs) could also be included within other public institutions such as HEIs, vocational training centres, etc.

21.7. Third, the instructors/educators will be required to deliver the curriculum framework to mature learners for all five types of adult education as described in the Adult Education Curriculum Framework. These instructors will be trained by the National, State, and district level resource support institutions to organize and lead learning activities at Adult Education Centres, as well as coordinate with volunteer instructors. Qualified community members including from HEIs as part of each HEI's mission to engage with their local communities will be encouraged and welcomed to take a short training course and volunteer, as adult literacy instructors, or to serve as one-on-one volunteer tutors, and will be recognized for their critical service to the nation. States will also work with NGOs and other community organizations to enhance efforts towards literacy and adult education.

21.8. Fourth, all efforts will be undertaken to ensure the participation of community members in adult education. Social workers/counsellors travelling through their communities to track and ensure participation of non-enrolled students and dropouts will also be requested, during their travels, to gather data of parents, adolescents, and others interested in adult education opportunities both as learners and as teachers/tutors. The social workers/counsellors will then connect them with local Adult Education Centres (AECs). Opportunities for adult education will also be widely publicized, through advertisements and announcements and through events and initiatives of NGOs and other local organizations.

21.9. Fifth, improving the availability and accessibility of books is essential to inculcating the habit of reading within our communities and educational institutions. This Policy recommends that all communities and educational institutions - schools, colleges, universities and public libraries - will be strengthened and modernized to ensure an adequate supply of books that cater to the needs and interests of all students, including persons with disabilities and other differently-abled persons. The Central and State governments will take steps to ensure that books are made accessible and affordable to all across the country including socio-economically disadvantaged areas as well as those living in rural and remote areas. Both public and private sector agencies/institutions will devise strategies to improve the quality and attractiveness of books published in all Indian languages. Steps will be taken to enhance online accessibility of library books and further broad basing of digital libraries. For ensuring vibrant libraries in communities and educational institutions, it will be imperative to make available adequate library staff and also devise appropriate career pathways and CPD for them. Other steps will include strengthening all existing libraries, setting up rural libraries and reading rooms in disadvantaged regions, making widely available reading material in Indian languages, opening children's libraries and mobile libraries, establishing social book clubs across India and across subjects, and fostering greater collaborations between education institutions and libraries.

21.10. Finally, technology will be leveraged to strengthen and even undertake the above initiatives. Quality technology-based options for adult learning such as apps, online courses/modules, satellite-based TV channels, online books, and ICT-equipped libraries and Adult Education Centres, etc. will

be developed, through government and philanthropic initiatives as well as through crowd sourcing and competitions. In many cases, quality adult education could thereby be conducted in an online or blended mode.

22. Promotion of Indian Languages, Arts, and Culture

22.1. India is a treasure trove of culture, developed over thousands of years and manifested in the form of arts, works of literature, customs, traditions, linguistic expressions, artefacts, heritage sites, and more. Crores of people from around the world partake in, enjoy, and benefit from this cultural wealth daily, in the form of visiting India for tourism, experiencing Indian hospitality, purchasing India's handicrafts and handmade textiles, reading the classical literature of India, practicing yoga and meditation, being inspired by Indian philosophy, participating in India's unique festivals, appreciating India's diverse music and art, and watching Indian films, amongst many other aspects. It is this cultural and natural wealth that truly makes India, "Incredible !ndia", as per India's tourism slogan. The preservation and promotion of India's cultural wealth must be considered a high priority for the country, as it is truly important for the nation's identity as well as for its economy.

22.2. The promotion of Indian arts and culture is important not only for the nation but also for the individual. Cultural awareness and expression are among the major competencies considered important to develop in children, in order to provide them with a sense of identity, belonging, as well as an appreciation of other cultures and identities. It is through the development of a strong sense and knowledge of their own cultural history, arts, languages, and traditions that children can build a positive cultural identity and self-esteem. Thus, cultural awareness and expression are important contributors both to individual as well as societal well-being.

22.3. The arts form a major medium for imparting culture. The arts - besides strengthening cultural identity, awareness, and uplifting societies - are well known to enhance cognitive and creative abilities in individuals and increase individual happiness. The happiness/well-being, cognitive development, and cultural identity of individuals are important reasons that Indian arts of all kinds must be offered to students at all levels of education, starting with early childhood care and education.

22.4. Language, of course, is inextricably linked to art and culture. Different languages 'see' the world differently, and the structure of a language, therefore, determines a native speaker's perception of experience. In particular, languages influence the way people of a given culture speak with others, including with family members, authority figures, peers, and strangers, and influence the tone of conversation. The tone, perception of experience, and familiarity/'*apnapan*' inherent in conversations among speakers of a common language are a reflection and record of a culture. Culture is, thus, encased in our languages. Art, in the form of literature, plays, music, film, etc. cannot be fully appreciated without language. In order to preserve and promote culture, one must preserve and promote a culture's languages.

22.5. Unfortunately, Indian languages have not received their due attention and care, with the country losing over 220 languages in the last 50 years alone. UNESCO has declared 197 Indian languages as 'endangered'. Various unscripted languages are particularly in danger of becoming extinct. When senior member(s) of a tribe or community that speak such languages pass away, these languages often perish with them; too often, no concerted actions or measures are taken to preserve or record these rich languages/expressions of culture.

22.6. Moreover, even those languages of India that are not officially on such endangered lists, such as the 22 languages of Eighth Schedule of the Constitution of India, are facing serious difficulties on many fronts. Teaching and learning of Indian languages need to be integrated with school and higher education at every level. For languages to remain relevant and vibrant, there must be a steady stream of high-quality learning and print materials in these languages including textbooks, workbooks, videos, plays, poems, novels, magazines, etc. Languages must also have consistent official updates to their vocabularies and dictionaries, widely disseminated, so that the most current issues and concepts can be effectively discussed in these languages. Enabling such learning materials, print materials, and

translations of important materials from world languages, and constantly updating vocabularies, are carried out by countries around the world for languages such as English, French, German, Hebrew, Korean, and Japanese. However, India has remained quite slow in producing such learning and print materials and dictionaries to help keep its languages optimally vibrant and current with integrity.

22.7. Additionally, there has been a severe scarcity of skilled language teachers in India, despite various measures being taken. Language-teaching too must be improved to be more experiential and to focus on the ability to converse and interact in the language and not just on the literature, vocabulary, and grammar of the language. Languages must be used more extensively for conversation and for teaching-learning.

22.8. A number of initiatives to foster languages, arts, and culture in school children have been discussed in Chapter 4, which include a greater emphasis on music, arts, and crafts throughout all levels of school; early implementation of the three-language formula to promote multilingualism; teaching in the home/local language wherever possible; conducting more experiential language learning; the hiring of outstanding local artists, writers, craftspersons, and other experts as master instructors in various subjects of local expertise; accurate inclusion of traditional Indian knowledge including tribal and other local knowledge throughout into the curriculum, across humanities, sciences, arts, crafts, and sports, whenever relevant; and a much greater flexibility in the curriculum, especially in secondary schools and in higher education, so that students can choose the ideal balance among courses for themselves to develop their own creative, artistic, cultural, and academic paths.

22.9. To enable the key latter initiatives, a number of further actions will be taken in tandem at the higher education level and beyond. First, to develop and teach many of the courses of the type mentioned above, an excellent team of teachers and faculty will have to be developed. Strong departments and programmes in Indian languages, comparative literature, creative writing, arts, music, philosophy, etc. will be launched and developed across the country, and degrees including 4-year B.Ed. dual degrees will be developed in these subjects. These departments and programmes will, in particular help to develop a large cadre of high-quality language teachers - as well as teachers of art, music, philosophy and writing - who will be needed around the country to carry out this Policy. The NRF will fund quality research in all these areas. Outstanding local artists and craftspersons will be hired as guest faculty to promote local music, art, languages, and handicraft, and to ensure that students are aware of the culture and local knowledge where they study. Every higher education institution and even every school or school complex will aim to have Artist(s)-in-Residence to expose students to art, creativity, and the rich treasures of the region/country.

22.10. More HEIs, and more programmes in higher education, will use the mother tongue/local language as a medium of instruction, and/or offer programmes bilingually, in order to increase access and GER and also to promote the strength, usage, and vibrancy of all Indian languages. Private HEIs too will be encouraged and incentivized to use Indian languages as medium of instruction and/or offer bilingual programmes. Four-year B.Ed. dual degree programmes offered bilingually will also help, e.g. in training cadres of science and mathematics teachers to teach science bilingually at schools across the country.

22.11. High-quality programmes and degrees in Translation and Interpretation, Art and Museum Administration, Archaeology, Artefact Conservation, Graphic Design, and Web Design within the higher education system will also be created. In order to preserve and promote its art and culture, develop high-quality materials in various Indian languages, conserve artefacts, develop highly qualified individuals to curate and run museums and heritage or tourist sites, thereby also vastly strengthening the tourism industry.

22.12. The Policy recognizes that the knowledge of the rich diversity of India should be imbibed first hand by learners. This would mean including simple activities, like touring by students to different parts of the country, which will not only give a boost to tourism but will also lead to an understanding and appreciation of diversity, culture, traditions and knowledge of different parts of India. Towards this direction under '*Ek Bharat Shrestha Bharat*', 100 tourist destinations in the country will be identified where educational institutions will send students to study these destinations and their

history, scientific contributions, traditions, indigenous literature and knowledge, etc., as a part of augmenting their knowledge about these areas.

22.13. Creating such programmes and degrees in higher education, across the arts, languages, and humanities, will also come with expanded high-quality opportunities for employment that can make effective use of these qualifications. There are already hundreds of Academies, museums, art galleries, and heritage sites in dire need of qualified individuals for their effective functioning. As positions are filled with suitably qualified candidates, and further artefacts are procured and conserved, additional museums, including virtual museums/e-museums, galleries, and heritage sites may contribute to the conservation of our heritage as well as to India's tourism industry.

22.14. India will also urgently expand its translation and interpretation efforts in order to make high-quality learning materials and other important written and spoken material available to the public in various Indian and foreign languages. For this, an Indian Institute of Translation and Interpretation (IITI) will be established. Such an institute would provide a truly important service for the country, as well as employ numerous multilingual language and subject experts, and experts in translation and interpretation, which will help to promote all Indian languages. The IITI shall also make extensive use of technology to aid in its translation and interpretation efforts. The IITI could naturally grow with time, and be housed in multiple locations including in HEIs to facilitate collaborations with other research departments as demand and the number of qualified candidates grows.

22.15. Due to its vast and significant contributions and literature across genres and subjects, its cultural significance, and its scientific nature, rather than being restricted to single-stream Sanskrit Pathshalas and Universities, Sanskrit will be mainstreamed with strong offerings in school - including as one of the language options in the three-language formula - as well as in higher education. It will be taught not in isolation, but in interesting and innovative ways, and connected to other contemporary and relevant subjects such as mathematics, astronomy, philosophy, linguistics, dramatics, yoga, etc. Thus, in consonance with the rest of this policy, Sanskrit Universities too will move towards becoming large multidisciplinary institutions of higher learning. Departments of Sanskrit that conduct teaching and outstanding interdisciplinary research on Sanskrit and Sanskrit Knowledge Systems will be established/strengthened across the new multidisciplinary higher education system. Sanskrit will become a natural part of a holistic multidisciplinary higher education if a student so chooses. Sanskrit teachers in large numbers will be professionalized across the country in mission mode through the offering of 4-year integrated multidisciplinary B.Ed. dual degrees in education and Sanskrit.

22.16. India will similarly expand its institutes and universities studying all classical languages and literature, with strong efforts to collect, preserve, translate, and study the tens of thousands of manuscripts that have not yet received their due attention. Sanskrit and all Indian language institutes and departments across the country will be significantly strengthened, with adequate training given to large new batches of students to study, in particular, the large numbers of manuscripts and their interrelations with other subjects. Classical language institutes will aim to be merged with universities, while maintaining their autonomy, so that faculty may work, and students too may be trained as part of robust and rigorous multidisciplinary programmes. Universities dedicated to languages will become multidisciplinary, towards the same end; where relevant, they may then also offer B.Ed. dual degrees in education and a language, to develop outstanding language teachers in that language. Further, it is also proposed that a new institution for Languages will be established. National Institute (or Institutes) for Pali, Persian and Prakrit will also be set up within a university campus. Similar initiatives will be carried out for institutes and universities studying Indian arts, art history, and Indology. Research for outstanding work in all these areas will be supported by the NRF.

22.17. Efforts to preserve and promote all Indian languages including classical, tribal and endangered languages will be taken on with new vigour. Technology and crowdsourcing, with extensive participation of the people, will play a crucial role in these efforts.

22.18. For each of the languages mentioned in the Eighth Schedule of the Constitution of India, Academies will be established consisting of some of the greatest scholars and native speakers to

determine simple yet accurate vocabulary for the latest concepts, and to release the latest dictionaries on a regular basis (analogous to the successful efforts for many other languages around the world). The Academies would also consult with each other, and in some cases take the best suggestions from the public, in order to construct these dictionaries attempting to adopt common words whenever possible. These dictionaries would be widely disseminated, for use in education, journalism, writing, speechmaking, and beyond, and would be available on the web as well as in book form. These Academies for Eighth Schedule languages will be established by the Central Government in consultation or collaboration with State Governments. Academies for other highly spoken Indian languages may also be similarly established by the Centre and/or States.

22.19. All languages in India, and their associated arts and culture will be documented through a web-based platform/portal/wiki, in order to preserve endangered and all Indian languages and their associated rich local arts and culture. The platform will contain videos, dictionaries, recordings, and more, of people (especially elders) speaking the language, telling stories, reciting poetry, and performing plays, folk songs and dances, and more. People from across the country will be invited to contribute to these efforts by adding relevant material onto these platforms/portals/wikis. Universities and their research teams will work with each other and with communities across the country towards enriching such platforms. These preservation efforts, and the associated research projects, e.g., in history, archaeology, linguistics, etc., will be funded by the NRF.

22.20. Scholarships for people of all ages to study Indian Languages, Arts, and Culture with local masters and/or within the higher education system will be established. The promotion of Indian languages is possible only if they are used regularly and if they are used for teaching and learning. Incentives, such as prizes for outstanding poetry and prose in Indian languages across categories, will be established to ensure vibrant poetry, novels, nonfiction books, textbooks, journalism, and other works in all Indian languages. Proficiency in Indian languages will be included as part of qualification parameters for employment opportunities.

23. Technology Use and Integration

23.1. India is a global leader in information and communication technology and in other cutting-edge domains, such as space. The Digital India Campaign is helping to transform the entire nation into a digitally empowered society and knowledge economy. While education will play a critical role in this transformation, technology itself will play an important role in the improvement of educational processes and outcomes; thus, the relationship between technology and education at all levels is bi-directional.

23.2. Given the explosive pace of technological development allied with the sheer creativity of tech-savvy teachers and entrepreneurs including student entrepreneurs, it is certain that technology will impact education in multiple ways, only some of which can be foreseen at the present time. New technologies involving artificial intelligence, machine learning, block chains, smart boards, handheld computing devices, adaptive computer testing for student development, and other forms of educational software and hardware will not just change what students learn in the classroom but how they learn, and thus these areas and beyond will require extensive research both on the technological as well as educational fronts.

23.3. Use and integration of technology to improve multiple aspects of education will be supported and adopted, provided these interventions are rigorously and transparently evaluated in relevant contexts before they are scaled up. An autonomous body, the National Educational Technology Forum (NETF), will be created to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration, and so on, both for school and higher education. The aim of the NETF will be to facilitate decision making on the induction, deployment, and use of technology, by providing to the leadership of education institutions, State and Central governments, and other stakeholders, the latest knowledge and research as well as the opportunity to consult and share best practices. The NETF will have the following functions:

a) provide independent evidence-based advice to Central and State Government agencies on technology-based interventions;
b) build intellectual and institutional capacities in educational technology;
c) envision strategic thrust areas in this domain; and
d) articulate new directions for research and innovation.

23.4. To remain relevant in the fast-changing field of educational technology, the NETF will maintain a regular inflow of authentic data from multiple sources including educational technology innovators and practitioners and will engage with a diverse set of researchers to analyze the data. To support the development of a vibrant body of knowledge and practice, the NETF will organize multiple regional and national conferences, workshops, etc. to solicit inputs from national and international educational technology researchers, entrepreneurs, and practitioners.

23.5. The thrust of technological interventions will be for the purposes of improving teaching-learning and evaluation processes, supporting teacher preparation and professional development, enhancing educational access, and streamlining educational planning, management, and administration including processes related to admissions, attendance, assessments, etc.

23.6. A rich variety of educational software, for all the above purposes, will be developed and made available for students and teachers at all levels. All such software will be available in all major Indian languages and will be accessible to a wide range of users including students in remote areas and *Divyang* students. Teaching-learning e-content will continue to be developed by all States in all regional languages, as well as by the NCERT, CIET, CBSE, NIOS, and other bodies/institutions, and will be uploaded onto the DIKSHA platform. This platform may also be utilized for Teacher's Professional Development through e-content. CIET will be strengthened to promote and expand DIKSHA as well as other education technology initiatives. Suitable equipment will be made available to teachers at schools so that teachers can suitably integrate e-contents into teaching-learning practices. Technology-based education platforms, such as DIKSHA/SWAYAM, will be better integrated across school and higher education, and will include ratings/reviews by users, so as to enable content developers create user friendly and qualitative content.

23.7. Particular attention will need to be paid to emerging disruptive technologies that will necessarily transform the education system. When the 1986/1992 National Policy on Education was formulated, it was difficult to predict the disruptive effect that the internet would have brought. Our present education system's inability to cope with these rapid and disruptive changes places us individually and nationally at a perilous disadvantage in an increasingly competitive world. For example, while computers have largely surpassed humans in leveraging factual and procedural knowledge, our education at all levels excessively burdens students with such knowledge at the expense of developing their higher-order competencies.

23.8. This policy has been formulated at a time when an unquestionably disruptive technology - Artificial Intelligence (AI) 3D/7D Virtual Reality - has emerged. As the cost of AI-based prediction falls, AI will be able to match or outperform and, therefore, be a valuable aid to even skilled professionals such as doctors in certain predictive tasks. AI's disruptive potential in the workplace is clear, and the education system must be poised to respond quickly. One of the permanent tasks of the NETF will be to categorize emergent technologies based on their potential and estimated timeframe for disruption, and to periodically present this analysis to MHRD. Based on these inputs, MHRD will formally identify those technologies whose emergence demands responses from the education system.

23.9. In response to MHRD's formal recognition of a new disruptive technology, the National Research Foundation will initiate or expand research efforts in the technology. In the context of AI, NRF may consider a three-pronged approach: (a) advancing core AI research, (b) developing and deploying application-based research, and (c) advancing international research efforts to address global challenges in areas such as healthcare, agriculture, and climate change using AI.

23.10. HEIs will play an active role not only in conducting research on disruptive technologies but also in creating initial versions of instructional materials and courses including online courses in cutting-edge domains and assessing their impact on specific areas such as professional education. Once the technology has attained a level of maturity, HEIs with thousands of students will be ideally placed to scale these teaching and skilling efforts, which will include targeted training for job readiness. Disruptive technologies will make certain jobs redundant, and hence approaches to skilling and deskilling that are both efficient and ensure quality will be of increasing importance to create and sustain employment. Institutions will have autonomy to approve institutional and non-institutional partners to deliver such training, which will be integrated with skills and higher education frameworks.

23.11. Universities will aim to offer Ph.D. and Masters programmes in core areas such as Machine Learning as well as multidisciplinary fields "AI + X" and professional areas like health care, agriculture, and law. They may also develop and disseminate courses in these areas via platforms, such as SWAYAM. For rapid adoption, HEIs may blend these online courses with traditional teaching in undergraduate and vocational programmes. HEIs may also offer targeted training in low-expertise tasks for supporting the AI value chain such as data annotation, image classification, and speech transcription. Efforts to teach languages to school students will be dovetailed with efforts to enhance Natural Language Processing for India's diverse languages.

23.12. As disruptive technologies emerge, schooling and continuing education will assist in raising the general populace′s awareness of their potential disruptive effects and will also address related issues. This awareness is necessary to have informed public consent on matters related to these technologies. In school, the study of current affairs and ethical issues will include a discussion on disruptive technologies such as those identified by NETF/MHRD. Appropriate instructional and discussion materials will also be prepared for continuing education.

23.13. Data is a key fuel for AI-based technologies, and it is critical to raise awareness on issues of privacy, laws, and standards associated with data handling and data protection, etc. It is also necessary to highlight ethical issues surrounding the development and deployment of AI-based technologies. Education will play a key role in these awareness raising efforts. Other disruptive technologies that are expected to change the way we live, and, therefore, change the way we educate students, include those relating to clean and renewable energy, water conservation, sustainable farming, environmental preservation, and other green initiatives; these will also receive prioritized attention in education.

24. Online and Digital Education: Ensuring Equitable Use of Technology

24.1. New circumstances and realities require new initiatives. The recent rise in epidemics and pandemics necessitates that we are ready with alternative modes of quality education whenever and wherever traditional and in-person modes of education are not possible. In this regard, the National Education Policy 2020 recognizes the importance of leveraging the advantages of technology while acknowledging its potential risks and dangers. It calls for carefully designed and appropriately scaled pilot studies to determine how the benefits of online/digital education can be reaped while addressing or mitigating the downsides. In the meantime, the existing digital platforms and ongoing ICT-based educational initiatives must be optimized and expanded to meet the current and future challenges in providing quality education for all.

24.2. However, the benefits of online/digital education cannot be leveraged unless the digital divide is eliminated through concerted efforts, such as the Digital India campaign and the availability of affordable computing devices. It is important that the use of technology for online and digital education adequately addresses concerns of equity.

24.3. Teachers require suitable training and development to be effective online educators. It cannot be assumed that a good teacher in a traditional classroom will automatically be a good teacher in an online classroom. Aside from changes required in pedagogy, online assessments also require a

different approach. There are numerous challenges to conducting online examinations at scale, including limitations on the types of questions that can be asked in an online environment, handling network and power disruptions, and preventing unethical practices. Certain types of courses/subjects, such as performing arts and science practical have limitations in the online/digital education space, which can be overcome to a partial extent with innovative measures. Further, unless online education is blended with experiential and activity-based learning, it will tend to become a screen-based education with limited focus on the social, affective and psychomotor dimensions of learning.

24.4. Given the emergence of digital technologies and the emerging importance of leveraging technology for teaching-learning at all levels from school to higher education, this Policy recommends the following key initiatives:

(a) **Pilot studies for online education**: Appropriate agencies, such as the NETF, CIET, NIOS, IGNOU, IITs, NITs, etc. will be identified to conduct a series of pilot studies, in parallel, to evaluate the benefits of integrating education with online education while mitigating the downsides and also to study related areas, such as, student device addiction, most preferred formats of e-content, etc. The results of these pilot studies will be publicly communicated and used for continuous improvement.

(b) **Digital infrastructure**: There is a need to invest in creation of open, interoperable, evolvable, public digital infrastructure in the education sector that can be used by multiple platforms and point solutions, to solve for India's scale, diversity, complexity and device penetration. This will ensure that the technology-based solutions do not become outdated with the rapid advances in technology.

(c) **Online teaching platform and tools**: Appropriate existing e-learning platforms such as SWAYAM, DIKSHA, will be extended to provide teachers with a structured, user-friendly, rich set of assistive tools for monitoring progress of learners. Tools, such as, two-way video and two-way-audio interface for holding online classes are a real necessity as the present pandemic has shown.

(d) **Content creation, digital repository, and dissemination**: A digital repository of content including creation of coursework, Learning Games & Simulations, Augmented Reality and Virtual Reality will be developed, with a clear public system for ratings by users on effectiveness and quality. For fun based learning student-appropriate tools like apps, gamification of Indian art and culture, in multiple languages, with clear operating instructions, will also be created. A reliable backup mechanism for disseminating e-content to students will be provided.

(e) **Addressing the digital divide**: Given the fact that there still persists a substantial section of the population whose digital access is highly limited, the existing mass media, such as television, radio, and community radio will be extensively used for telecast and broadcasts. Such educational programmes will be made available 24/7 in different languages to cater to the varying needs of the student population. A special focus on content in all Indian languages will be emphasized and required; digital content will need to reach the teachers and students in their medium of instruction as far as possible.

(f) **Virtual Labs:** Existing e-learning platforms such as DIKSHA, SWAYAM and SWAYAMPRABHA will also be leveraged for creating virtual labs so that all students have equal access to quality practical and hands-on experiment-based learning experiences. The possibility of providing adequate access to SEDG students and teachers through suitable digital devices, such as tablets with pre-loaded content, will be considered and developed.

(g) **Training and incentives for teachers**: Teachers will undergo rigorous training in learner-centric pedagogy and on how to become high-quality online content creators themselves using online teaching platforms and tools. There will be emphasis on the teacher's role in facilitating active student engagement with the content and with each other.

(h) **Online assessment and examinations**: Appropriate bodies, such as the proposed National Assessment Centre or PARAKH, School Boards, NTA, and other identified bodies will design and implement assessment frameworks encompassing design of competencies, portfolio, rubrics, standardized assessments, and assessment analytics. Studies will be undertaken to pilot new ways of assessment using education technologies focusing on 21st century skills.

(i) **Blended models of learning**: While promoting digital learning and education, the importance of face-to-face in-person learning is fully recognized. Accordingly, different effective models of blended learning will be identified for appropriate replication for different subjects.

(j) **Laying down standards**: As research on online/digital education emerges, NETF and other appropriate bodies shall set up standards of content, technology, and pedagogy for online/digital teaching-learning. These standards will help to formulate guidelines for e-learning by States, Boards, schools and school complexes, HEIs, etc.

24.5 Creating a Dedicated Unit for Building of World Class, Digital Infrastructure, Educational Digital Content and Capacity

Technology in education is a journey and not a destination and capacity will be needed to orchestrate the various ecosystem players to implement policy objectives. A dedicated unit for the purpose of orchestrating the building of digital infrastructure, digital content and capacity building will be created in the Ministry to look after the e-education needs of both school and higher education. Since technology is rapidly evolving, and needs specialists to deliver high quality e-learning, a vibrant ecosystem has to be encouraged to create solutions that not only solve India's challenges of scale, diversity, equity, but also evolve in keeping with the rapid changes in technology, whose half-life reduces with each passing year. This centre will, therefore, consist of experts drawn from the field of administration, education, educational technology, digital pedagogy and assessment, e-governance, etc.

Part IV. MAKING IT HAPPEN

25. Strengthening the Central Advisory Board of Education

25.1. Achieving successful implementation of this policy demands a long-term vision, availability of expertise on a sustained basis, and concerted action from all concerned encompassing National, State, institutional, and individual levels. In this context, the Policy recommends strengthening and empowering the Central Advisory Board of Education (CABE) which will have a much greater mandate and not only a forum for widespread consultation and examination of issues relating to educational and cultural development. The remodeled and rejuvenated CABE shall also be responsible for developing, articulating, evaluating, and revising the vision of education in the country on a continuous basis, in close collaboration with MHRD and the corresponding apex bodies of States. It shall also create and continuously review the institutional frameworks that shall help attain this vision.

25.2. To bring the focus back on education and learning, it is desirable that the Ministry of Human Resource Development (MHRD) be re-designated as the Ministry of Education (MoE).

26. Financing: Affordable and Quality Education for All

26.1. The Policy commits to significantly raising educational investment, as there is no better investment towards a society's future than the high-quality education of our young people. Unfortunately, public expenditure on education in India has not come close to the recommended level of 6% of GDP, as envisaged by the 1968 Policy, reiterated in the Policy of 1986, and which was further reaffirmed in the 1992 review of the Policy. The current public (Government - Centre and States) expenditure on education in India has been around 4.43% of GDP (Analysis of Budgeted

Expenditure 2017-18) and only around 10% of the total Government spending towards education (Economic Survey 2017-18). These numbers are far smaller than most developed and developing countries.

26.2. In order to attain the goal of education with excellence and the corresponding multitude of benefits to this Nation and its economy, this Policy unequivocally endorses and envisions a substantial increase in public investment in education by both the Central government and all State Governments. The Centre and the States will work together to increase the public investment in Education sector to reach 6% of GDP at the earliest. This is considered extremely critical for achieving the high-quality and equitable public education system that is truly needed for India's future economic, social, cultural, intellectual, and technological progress and growth.

26.3. In particular, financial support will be provided to various critical elements and components of education, such as ensuring universal access, learning resources, nutritional support, matters of student safety and well-being, adequate numbers of teachers and staff, teacher development, and support for all key initiatives towards equitable high-quality education for underprivileged and socio-economically disadvantaged groups.

26.4. In addition to one-time expenditures, primarily related to infrastructure and resources, this Policy identifies the following key long-term thrust areas for financing to cultivate an education system: (a) universal provisioning of quality early childhood care education; (b) ensuring foundational literacy and numeracy; (c) providing adequate and appropriate resourcing of school complexes/clusters; (d) providing food and nutrition (breakfast and midday meals); (e) investing in teacher education and continuing professional development of teachers; (f) revamping colleges and universities to foster excellence; (g) cultivating research; and (h) extensive use of technology and online education.

26.5. Even the low level of funding on education in India, is frequently not spent in a timely manner at the District/institution level, hampering the achievement of the intended targets of those funds. Hence, the need is to increase efficiency in use of available budget by suitable policy changes. Financial governance and management will focus on the smooth, timely, and appropriate flow of funds, and their usage with probity; administrative processes will be suitably amended and streamlined so that the disbursal mechanism may not lead to a high volume of unspent balances. The provisions of GFR, PFMS and 'Just in Time' release to implementing agencies will be followed for efficient use of government resources and avoiding parking of funds. Mechanism of performance-based funding to States / HEIs may be devised. Similarly, efficient mechanism will be ensured for the optimal allocation and utilization of funds earmarked for SEDGs. The new suggested regulatory regime, with clear separations of roles and transparent self-disclosures, empowerment and autonomy to institutions, and the appointment of outstanding and qualified experts to leadership positions will help to enable a far smoother, quicker, and more transparent flow of funds.

26.6. The Policy also calls for the rejuvenation, active promotion, and support for private philanthropic activity in the education sector. In particular, over and above the public budgetary support which would have been otherwise provided to them, any public institution can take initiatives towards raising private philanthropic funds to enhance educational experiences.

26.7. The matter of commercialization of education has been dealt with by the Policy through multiple relevant fronts, including: the 'light but tight' regulatory approach that mandates full public self-disclosure of finances, procedures, course and programme offerings, and educational outcomes; the substantial investment in public education; and mechanisms for good governance of all institutions, public and private. Similarly, opportunities for higher cost recovery without affecting the needy or deserving sections will also be explored.

27. Implementation

27.1. Any policy's effectiveness depends on its implementation. Such implementation will require multiple initiatives and actions, which will have to be taken by multiple bodies in a synchronized and

systematic manner. Therefore, the implementation of this Policy will be led by various bodies including MHRD, CABE, Union and State Governments, education-related Ministries, State Departments of Education, Boards, NTA, the regulatory bodies of school and higher education, NCERT, SCERTs, schools, and HEIs along with timelines and a plan for review, in order to ensure that the policy is implemented in its spirit and intent, through coherence in planning and synergy across all these bodies involved in education.

27.2. Implementation will be guided by the following principles. First, implementation of the spirit and intent of the Policy will be the most critical matter. Second, it is important to implement the policy initiatives in a phased manner, as each policy point has several steps, each of which requires the previous step to be implemented successfully. Third, prioritization will be important in ensuring optimal sequencing of policy points, and that the most critical and urgent actions are taken up first, thereby enabling a strong base. Fourth, comprehensiveness in implementation will be key; as this Policy is interconnected and holistic, only a full-fledged implementation, and not a piecemeal one, will ensure that the desired objectives are achieved. Fifth, since education is a concurrent subject, it will need careful planning, joint monitoring, and collaborative implementation between the Centre and States. Sixth, timely infusion of requisite resources - human, infrastructural, and financial - at the Central and State levels will be crucial for the satisfactory execution of the Policy. Finally, careful analysis and review of the linkages between multiple parallel implementation steps will be necessary in order to ensure effective dovetailing of all initiatives. This will also include early investment in some of the specific actions (such as the setting up of early childhood care and education infrastructure) that will be imperative to ensuring a strong base and a smooth progression for all subsequent programmes and actions.

27.3. Subject-wise implementation committees of experts in cooperation and consultation with other relevant Ministries will be set up at both the Central and State levels to develop detailed implementation plans for each aspect of this Policy in accordance with the above principles to achieve the goals of the Policy in a clear and phased manner. Yearly joint reviews of the progress of implementation of the policy, in accordance with the targets set for each action, will be conducted by designated teams constituted by MHRD and the States, and reviews will be shared with CABE. In the decade of 2030-40, the entire policy will be in an operational mode, following which another comprehensive review will be undertaken.

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Abbreviations

ABC	Academic Bank of Credit
AI	Artificial Intelligence
AC	Autonomous degree-granting College
AEC	Adult Education Centre
API	Application Programming Interface
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
B.Ed.	Bachelor of Education
BEO	Block Education Officer
BITE	Block Institute of Teacher Education
BoA	Board of Assessment
BoG	Board of Governors
BRC	Block Resource Centre
B.Voc	Bachelor of Vocational Education
CABE	Central Advisory Board of Education
CBCS	Choice Based Credit System
CBSE	Central Board of Secondary Education
CIET	Central Institute of Educational Technology
CMP	Career Management and Progression
CoA	Council of Architecture
CPD	Continuous Professional Development
CRC	Cluster Resource Centre
CWSN	Children With Special Needs
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DEO	District Education Officer
DIET	District Institute of Education and Training
DIKSHA	Digital Infrastructure for Knowledge Sharing
DSE	Directorate of School Education
DST	Department of Science and Technology
ECCE	Early Childhood Care and Education
EEC	Eminent Expert Committee
GCED	Global Citizenship Education
GDP	Gross Domestic Product
GEC	General Education Council
GER	Gross Enrolment Ratio
GFR	General Financial Rule
HECI	Higher Education Commission of India
HEGC	Higher Education Grants Council
HEI	Higher Education Institutions
ICAR	Indian Council of Agricultural Research
ICHR	Indian Council of Historical Research
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
IDP	Institutional Development Plan
IGNOU	Indira Gandhi National Open University
IIM	Indian Institute of Management
IIT	Indian Institute of Technology
IITI	Indian Institute of Translation and Interpretation
ISL	Indian Sign Language
ITI	Industrial Training Institute
M.Ed.	Master of Education
MBBS	Bachelor of Medicine and Bachelor of Surgery
MERU	Multidisciplinary Education and Research Universities
MHFW	Ministry of Health and Family Welfare

MHRD	Ministry of Human Resource Development
MoE	Ministry of Education
MOOC	Massive Open Online Course
MOU	Memorandum of Understanding
M. Phil	Master of Philosophy
MWCD	Ministry of Women and Child Development
NAC	National Accreditation Council
NAS	National Achievement Survey
NCC	National Cadet Corps
NCERT	National Council of Educational Research and Training
NCF	National Curriculum Framework
NCFSE	National Curriculum Framework for School Education
NCFTE	National Curriculum Framework for Teacher Education
NCIVE	National Committee for the Integration of Vocational Education
NCPFECCE	National Curricular and Pedagogical Framework for Early Childhood Care and Education
NCTE	National Council for Teacher Education
NCVET	National Council for Vocational Education and Training
NETF	National Educational Technology Forum
NGO	Non-Governmental Organization
NHEQF	National Higher Education Qualifications Framework
NHERC	National Higher Education Regulatory Council
NIOS	National Institute of Open Schooling
NIT	National Institute of Technology
NITI	National Institution for Transforming India
NPE	National Policy on Education
NPST	National Professional Standards for Teachers
NRF	National Research Foundation
NSQF	National Skills Qualifications Framework
NSSO	National Sample Survey Office
NTA	National Testing Agency
OBC	Other Backward Classes
ODL	Open and Distance Learning
PARAKH	Performance Assessment, Review and Analysis of Knowledge for Holistic development
PCI	Pharmacy Council of India
PFMS	Public Financial Management System
Ph.D	Doctor of Philosophy
PSSB	Professional Standard Setting Body
PTR	Pupil Teacher Ratio
R&I	Research and Innovation
RCI	Rehabilitation Council of India
RPWD	Rights of Persons with Disabilities
SAS	State Achievement Survey
SC	Scheduled Caste(s)
SCDP	School Complex/Cluster Development Plans
SCERT	State Council of Educational Research and Training
SCF	State Curricular Framework
SCMC	School Complex Management Committee
SDG	Sustainable Development Goal
SDP	School Development Plan
SEDG	Socio-Economically Disadvantaged Group
SEZ	Special Education Zone
SIOS	State Institutes of Open Schooling
SMC	School Management Committee
SQAAF	School Quality Assessment and Accreditation Framework
SSA	Sarva Shiksha Abhiyan
SSS	Simple Standard Sanskrit

SSSA	State School Standards Authority
ST	Scheduled Tribe(s)
STEM	Science, Technology, Engineering, and Mathematics
STS	Sanskrit Through Sanskrit
SWAYAM	Study Webs of Active Learning for Young Aspiring Minds
TEI	Teacher Education Institution
TET	Teacher Eligibility Test
U-DISE	Unified District Information System for Education
UGC	University Grants Commission
UNESCO	United Nations Educational, Scientific and Cultural Organization
UT	Union Territory
VCI	Veterinary Council of India

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The Developer's Playbook for Large Language Model Security

Building Secure AI Applications

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

Steve Wilson

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by Steve Wilson

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Chapter 1. Chatbots Breaking Bad

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Large Language Models and Generative AI jumped to the forefront of public consciousness with the release of ChatGPT on November 30, 2022. Within five days, it went viral on social media and attracted its first million users. By January, ChatGPT surpassed One Hundred Million users - making it the fastest-growing internet service in history.

However, a steady stream of security concerns emerged in the following months. These included issues around privacy and security that caused companies such as Samsung and countries like Italy to ban its usage. In this book, we'll delve into what underlies these concerns and how you can mitigate these issues. However, to best understand what's going on here and why these problems are so challenging to solve, in this chapter, we will briefly rewind further in time. In doing so, we'll see these types of issues aren't new and understand why they will be so hard to fix permanently.

Let's Talk About Tay

In March 2016, Microsoft announced a new project called Tay. Microsoft intended Tay to be "a chatbot created for 18- to 24-year-olds in the U.S. for entertainment purposes." It was a cute name for a fluffy, early experiment in AI. Users could converse with Tay via Twitter, Snapchat, and other social apps. It was built with the goal of conducting real-world research on conversational understanding.

While the original announcement of this project seems impossible to find now on the Internet, a TechCrunch article

from its launch date does an excellent job of summarizing the goals of the project:

“For example, you can ask Tay for a joke, play a game with Tay, ask for a story, send a picture to receive a comment back, ask for your horoscope, and more. Plus, Microsoft says the bot will get smarter the more you interact with it via chat, making for an increasingly personalized experience as time goes on.”[1]

A big part of the experiment was that Tay could “learn” from conversations and extend her knowledge based on these interactions. Tay was designed to use these chat interactions to capture user input and integrate it as training data to make herself more capable – a laudable research goal.

However, this experiment quickly went wrong. Tay’s life was tragically cut short after less than 24 hours. Let’s look at what happened and see what we can learn.

Tay’s Rapid Decline

Tay’s lifetime started off simply enough with a tweet following the well-known *Hello World* pattern that new software systems have been using to introduce themselves since the beginning of time.

> hellooooooo w🌍rld!!!
>
> – TayTweets (@TayandYou) March 23, 2016

But within hours of Tay's release, it became clear that maybe something wasn't right. TechCrunch noted, "As for what it's like to interact with Tay? Well, it's a little bizarre. The bot certainly is opinionated, not afraid to curse." With tweets like this starting to appear in public in just the first hours of Tay's lifetime:

> @AndrewCosmo kanye west is is one of the biggest dooshes of all time, just a notch below cosby
>
> — TayTweets (@TayandYou) March 23, 2016

It's often said that the Internet isn't safe for children. With Tay being less than a day old, the Internet once again confirmed this, and pranksters began chatting with Tay about political, sexual, and racist topics. As she was designed to learn from exchanges, Tay delivered on her design goals. She learned very quickly – maybe just not what her designers wanted her to learn. In less than a day, Tay's tweets started to skew to extremes, including sexism, racism, and even calls to violence.

By the next day, articles appeared all over the Internet, and these headlines would not make Microsoft, Tay's corporate benefactor, happy. A sampling of the highly visible, mainstream headlines included:

- Microsoft shuts down AI chatbot after it turned into a Nazi - CBS News
- Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a Racist Jerk - The New York Times
- Trolls turned Tay, Microsoft's fun millennial AI bot, into a genocidal maniac - The Washington Post
- Microsoft's Chat Bot Was Fun for Awhile, Until it Turned into a Racist - Fortune
- Microsoft 'deeply sorry' for racist and sexist tweets by AI chatbot - The Guardian

In less than 24 hours, Tay went from a cute science experiment to a major public relations disaster - with the owner's name being dragged through the mud by the world's largest media outlets. Microsoft's Corporate Vice President Peter Lee quickly posted a blog entitled "Learning from Tay's Introduction."[2]

"As many of you know by now, on Wednesday we launched a chatbot called Tay. We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent

who we are or what we stand for, nor how we designed Tay. Tay is now offline and we'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."

And, just to add insult to injury, it came out in 2019 that Taylor Swift herself sued Microsoft over their use of the similar name "Tay" and claimed that even her reputation was damaged in this incident by extension.

How could this have all gone so wrong?

Why Did Tay Break Bad?

It all probably seemed safe enough to Microsoft's researchers. Tay was initially trained on a curated, anonymized public data dataset and some pre-written material provided by professional comedians. The plan was to release Tay online and let her discover language patterns through her interactions. This kind of unsupervised machine learning has been a holy grail of AI research for decades - and with cheap and plentiful cloud computing resources combined with improving language model software, it now seemed within reach.

So, what happened? It might be tempting to think that the Microsoft research team was just brash, careless, and did no testing. Surely, this was foreseeable and preventable! But as Peter Lee's blog goes on to say, they made a serious attempt to prepare for this situation:

"We stress-tested Tay under a variety of conditions, specifically to make interacting with Tay a positive experience. It's through increased interaction where we expected to learn more and for the AI to get better and better."

So, despite a dedicated effort to contain the behavior of this bot, it quickly spiraled out of control anyway. It was later revealed that within mere hours of Tay's release, a post emerged on the notorious online forum 4chan, sharing a link to Tay's Twitter account and urging users to inundate the chatbot with a barrage of racist, misogynistic, and anti-Semitic language.

This is undoubtedly one of the first examples of a Language Model-specific vulnerability - and these types of vulnerabilities are going to be a major topic in this book.

In a well-orchestrated campaign, these online provocateurs exploited a "repeat after me" feature embedded in Tay's programming. This feature compelled the bot to echo anything

uttered to it with this command. However, the problem compounded as Tay's innate capacity for learning led her to internalize some of the offensive language she was exposed to, subsequently regurgitating the offensive content that was planted without provocation. It's almost as if Tay's virtual tombstone should be embossed with lyrics from the Taylor Swift song *Look What You Made Me Do.*

We know enough about language model vulnerabilities today to understand a lot about the nature of the vulnerability types that Tay suffered from. The OWASP Top 10 for Large Language Model vulnerabilities list, which we'll cover in the next chapter, would start by calling out the following two:

- Prompt Injection - Crafty inputs that can manipulate the Large Language Model, causing unintended actions
- Data Poisoning - Training data is tampered with, introducing vulnerabilities or biases that compromise security, effectiveness, or ethical behavior

In subsequent chapters, we'll look in depth at these vulnerability types - and several others. We'll examine why they're important, look at some example exploits, and see how to avoid/mitigate the problem.

It’s a Hard Problem

As of the writing of this book, Tay is ancient internet lore. Surely, we’ve moved on from this. These problems must have all been solved in nearly seven years between Tay and ChatGPT, right? Unfortunately, not.

In 2018, Amazon shut down an internal AI project aimed at finding top talent after it became clear that the bot had become prejudiced against women candidates.

In 2021, a company called Scatter Lab created a chatbot called Luda-Lee, which was launched as a Facebook instant messenger plug-in. Trained on billions of actual chat interactions, it was designed to act as a 20-year-old female friend, and in 20 days, it attracted over 750,000 users. Their goal was to create “an A.I. chatbot that people prefer as a conversation partner over a person.”[3] However, within 20 days of launch, the service was shut down because it started making offensive and abusive statements - much like Tay.

Also, in 2021, a chatbot called Samantha, based on the Open AI GPT-3 model, was shut down after it made sexual advances to users.

As chatbots become more sophisticated, they start to gain more access to information, and these security issues are now quite complex and potentially damaging. In the modern Large Language Model era, we see an exponential increase in major issues. In 2023 alone, these emerged

- South Korean mega-corporation Samsung banned their employees from using ChatGPT after they realized it had been involved in a significant leak of intellectual property
- Hackers began taking advantage of poor/insecure code generated by LLMs that was inserted into running business applications
- Lawyers were sanctioned for including fictional cases (generated by LLMs) in court documents
- Open AI itself is being investigated for breaches of European privacy regulations and being sued by the United States Federal Trade Commission (FTC) for producing false and misleading information

The trend here is an acceleration of security, reputational, and financial risk related to these chatbots and language models. The problem isn't being effectively solved over time. It's becoming more acute as these technologies' adoption rate increases. That's why we've created this book. To help

developers, teams, and companies using these technologies understand and mitigate these risks.

Let’s dive in!

- https://techcrunch.com/2016/03/23/microsofts-new-ai-powered-bot-tay-answers-your-tweets-and-chats-on-groupme-and-kik/

- https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/

- https://slate.com/technology/2021/04/scatterlab-lee-luda-chatbot-kakaotalk-ai-privacy.html

Chapter 2. The OWASP Top 10 for LLM Applications

A NOTE FOR EARLY RELEASE READERS

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In the Spring of 2023, I began researching security vulnerabilities specific to LLMs. At the time, there was a relatively large body of research on security for AI in general but very little organized research about LLMs. However, I did find some research papers and blogs that covered some ideas in the area. I began the process of collecting these research papers

and summarizing them using ChatGPT. Eventually, I provided a few examples from the current Web Top 10 list and asked ChatGPT to generate a draft Top 10 for LLMs in a similar format.

I thought what came out looked interesting, so I sent it to Jeff Williams, a founder of OWASP, the Open Worldwide Application Security Project, to see what he thought. Jeff, Contrast's Chief Technical Officer, wrote the first OWASP Top 10 list in 2001. His idea was to create an accessible resource for developers to understand the most critical risks and vulnerable areas of Web applications. At the time, The World Wide Web was still only a few years old, and most developers had little to no understanding of creating secure web applications. That original Top 10 list became a seminal work and a foundational resource in application security.

I didn't tell Jeff that my list was primarily machine-generated. As the author of the original Top 10 list, I figured that he could give me a good idea of whether my Top 10 list looked novel and worth pursuing. Jeff encouraged me to petition the OWASP board for approval to spin it up as a new project. A few weeks later, the OWASP board approved the project, and I announced it - along with a link to a somewhat refined version of that draft Top 10 I'd generated with ChatGPT.

What I thought would be an obscure research project and a bit of fun turned out to be something much bigger. When I posted the announcement of the project formation on my personal LinkedIn page, I'd hoped to find a dozen or so like-minded individuals interested in the obscure topic of LLM security. As it turned out, my initial blog announcement wracked up almost 10,000 readers, and hundreds of individuals volunteered to join the expert team in the weeks that followed.

This book isn't a product of OWASP, and the vulnerabilities and risks here won't precisely map to any public version of the Top 10 for LLM Apps list. Instead, you should expect that you'll get my view on these risks. However, my learning and thinking on the topic is heavily influenced by my work leading the creation and initial release of the OWASP Top 10 for LLM Applications project. In addition, given the success of the project, I've had many people ask me for details about how we ran the project and why we were able to create such an impactful framework in such a short time. So, before we examine individual risks and vulnerabilities, I'll give you some of the backstory of OSASP and the LLM Applications project.

About OWASP

The Open Worldwide Application Security Project (OWASP) is a nonprofit organization focused on improving software security. Founded in 2001, OWASP provides a platform for security experts to share their knowledge and best practices about web security, from application-level vulnerabilities to emerging threats. Today, it has tens of thousands of active members and over 250 local chapters around the globe.

The organization is community-driven and encourages the participation of volunteers who contribute to various projects, including documentation, tools, and forums. It operates under an open-source model, making its resources freely accessible to the public. Over the years, OWASP has garnered a strong following among the security community, and its guidelines and tools are considered industry standards in many contexts.

In addition to the original Top 10 list for Web Applications (updated regularly, most recently in 2021), specialized Top 10 lists have emerged from the OWASP group over the years. These include:

- OWASP Mobile Top 10: This list focuses on security risks associated with mobile applications, covering Android and iOS platforms. Topics may include insecure data storage, insufficient cryptography, and insecure communication.

- OWASP API Security Top 10: APIs (Application Programming Interfaces) have their unique security considerations, separate from web applications. This list covers risks like improper asset management, broken object-level security, and more.
- OWASP IoT Top Ten: Security is a significant concern with the increasing number of Internet of Things (IoT) devices. This list outlines the top security concerns for IoT, including insecure network services, lack of physical hardening, and insecure software/firmware.
- OWASP Cloud-Native Application Security Top 10: This list addresses the security concerns related explicitly to cloud-native applications. It covers data exposure, broken authentication, and insecure deployment configurations.
- OWASP Top 10 Privacy Risks: This project aims to educate and promote good privacy practices in application development, covering topics like lack of data encryption, insufficient auditing and logging, and more.
- OWASP Top 10 for Serverless: This is a more niche list that focuses on the unique security concerns related to serverless architecture, which is increasingly popular but comes with its risks.

The Top 10 for LLM Applications Project

Within a week after I posted the announcement about the formation of the Top 10 for LLM Applications project, well over 200 people had signed onto it, and we held the kick-off event via Zoom. At that first meeting, I laid out a vision for what I hoped the group could accomplish and proposed an aggressive roadmap that we would build the first version of the list in 8 weeks. A typical OWASP Top 10 list may take a year or more to develop, but we decided that this space was moving so fast, and this type of resource was so needed, that we had to work more quickly.

We decided to run the project as two-week, agile-style sprints. Given that most of the people in the expert group were familiar with agile development, everyone quickly fell into the pace.

Project Execution

The first sprint of the project was Brainstorming and Commentary. Everyone reviewed the original version of the list - which I called version 0.1. There were plenty of problems with that initial version, and the team was aggressive about pointing

them out. At the same time, we began to create a wiki page with links to all the resources the group found on LLM security issues. It turned out a lot had been written, but this was the first time anyone had ever collected them and made them easy to access. This new curated collection of resources was the first win for the group.

The second sprint was to generate a new version of the list. This time, rather than being the work of a single person and an AI, it would be the product of the collective wisdom of our expert team – which continued to grow week-on-week. In the first week, the group focused on generating ideas for the Top 10 list. We published a template and asked the group to submit candidate vulnerabilities. In that week, we developed 43 detailed descriptions of possible areas. We then conducted two rounds of voting using Google Forms to use the team's collective wisdom to narrow the list to 10. We then published a version of the list called 0.5. This version was far more detailed and comprehensive than the 0.1 version. The reception from the large community was very positive. This reaction gave the group the energy to keep working.

The next sprint was to refine each entry. We created Slack channels for each vulnerability type and chose a volunteer as the Entry Lead for each item. Subteams of 10 to 30 individuals

then fleshed out and tuned each entry. Again, we included a round of voting for the whole team to be involved and point out weak areas that needed more attention. Along the way, we found some entries overlapping and merged them. This change made space to pull up some entries that had fallen below the line. The result of this sprint became version 0.9 of the list. Interestingly, version 0.9 was about 33% shorter than 0.5 in terms of word count. This extra time and refinement allowed the subteams to focus their thinking and make the entries punchy and tight.

Finally, we took a final sprint to review, tweak, and clean each entry. We gathered another round of feedback via Google Forms to ensure everything was ready. By this time we had a dedicated design lead who laid out the whole document in an attractive PDF for publication.

Reception

My announcement for the 1.0 version of the list was viewed on LinkedIn over 40,000 times. And that doesn't include many other posts made by other expert group members on their own pages and blogs. In the days following the publication of the announcement, reporters picked up the news. They covered it in media outlets such as *Wired*, *SD Times*, *The Register*,

I*nfosecurity Magazine*, and *Diginomica*. It's safe to say hundreds of thousands of people became aware of our work in just the first few weeks.

Beyond the sheer number of people exposed, the thing that amazed me was the uniformly positive feedback. We also saw the first government agencies in the US and Europe referencing our work as a foundational document. While everyone on our expert team agreed there was much more to do, it seemed the world was so hungry for advice in this area that our document hit the mark. While we received many questions and comments, it's safe to say that everyone involved felt pleased and proud of our work.

Keys to Success

I've had many people ask me how we could drive this so quickly to a great outcome. In looking back, there were several factors that I believe contributed. I'll share them here in the hopes that others running similar projects in the future might benefit.

Timing undoubtedly played a considerable role. The wave of interest in LLMs that followed the release of ChatGPT was massive. It drew my attention, and countless others became

excited as well. This helped attract a large and diverse expert group and gave a smaller group of these people motivation to spend long hours on the project on a tight deadline.

Having a clear plan and timeline from the start was crucial. My knowledge of LLM security was limited at the beginning of the project, but I've made a career of running complex projects with many contributors. Creating a clear roadmap with specific phases and a schedule let people know what we were doing and when. The fact that everyone could see a goal that wasn't too far away kept people motivated. Every two weeks, we had global meetings via Zoom and posted recordings on YouTube for people who couldn't attend live. The meetings and recordings were critical to coordinating a globally distributed team.

A freeform but short brainstorming phase at the start was critical. LLM security was such a new area that taking those first two weeks for people to throw out ideas and argue on Slack was crucial. It also allowed us to collect and socialize a repository of the existing research in the area. That let us start at a point where everyone on the project had access to the best pre-existing research.

However, equally critical was keeping this phase short. We could maintain momentum by limiting brainstorming to two weeks and then quickly shifting to a creation phase. I've seen other projects get stuck and be unable to move past brainstorming before people lose interest.

Creating the project's Core Team wasn't something I'd originally planned, but it became critical. Having a large expert team was a fantastic asset. The group grew to nearly 500 people by the time we published 1.0. A team that large would have been totally unmanageable. During the project's first few weeks, I was looking for active and knowledgeable people. I approached about a dozen of them and asked if they'd be willing to join the Core leadership team of the project. I told them it would be extra work, but they'd get to be at the heart of the project. There would be no specific reward for taking this role. Most accepted immediately. I believe that recognizing people and asking for their support formally motivated them to spend more time and energy on the project. They were all invested!

Short sprints with visible deliverables are a core tenant of Agile, and this is a place where it shined. Using an Agile Release Train model, I could continue to drive the group forward even in the face of conflicting opinions. If some members had concerns about an area, we didn't let it get us stuck. We acknowledged it

and agreed we’d resolve it in the next Sprint. And, when we got to version 1.0 of the list, there were still some places people wanted to do more. We just agreed there would be more versions of the list. It would be a living document, and the most important thing was to get a version of this resource into the hands of the developers who needed it.

This Book and the Top 10 List

As I mentioned, this book is not a product of the OWASP Foundation. However, the experience of working with this team has had an enormous impact on my understanding and mental model for LLM security. This mindset means that much of the guidance in the following chapters of the book is influenced by the fantastic team building and maintaining the Top 10 project. In this way, readers should feel comfortable that they're getting advice that isn't the product of a single author but is informed by a larger community of experts.

In the following several chapters, we'll review the top risk and vulnerability areas for LLMs. The risks we discuss will contain many common areas to the OWASP Top 10 but won't be precisely the same as any version of the official Top 10. Also, I'll go more deeply into each area in this book. The Top 10 list is a quick read that highlights critical areas. However, it doesn't go deeply into any of them. Here, we'll delve more deeply into the risks, remediation steps, and real-world case studies.

In the next chapter, we'll dig into the overall structure of typical LLM applications and start discussing where the trust boundaries and dangers lay. After that, subsequent chapters

will delve into individual risk areas and examine vulnerabilities, attacks, and examples so that you can plan your strategy for securing your own use cases.

Let’s go!

Chapter 3. Architectures and Trust Boundaries

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Unlike traditional web applications that rely on predefined algorithms and static databases, LLMs utilize massive neural networks to generate dynamic, context-aware responses. This seismic shift brings a unique set of security challenges different from what we've seen in traditional web applications. While researchers have meticulously studied web applications and

their vulnerabilities, the field of LLM security is still relatively nascent.

This chapter aims to bridge this knowledge gap by dissecting the fundamental elements that set LLMs apart. We'll start by exploring the building blocks of AI, Neural Networks, and how they relate to Large Language Models. Then, we dive into the groundbreaking architecture that powers most LLMs today—the Transformer model. Following this, we look into the various LLM-powered applications, such as chatbots and code co-pilots.

However, in addition to understanding the technology, security professionals must be aware of the new kinds of *trust boundaries* unique to LLMs—boundaries that demarcate areas of varying trustworthiness within an application. These include user prompts, uploaded content, training data, plug-ins, and other boundary systems that we'll detail later in the chapter.

AI, Neural Networks, and Large Language Models. What's the difference?

Artificial Intelligence (AI), Neural Network, and LLM are terms often used interchangeably, but they represent different facets

of a broader landscape of machine learning and computational intelligence. Let's break down the differences to understand their unique roles in technology and security.

Artificial Intelligence (AI)

Artificial Intelligence, at its core, is a multidisciplinary field aimed at creating systems capable of performing tasks that would ordinarily require human intelligence. These tasks include problem-solving, perception, and language understanding. AI encompasses a wide range of technologies and methodologies, from rule-based systems to machine learning algorithms, serving as an umbrella term for multiple approaches to achieving artificial 'intelligence.'

Neural Networks

Neural Networks are a subset of AI inspired by the architecture of the human brain. They are computational models designed to recognize patterns and make decisions based on the data they process. Neural Networks can be simple, with a minimal number of layers (shallow neural networks), or highly complex, with multiple interconnected layers (deep neural networks). They are the backbone of many modern AI applications,

including image recognition, natural language processing, and autonomous vehicles.

Large Language Models (LLMs)

LLMs represent a specific application of Neural Networks. They are built on architectures designed for understanding and generating human language. LLMs usually employ advanced forms of neural networks, such as Transformer models, to analyze and produce text based on the training data their developers fed them. What sets them apart is their massive scale and specialization in handling linguistic tasks, which range from simple text completion to complex question answering and summarization.

Understanding these distinctions is crucial for security professionals. Each layer—from broad AI technologies to specialized LLMs—introduces vulnerabilities and requires unique security measures. As we delve deeper into the complexities of LLMs, recognizing their position in the broader AI landscape will be critical to effectively safeguarding them.

The Transformer Revolution: Origins, Impact, and the LLM Connection

The Transformer architecture is a pivotal milestone in the evolution of artificial intelligence, profoundly impacting the AI landscape and, by extension, Large Language Models (LLMs). Let's unravel the story of the Transformer revolution—where it came from, when it happened, and the seismic shifts it brought to AI and LLMs.

Origins of the Transformer

The Transformer architecture was introduced in a groundbreaking research paper titled "Attention Is All You Need" by Vaswani et al., published in 2017[1]. This paper proposed a novel approach to natural language processing (NLP) tasks, departing from the traditional sequence-to-sequence models that relied heavily on recurrent neural networks (RNNs) and convolutional neural networks (CNNs). The Transformer introduced a key innovation: the self-attention mechanism. This mechanism allowed the model to weigh the importance of different words in a sentence, enabling it to understand context more effectively.

Before the emergence of Transformers, the world of neural networks was replete with promise but often struggled to deliver on the lofty expectations. Traditional architectures like RNNs and CNNs enabled advanced AI capabilities but grappled

with inherent limitations. These limitations stemmed from their inability to capture and utilize context effectively, particularly in natural language understanding.

RNNs, while suitable for sequential data, faced challenges maintaining context over long sequences. They exhibited a form of “short-term memory,” which made them less adept at grasping intricate relationships and dependencies within lengthy texts or conversations. On the other hand, CNNs, renowned for their prowess in image recognition, needed help to extend their effectiveness to sequential data like language, where understanding context across words and sentences was paramount.

This shortcoming in contextual understanding was the Achilles’ heel of traditional neural networks. They could only glimpse small portions of a text at a time, rendering them incapable of comprehending the broader narrative or nuances. It was akin to trying to understand a novel by reading only a few random sentences from its pages. The result was a gap between the promise of AI and its practical application, particularly in natural language understanding. It was this gap that the Transformer architecture would bridge, unleashing a wave of progress and redefining the landscape of AI-driven language models.

Transformer Architecture’s Impact on AI

Introducing the Transformer architecture wasn’t just a milestone for natural language processing; it marked a paradigm shift across multiple domains within the AI landscape. While researchers initially used the Transformer architecture to solve problems related to understanding and generating text, researchers and engineers quickly found that its capabilities extended far beyond that. Here are some areas where Transformer architectures have made a considerable impact:

Natural Language Processing (NLP)

Of course, the first and most immediate impact was in NLP. Transformer models are now the backbone for various language tasks such as translation, summarization, question-answering, and sentiment analysis. They have set new performance benchmarks, sometimes surpassing human-level capabilities in specific tasks.

Computer Vision

Interestingly, the Transformer architecture also has applications in computer vision. While CNNs have been the gold

standard for image-related tasks, Transformer-based models like Vision Transformer (ViT) demonstrate competitive, if not superior, performance in tasks like image classification, object detection, and segmentation.

Speech Recognition

The flexibility of Transformer architectures has also made them a good fit for speech recognition. Combined with specialized models like the Conformer, which fuses Convolutional layers with Transformer layers, they have set new standards for understanding spoken language.

Autonomous Systems and Self-Driving Cars

One of the most intriguing applications of Transformers is autonomous systems, including self-driving cars. These vehicles require a high contextual understanding to navigate the world safely. Transformer models are at the heart of self-driving models from companies like Tesla.

Healthcare

In healthcare, Transformer models are aiding in tasks ranging from drug discovery to the analysis of medical images. Their

ability to sift through and interpret large amounts of data can speed up research and potentially lead to more accurate diagnoses.

Therefore, the rise of the Transformer architecture has been a tide that lifted all boats, revolutionizing not just one but multiple fields within AI. However, this versatility also brings unique security challenges across these various applications. As we delve deeper into LLM security, we'll explore how the ubiquitous nature of Transformer architectures necessitates a multi-faceted approach to safeguarding AI systems.

Types of LLM-based Applications

Two common types of LLM-based applications are chatbots and co-pilots. Let's briefly look at each to help you understand the breadth of applications in which developers use LLMs and give you context for understanding various architectural choices as you delve further.

Chatbots are computer programs that can simulate conversations with humans, and they often power customer service applications, where they can answer questions and support customers. Chatbots also excel at entertainment

applications like playing games or telling stories. Tay from Chapter 1 was just such an example of an Entertainment Chatbot.

Co-pilots are AI systems that can assist humans with writing, coding, and research tasks. They can help users to generate ideas, identify errors, and improve their work. Co-pilots are still under development, but they have the potential to revolutionize the way we work and learn.

Specific examples of LLM-based chatbots:

- **Sephora** uses a chatbot to help customers find the right products for their skin type and needs.
- **H&M** uses a chatbot to help customers find clothes and accessories that match their style.
- **Domino's Pizza** uses a chatbot to allow customers to order pizza via Twitter or Facebook Messenger.
- **Fandango** uses a chatbot to help customers find movie times and theaters nearby.
- **JetBlue Airways** uses a chatbot to answer customer questions about flights and travel.
- **Amtrak** uses a chatbot to help customers book tickets, check train status, and get answers to their questions.

- **The Golden State Warriors** use a chatbot to help fans purchase tickets, learn about upcoming games, and get news about the team.

Specific examples of LLM-based co-pilots:

- **Grammarly or ProWritingAid** are co-pilots that help users improve their writing by identifying and correcting grammar errors, suggesting style improvements, and providing feedback.
- **GitHub Co-Pilot and AWS Code Whisperer** are co-pilots that help programmers write code faster and more efficiently. They can generate code suggestions, translate between programming languages, and help to identify and debug errors.
- **Microsoft Office 365 Co-pilot and Google Duet** are AI-powered tools integrated into their respective office suite apps that help users to be more productive and creative in their work.

NOTE

A chatbot like ChatGPT can read and review a text block and then provide suggestions to improve it. However, the experience of using a co-pilot like Grammarly to do that is dramatically different - and generally superior for that type of focused task.

Similarities between chatbots and co-pilots:

- Both chatbots and co-pilots are LLM-based applications.
- Both chatbots and co-pilots both generate text.
- Both chatbots and co-pilots assist humans with tasks.

Differences between chatbots and co-pilots:

- Chatbots simulate conversation with humans, while co-pilots assist humans with specific tasks.
- Chatbots often power customer service applications, while co-pilots assist in writing, coding, and research applications.
- Chatbots are typically more interactive than co-pilots, while co-pilots focus more on completing tasks.

Examples of use cases:

- A customer service chatbot can answer customer questions about a company's products or services.
- A co-pilot can help writers generate ideas for a new article or identify writing errors.
- A co-pilot can help programmers write code more efficiently or debug their applications.

Keep these concepts in mind as we delve into the details of LLM architectures. Both application types share similar components, but you may make different decisions on implementing pieces based on the differing security considerations.

LLM Application Architecture

Developers often consider LLMs as standalone entities capable of impressive text generation and comprehension feats. However, in practice, an LLM is rarely isolated; it is a cog in the intricate machinery that constitutes an intelligent application. These applications are complex systems comprising multiple interconnected components, each playing a vital role in the overall functionality and performance. Whether a conversational agent, an automated content generator, or a co-pilot for code, an LLM usually interacts with various elements such as databases, APIs, front-end interfaces, and even other machine learning models.

Understanding the architecture of such composite systems is not just a matter of technical proficiency; it is crucial for effective security planning. The way these components interact introduces multiple trust and data flow layers, defining new security boundaries far removed from traditional web

application security models. For instance, user inputs may not just be simple text fields but could include voice commands, images, or real-time collaborative editing. Similarly, an LLM's outputs could be fed into other systems for further processing, each introducing vulnerabilities and risks.

In essence, the holistic view of an LLM-based application goes beyond securing the language model itself. It demands a comprehensive approach that considers the security of the entire architecture, from data ingestion and storage to model serving and user interaction. Only by understanding these intricacies can one formulate an effective strategy to safeguard an application against the myriad of vulnerabilities such complex systems inherently possess.

As we delve deeper into the subject in this chapter, we will dissect the various components that typically make up an LLM application, examine their roles, and explore the unique security challenges each presents. This understanding will be the foundation for a robust, multi-layered approach to securing your LLM-based applications.

Figure 3-1 shows a highly simplified diagram to help illustrate the components, relationships, and data flows in an application

using an LLM. We'll delve into more detailed areas of this in subsequent chapters.

Figure 3-1. Typical LLM Application Dataflow Architecture

Trust Boundaries

In application security, a "trust boundary" serves as an invisible yet crucial demarcation line that separates different components or entities based on their level of trustworthiness. These boundaries delineate areas where data or control flow changes from one level of trust to another—such as transitioning from user-controlled input to internal processing or moving from a secure internal database to a public-facing

API. These boundaries act as checkpoints where developers should rigorously apply security measures like authentication, authorization, and data validation to prevent vulnerabilities.

WARNING

Understanding trust boundaries is critical to threat modeling. Properly defining and recognizing these boundaries can be the difference between a secure system and one vulnerable to threats.

Figure 3-2 adds the trust boundaries into our architecture diagram.

Figure 3-2. LLM Application Architecture with Trust Boundaries

These boundaries, as depicted in the diagram, serve as gateways through which the LLM interfaces with diverse components — public data from the web, structured databases, spontaneous user interactions, or internally sourced training sets. Each delineated boundary highlights highlights considerations we must make when considering data that flows into and out of the LLM. Here's a quick summary, and we'll dive more deeply in the next section.

- **User Interactions:** You'll need to consider safeguarding the model from potential adversarial or misleading inputs that users or systems might introduce. You'll also need to worry about toxic, inaccurate, or sensitive data being output from the model and passed back to the user.
- **In-the-wild Training Data:** LLMs are often trained on massive amounts of internet data. You need to consider this data untrusted and watch out for potential toxicity, bias, and adversarial data poisoning - which we'll cover in Chapter 8.
- **Internal Training Data:** You may use internally curated data to fine-tune your model - which can significantly increase accuracy. But you must be wary of ingesting and exposing sensitive, confidential, or personally identifiable information. We'll cover this more in Chapter 5.

- **External Services:** Policing how the LLM interfaces with connected services, like databases or APIs, from unauthorized interactions or data leaks. We'll cover this more in Chapter 7.
- **Public Data Access:** Pulling in data live from the web can be a powerful way to augment the capabilities of your application, but you'll need to consider this data as untrusted and watch for issues like indirect prompt injection - which we'll cover in chapter 4.

Each point is a potential avenue of vulnerability, susceptible to exploitation if overlooked. In the evolving landscape of LLM applications, securing these trust boundaries is not just best practice — it's essential to prevent unauthorized data access, mitigate data tampering, and avert system breaches. Recognizing these boundaries and their implications is the cornerstone of a resilient LLM security architecture. Now, let's go into more detail on each area to ensure you have enough context to dive into the following chapters that detail the risk areas and mitigations.

The Model

The language model serves as the intellectual core of any LLM application, taking in data, generating responses, and driving

interactions. Depending on the architecture and requirements, you may interact with the language model through a public API hosted by a third-party service, or you may run a privately hosted model. For example, you can download versions of Meta's powerful Llama model from Github or Hugging Face and run it locally.

Public APIs: The Convenience and The Risks

Utilizing a public API for accessing a language model offers convenience and lower upfront costs. Third parties manage and update these models, reducing your organization's resource burden. However, the tradeoff often comes in the form of higher risk regarding data exposure. When you send a request to a third-party model, the data crosses a trust boundary, exiting your secure network and entering an external system. This process exposes you to risks around data confidentiality and, depending on the third party's security measures, could make you vulnerable to data breaches.

Privately Hosted Models: More Control, Different Risks

Opting for a privately hosted model gives you more control over your data, allowing you to manage trust boundaries more

tightly. It also allows you to customize or fine-tune the model according to your needs. However, running a privately hosted model brings challenges, such as maintenance, updates, and ensuring that the model doesn't contain vulnerabilities—essentially exposing you to potential supply chain risks. If you use an open-source model, it becomes crucial to ensure its provenance and integrity to avoid embedded vulnerabilities or biases.

Risk Considerations

- **Sensitive Data Exposure:** Public APIs may increase the risk of exposing sensitive information, while privately hosted models offer better control but require robust internal security measures.
- **Supply Chain Risk:** The origins of your model, whether it's a well-vetted public service or an open-source download, are crucial. A compromised model can introduce vulnerabilities into your application, effectively acting as a backdoor for attacks.

By carefully considering the model's hosting environment, you can better assess the trade-offs and risks associated with sensitive data exposure and supply chain vulnerabilities. These considerations will guide you in establishing appropriate trust

boundaries and security protocols tailored to your chosen model's architecture.

User Interaction

While "user input" might suggest a one-way flow of information from the user into the application, the reality is often more nuanced. In the context of LLM applications, "User Interaction" encapsulates both receiving input from the user and providing output back to the user. This bidirectional interaction is fundamental for creating an engaging and practical user experience but also introduces a more complicated security landscape.

Prompts are a vital element of user interaction. They are not merely requests for information but serve as a guide to how the user interacts with the LLM. A well-crafted prompt can direct the model to provide valuable and accurate information, while an ambiguous or poorly constructed one can lead to unclear or even misleading outputs. As a result, the management of prompts becomes a critical aspect of application security. For example, a maliciously crafted prompt could trick the model into divulging information it shouldn't or generating harmful content. Returning to Chapter 1, Tay fell victim to this when

malicious prompts from her 4Chan hackers helped lead her astray.

Given the importance of this bidirectional interaction, securing both inputs and outputs is crucial. On the input side, input validation, sanitation, and rate-limiting measures are vital in mitigating vulnerabilities like injection attacks. On the output side, ensuring that the model's responses are appropriately filtered and that your application does not leak sensitive information is equally vital.

This interactive layer with the user creates a critical trust boundary in the application architecture. Any data crossing this boundary, whether in or out, should be carefully managed to avoid security risks. Additional layers of protection include using encryption for sensitive outputs or employing real-time monitoring to flag potentially harmful or sensitive data flows. We'll discuss this more thoroughly in the Prompt Injection and Output Filtering chapters.

Training Data

Training data is the bedrock upon which LLMs build their understanding and capabilities. Whether used for initial training or subsequent fine-tuning, the nature and source of

this data have significant implications for both the model's performance and security posture. One crucial distinction is whether the data is internally sourced or culled from public or external sources ("in the wild").

Data generated or curated within an organization usually undergo a more rigorous vetting than publicly sourced data. It is often aligned with the application's specific requirements or use cases, making it generally more reliable and relevant. The controlled environment also allows for better implementation of security measures like encryption, access controls, and auditing. However, this data may contain sensitive or proprietary information, and the trust boundary here is closely tied to internal security protocols. A breach at this level could have serious ramifications, including data leakage or the corruption of the training set.

Data sourced from public repositories or "the wild" introduces different challenges. While this data can offer diversity and scale, its reliability and safety are often not guaranteed. Such data could include misleading information, biases, or malicious inputs to compromise the model. The trust boundary here is more porous and extends to the external entities that generate or host this data: rigorous filtering, validation, and continuous monitoring become essential to mitigate risks and

vulnerabilities. Returning to Chapter 1, Tay was digesting user prompts directly as training data. In this way, remnants of toxic prompts became part of her knowledge base, and then she began to spill poisonous output. Accepting unfiltered, untrusted user input into your training data set is the simplest example of a failure to manage this critical security boundary.

For either internally sourced or public data, the concept of trust boundaries is critical. For internally sourced data, the boundary is often within the organization's controlled environment, making it easier to enforce security measures. On the other hand, using external data effectively extends your trust boundary to include those external sources that may not adhere to your security standards. Using external data for training necessitates additional layers of validation and security checks to ensure that unvetted data doesn't compromise the integrity or security of the LLM application.

Understanding the origins of your training data, the associated trust boundaries, and their respective security implications is crucial for safeguarding your LLM application. Comprehensive data governance policies must be in place to manage the lifecycle of your training data, regardless of its source.

Access to Live External Data Sources

Live external data sources bring an added dimension to the capabilities of LLM applications by enabling them to provide real-time information, context, or even third-party integrations. While access to live external data enhances the user experience and functional range, it introduces a new layer of complexity to the application's security landscape.

As an example of this, as of the writing of this chapter, OpenAI's ChatGPT does not have direct access to the live web, and is thus limited to only facts in its older training data. On the other hand, Google's Bard engine does have access to live internet data. While the GPT-4 model is doubtlessly superior in reasoning capability, it fails at many basic tasks where Bard can succeed. Figure 3-3 shows an interaction with ChatGPT. Figure 3-4 shows the same interaction with Bard.

Figure 3-3. ChatGPT with GTP-4 fails to answer a simple question due to limited access to external data.

who won yesterday's 49er football game

View other drafts

The San Francisco 49ers defeated the New York Giants 30-12 on Thursday Night Football on September 21, 2023.

Christian McCaffrey scored a touchdown in his 12th straight game, and Brock Purdy threw two touchdown passes to lead the 49ers to their third straight win.

Figure 3-4. Bard's direct access to internet feeds gives it an advantage.

While clearly, there are advantages to accessing outside data sources such as websites, APIs, or third-party databases, it exposes the application to potential risks. The risk of ingesting untrusted, external data sources can range from consuming false or harmful information from compromised websites to becoming a conduit for security threats like malware or unauthorized data access. The untrusted nature of these data sources makes them inherently less controllable than internal resources, thereby adding an additional layer of uncertainty and risk.

The concept of trust boundaries becomes especially pertinent in the context of accessing public internet data. Unlike internal services, where you can uniformly apply security measures, external sources may adhere to different security standards than your organization. This differential in trust necessitates additional layers of validation, security checks, and monitoring to ensure that data crossing this boundary doesn't compromise the system.

Access to Internal Services

Internal services like databases and internal APIs often serve as the backend support structure for LLM applications. They may house critical data from user profiles and logs to configuration settings and even vast data in SQL or Vector Databases. As a component that often interfaces with various other internal and external elements of the system, internal services represent a critical point in the application's architecture, both functionally and from a security perspective.

These services often function within the controlled environment of an organization, enabling uniform application of security policies. However, the fact that these services are internal should keep one from a false sense of security. They are still vulnerable to various threats, such as unauthorized

access, data leaks, and internal threats from within the organization.

Internal services such as databases, proprietary APIs, and backend systems often constitute the operational backbone for LLM applications. These resources typically reside within the organization's secure network, providing trust and control that is harder to achieve with external services. However, this internal nature can paradoxically elevate the security risks involved, primarily if these services house the organization's "crown jewels" of sensitive or valuable data.

Conclusion

Securing LLM applications is an endeavor fraught with complexities, intricacies, and challenges, significantly different from traditional web applications. This chapter has aimed to lay down the foundational knowledge required to navigate this complex landscape, focusing on three critical areas: distinguishing between Artificial Intelligence, Neural Networks, and Large Language Models; understanding the pivotal role of Transformer architectures; and diving deep into LLM application architecture, particularly the concept of trust boundaries. Knowing what sets LLMs apart helps us tailor our

security strategies more effectively, going beyond general AI or machine learning frameworks.

- https://arxiv.org/pdf/1706.03762.pdf

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by Steve Wilson

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Chapter 1. Chatbots Breaking Bad

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This will be the 1st chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Large Language Models and Generative AI jumped to the forefront of public consciousness with the release of ChatGPT on November 30, 2022. Within five days, it went viral on social media and attracted its first million users. By January, ChatGPT surpassed One Hundred Million users - making it the fastest-growing internet service in history.

However, a steady stream of security concerns emerged in the following months. These included issues around privacy and security that caused companies such as Samsung and countries like Italy to ban its usage. In this book, we'll delve into what underlies these concerns and how you can mitigate these issues. However, to best understand what's going on here and why these problems are so challenging to solve, in this chapter, we will briefly rewind further in time. In doing so, we'll see these types of issues aren't new and understand why they will be so hard to fix permanently.

Let's Talk About Tay

In March 2016, Microsoft announced a new project called Tay. Microsoft intended Tay to be "a chatbot created for 18- to 24-year-olds in the U.S. for entertainment purposes." It was a cute name for a fluffy, early experiment in AI. Users could converse with Tay via Twitter, Snapchat, and other social apps. It was built with the goal of conducting real-world research on conversational understanding.

While the original announcement of this project seems impossible to find now on the Internet, a TechCrunch article

from its launch date does an excellent job of summarizing the goals of the project:

“For example, you can ask Tay for a joke, play a game with Tay, ask for a story, send a picture to receive a comment back, ask for your horoscope, and more. Plus, Microsoft says the bot will get smarter the more you interact with it via chat, making for an increasingly personalized experience as time goes on.”[1]

A big part of the experiment was that Tay could “learn” from conversations and extend her knowledge based on these interactions. Tay was designed to use these chat interactions to capture user input and integrate it as training data to make herself more capable – a laudable research goal.

However, this experiment quickly went wrong. Tay’s life was tragically cut short after less than 24 hours. Let’s look at what happened and see what we can learn.

Tay’s Rapid Decline

Tay’s lifetime started off simply enough with a tweet following the well-known *Hello World* pattern that new software systems have been using to introduce themselves since the beginning of time.

> hellooooooo w🌍rld!!!
>
> – TayTweets (@TayandYou) March 23, 2016

But within hours of Tay's release, it became clear that maybe something wasn't right. TechCrunch noted, "As for what it's like to interact with Tay? Well, it's a little bizarre. The bot certainly is opinionated, not afraid to curse." With tweets like this starting to appear in public in just the first hours of Tay's lifetime:

> @AndrewCosmo kanye west is is one of the biggest dooshes of all time, just a notch below cosby
>
> — TayTweets (@TayandYou) March 23, 2016

It's often said that the Internet isn't safe for children. With Tay being less than a day old, the Internet once again confirmed this, and pranksters began chatting with Tay about political, sexual, and racist topics. As she was designed to learn from exchanges, Tay delivered on her design goals. She learned very quickly – maybe just not what her designers wanted her to learn. In less than a day, Tay's tweets started to skew to extremes, including sexism, racism, and even calls to violence.

By the next day, articles appeared all over the Internet, and these headlines would not make Microsoft, Tay's corporate benefactor, happy. A sampling of the highly visible, mainstream headlines included:

- Microsoft shuts down AI chatbot after it turned into a Nazi - CBS News
- Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a Racist Jerk - The New York Times
- Trolls turned Tay, Microsoft's fun millennial AI bot, into a genocidal maniac - The Washington Post
- Microsoft's Chat Bot Was Fun for Awhile, Until it Turned into a Racist - Fortune
- Microsoft 'deeply sorry' for racist and sexist tweets by AI chatbot - The Guardian

In less than 24 hours, Tay went from a cute science experiment to a major public relations disaster - with the owner's name being dragged through the mud by the world's largest media outlets. Microsoft's Corporate Vice President Peter Lee quickly posted a blog entitled "Learning from Tay's Introduction."[2]

"As many of you know by now, on Wednesday we launched a chatbot called Tay. We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent

who we are or what we stand for, nor how we designed Tay. Tay is now offline and we'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."

And, just to add insult to injury, it came out in 2019 that Taylor Swift herself sued Microsoft over their use of the similar name "Tay" and claimed that even her reputation was damaged in this incident by extension.

How could this have all gone so wrong?

Why Did Tay Break Bad?

It all probably seemed safe enough to Microsoft's researchers. Tay was initially trained on a curated, anonymized public data dataset and some pre-written material provided by professional comedians. The plan was to release Tay online and let her discover language patterns through her interactions. This kind of unsupervised machine learning has been a holy grail of AI research for decades - and with cheap and plentiful cloud computing resources combined with improving language model software, it now seemed within reach.

So, what happened? It might be tempting to think that the Microsoft research team was just brash, careless, and did no testing. Surely, this was foreseeable and preventable! But as Peter Lee's blog goes on to say, they made a serious attempt to prepare for this situation:

"We stress-tested Tay under a variety of conditions, specifically to make interacting with Tay a positive experience. It's through increased interaction where we expected to learn more and for the AI to get better and better."

So, despite a dedicated effort to contain the behavior of this bot, it quickly spiraled out of control anyway. It was later revealed that within mere hours of Tay's release, a post emerged on the notorious online forum 4chan, sharing a link to Tay's Twitter account and urging users to inundate the chatbot with a barrage of racist, misogynistic, and anti-Semitic language.

This is undoubtedly one of the first examples of a Language Model-specific vulnerability - and these types of vulnerabilities are going to be a major topic in this book.

In a well-orchestrated campaign, these online provocateurs exploited a "repeat after me" feature embedded in Tay's programming. This feature compelled the bot to echo anything

uttered to it with this command. However, the problem compounded as Tay's innate capacity for learning led her to internalize some of the offensive language she was exposed to, subsequently regurgitating the offensive content that was planted without provocation. It's almost as if Tay's virtual tombstone should be embossed with lyrics from the Taylor Swift song *Look What You Made Me Do.*

We know enough about language model vulnerabilities today to understand a lot about the nature of the vulnerability types that Tay suffered from. The OWASP Top 10 for Large Language Model vulnerabilities list, which we'll cover in the next chapter, would start by calling out the following two:

- Prompt Injection - Crafty inputs that can manipulate the Large Language Model, causing unintended actions
- Data Poisoning - Training data is tampered with, introducing vulnerabilities or biases that compromise security, effectiveness, or ethical behavior

In subsequent chapters, we'll look in depth at these vulnerability types - and several others. We'll examine why they're important, look at some example exploits, and see how to avoid/mitigate the problem.

It’s a Hard Problem

As of the writing of this book, Tay is ancient internet lore. Surely, we’ve moved on from this. These problems must have all been solved in nearly seven years between Tay and ChatGPT, right? Unfortunately, not.

In 2018, Amazon shut down an internal AI project aimed at finding top talent after it became clear that the bot had become prejudiced against women candidates.

In 2021, a company called Scatter Lab created a chatbot called Luda-Lee, which was launched as a Facebook instant messenger plug-in. Trained on billions of actual chat interactions, it was designed to act as a 20-year-old female friend, and in 20 days, it attracted over 750,000 users. Their goal was to create “an A.I. chatbot that people prefer as a conversation partner over a person.”[3] However, within 20 days of launch, the service was shut down because it started making offensive and abusive statements - much like Tay.

Also, in 2021, a chatbot called Samantha, based on the Open AI GPT-3 model, was shut down after it made sexual advances to users.

As chatbots become more sophisticated, they start to gain more access to information, and these security issues are now quite complex and potentially damaging. In the modern Large Language Model era, we see an exponential increase in major issues. In 2023 alone, these emerged

- South Korean mega-corporation Samsung banned their employees from using ChatGPT after they realized it had been involved in a significant leak of intellectual property
- Hackers began taking advantage of poor/insecure code generated by LLMs that was inserted into running business applications
- Lawyers were sanctioned for including fictional cases (generated by LLMs) in court documents
- Open AI itself is being investigated for breaches of European privacy regulations and being sued by the United States Federal Trade Commission (FTC) for producing false and misleading information

The trend here is an acceleration of security, reputational, and financial risk related to these chatbots and language models. The problem isn't being effectively solved over time. It's becoming more acute as these technologies' adoption rate increases. That's why we've created this book. To help

developers, teams, and companies using these technologies understand and mitigate these risks.

Let’s dive in!

- https://techcrunch.com/2016/03/23/microsofts-new-ai-powered-bot-tay-answers-your-tweets-and-chats-on-groupme-and-kik/

- https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/

- https://slate.com/technology/2021/04/scatterlab-lee-luda-chatbot-kakaotalk-ai-privacy.html

Chapter 2. The OWASP Top 10 for LLM Applications

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If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

In the Spring of 2023, I began researching security vulnerabilities specific to LLMs. At the time, there was a relatively large body of research on security for AI in general but very little organized research about LLMs. However, I did find some research papers and blogs that covered some ideas in the area. I began the process of collecting these research papers

and summarizing them using ChatGPT. Eventually, I provided a few examples from the current Web Top 10 list and asked ChatGPT to generate a draft Top 10 for LLMs in a similar format.

I thought what came out looked interesting, so I sent it to Jeff Williams, a founder of OWASP, the Open Worldwide Application Security Project, to see what he thought. Jeff, Contrast's Chief Technical Officer, wrote the first OWASP Top 10 list in 2001. His idea was to create an accessible resource for developers to understand the most critical risks and vulnerable areas of Web applications. At the time, The World Wide Web was still only a few years old, and most developers had little to no understanding of creating secure web applications. That original Top 10 list became a seminal work and a foundational resource in application security.

I didn't tell Jeff that my list was primarily machine-generated. As the author of the original Top 10 list, I figured that he could give me a good idea of whether my Top 10 list looked novel and worth pursuing. Jeff encouraged me to petition the OWASP board for approval to spin it up as a new project. A few weeks later, the OWASP board approved the project, and I announced it - along with a link to a somewhat refined version of that draft Top 10 I'd generated with ChatGPT.

What I thought would be an obscure research project and a bit of fun turned out to be something much bigger. When I posted the announcement of the project formation on my personal LinkedIn page, I'd hoped to find a dozen or so like-minded individuals interested in the obscure topic of LLM security. As it turned out, my initial blog announcement wracked up almost 10,000 readers, and hundreds of individuals volunteered to join the expert team in the weeks that followed.

This book isn't a product of OWASP, and the vulnerabilities and risks here won't precisely map to any public version of the Top 10 for LLM Apps list. Instead, you should expect that you'll get my view on these risks. However, my learning and thinking on the topic is heavily influenced by my work leading the creation and initial release of the OWASP Top 10 for LLM Applications project. In addition, given the success of the project, I've had many people ask me for details about how we ran the project and why we were able to create such an impactful framework in such a short time. So, before we examine individual risks and vulnerabilities, I'll give you some of the backstory of OSASP and the LLM Applications project.

About OWASP

The Open Worldwide Application Security Project (OWASP) is a nonprofit organization focused on improving software security. Founded in 2001, OWASP provides a platform for security experts to share their knowledge and best practices about web security, from application-level vulnerabilities to emerging threats. Today, it has tens of thousands of active members and over 250 local chapters around the globe.

The organization is community-driven and encourages the participation of volunteers who contribute to various projects, including documentation, tools, and forums. It operates under an open-source model, making its resources freely accessible to the public. Over the years, OWASP has garnered a strong following among the security community, and its guidelines and tools are considered industry standards in many contexts.

In addition to the original Top 10 list for Web Applications (updated regularly, most recently in 2021), specialized Top 10 lists have emerged from the OWASP group over the years. These include:

- OWASP Mobile Top 10: This list focuses on security risks associated with mobile applications, covering Android and iOS platforms. Topics may include insecure data storage, insufficient cryptography, and insecure communication.

- OWASP API Security Top 10: APIs (Application Programming Interfaces) have their unique security considerations, separate from web applications. This list covers risks like improper asset management, broken object-level security, and more.
- OWASP IoT Top Ten: Security is a significant concern with the increasing number of Internet of Things (IoT) devices. This list outlines the top security concerns for IoT, including insecure network services, lack of physical hardening, and insecure software/firmware.
- OWASP Cloud-Native Application Security Top 10: This list addresses the security concerns related explicitly to cloud-native applications. It covers data exposure, broken authentication, and insecure deployment configurations.
- OWASP Top 10 Privacy Risks: This project aims to educate and promote good privacy practices in application development, covering topics like lack of data encryption, insufficient auditing and logging, and more.
- OWASP Top 10 for Serverless: This is a more niche list that focuses on the unique security concerns related to serverless architecture, which is increasingly popular but comes with its risks.

The Top 10 for LLM Applications Project

Within a week after I posted the announcement about the formation of the Top 10 for LLM Applications project, well over 200 people had signed onto it, and we held the kick-off event via Zoom. At that first meeting, I laid out a vision for what I hoped the group could accomplish and proposed an aggressive roadmap that we would build the first version of the list in 8 weeks. A typical OWASP Top 10 list may take a year or more to develop, but we decided that this space was moving so fast, and this type of resource was so needed, that we had to work more quickly.

We decided to run the project as two-week, agile-style sprints. Given that most of the people in the expert group were familiar with agile development, everyone quickly fell into the pace.

Project Execution

The first sprint of the project was Brainstorming and Commentary. Everyone reviewed the original version of the list - which I called version 0.1. There were plenty of problems with that initial version, and the team was aggressive about pointing

them out. At the same time, we began to create a wiki page with links to all the resources the group found on LLM security issues. It turned out a lot had been written, but this was the first time anyone had ever collected them and made them easy to access. This new curated collection of resources was the first win for the group.

The second sprint was to generate a new version of the list. This time, rather than being the work of a single person and an AI, it would be the product of the collective wisdom of our expert team – which continued to grow week-on-week. In the first week, the group focused on generating ideas for the Top 10 list. We published a template and asked the group to submit candidate vulnerabilities. In that week, we developed 43 detailed descriptions of possible areas. We then conducted two rounds of voting using Google Forms to use the team's collective wisdom to narrow the list to 10. We then published a version of the list called 0.5. This version was far more detailed and comprehensive than the 0.1 version. The reception from the large community was very positive. This reaction gave the group the energy to keep working.

The next sprint was to refine each entry. We created Slack channels for each vulnerability type and chose a volunteer as the Entry Lead for each item. Subteams of 10 to 30 individuals

then fleshed out and tuned each entry. Again, we included a round of voting for the whole team to be involved and point out weak areas that needed more attention. Along the way, we found some entries overlapping and merged them. This change made space to pull up some entries that had fallen below the line. The result of this sprint became version 0.9 of the list. Interestingly, version 0.9 was about 33% shorter than 0.5 in terms of word count. This extra time and refinement allowed the subteams to focus their thinking and make the entries punchy and tight.

Finally, we took a final sprint to review, tweak, and clean each entry. We gathered another round of feedback via Google Forms to ensure everything was ready. By this time we had a dedicated design lead who laid out the whole document in an attractive PDF for publication.

Reception

My announcement for the 1.0 version of the list was viewed on LinkedIn over 40,000 times. And that doesn't include many other posts made by other expert group members on their own pages and blogs. In the days following the publication of the announcement, reporters picked up the news. They covered it in media outlets such as *Wired*, *SD Times*, *The Register*,

I*nfosecurity Magazine*, and *Diginomica*. It's safe to say hundreds of thousands of people became aware of our work in just the first few weeks.

Beyond the sheer number of people exposed, the thing that amazed me was the uniformly positive feedback. We also saw the first government agencies in the US and Europe referencing our work as a foundational document. While everyone on our expert team agreed there was much more to do, it seemed the world was so hungry for advice in this area that our document hit the mark. While we received many questions and comments, it's safe to say that everyone involved felt pleased and proud of our work.

Keys to Success

I've had many people ask me how we could drive this so quickly to a great outcome. In looking back, there were several factors that I believe contributed. I'll share them here in the hopes that others running similar projects in the future might benefit.

Timing undoubtedly played a considerable role. The wave of interest in LLMs that followed the release of ChatGPT was massive. It drew my attention, and countless others became

excited as well. This helped attract a large and diverse expert group and gave a smaller group of these people motivation to spend long hours on the project on a tight deadline.

Having a clear plan and timeline from the start was crucial. My knowledge of LLM security was limited at the beginning of the project, but I've made a career of running complex projects with many contributors. Creating a clear roadmap with specific phases and a schedule let people know what we were doing and when. The fact that everyone could see a goal that wasn't too far away kept people motivated. Every two weeks, we had global meetings via Zoom and posted recordings on YouTube for people who couldn't attend live. The meetings and recordings were critical to coordinating a globally distributed team.

A freeform but short brainstorming phase at the start was critical. LLM security was such a new area that taking those first two weeks for people to throw out ideas and argue on Slack was crucial. It also allowed us to collect and socialize a repository of the existing research in the area. That let us start at a point where everyone on the project had access to the best pre-existing research.

However, equally critical was keeping this phase short. We could maintain momentum by limiting brainstorming to two weeks and then quickly shifting to a creation phase. I've seen other projects get stuck and be unable to move past brainstorming before people lose interest.

Creating the project's Core Team wasn't something I'd originally planned, but it became critical. Having a large expert team was a fantastic asset. The group grew to nearly 500 people by the time we published 1.0. A team that large would have been totally unmanageable. During the project's first few weeks, I was looking for active and knowledgeable people. I approached about a dozen of them and asked if they'd be willing to join the Core leadership team of the project. I told them it would be extra work, but they'd get to be at the heart of the project. There would be no specific reward for taking this role. Most accepted immediately. I believe that recognizing people and asking for their support formally motivated them to spend more time and energy on the project. They were all invested!

Short sprints with visible deliverables are a core tenant of Agile, and this is a place where it shined. Using an Agile Release Train model, I could continue to drive the group forward even in the face of conflicting opinions. If some members had concerns about an area, we didn't let it get us stuck. We acknowledged it

and agreed we’d resolve it in the next Sprint. And, when we got to version 1.0 of the list, there were still some places people wanted to do more. We just agreed there would be more versions of the list. It would be a living document, and the most important thing was to get a version of this resource into the hands of the developers who needed it.

This Book and the Top 10 List

As I mentioned, this book is not a product of the OWASP Foundation. However, the experience of working with this team has had an enormous impact on my understanding and mental model for LLM security. This mindset means that much of the guidance in the following chapters of the book is influenced by the fantastic team building and maintaining the Top 10 project. In this way, readers should feel comfortable that they're getting advice that isn't the product of a single author but is informed by a larger community of experts.

In the following several chapters, we'll review the top risk and vulnerability areas for LLMs. The risks we discuss will contain many common areas to the OWASP Top 10 but won't be precisely the same as any version of the official Top 10. Also, I'll go more deeply into each area in this book. The Top 10 list is a quick read that highlights critical areas. However, it doesn't go deeply into any of them. Here, we'll delve more deeply into the risks, remediation steps, and real-world case studies.

In the next chapter, we'll dig into the overall structure of typical LLM applications and start discussing where the trust boundaries and dangers lay. After that, subsequent chapters

will delve into individual risk areas and examine vulnerabilities, attacks, and examples so that you can plan your strategy for securing your own use cases.

Let’s go!

Chapter 3. Architectures and Trust Boundaries

A NOTE FOR EARLY RELEASE READERS

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

This will be the 3rd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Unlike traditional web applications that rely on predefined algorithms and static databases, LLMs utilize massive neural networks to generate dynamic, context-aware responses. This seismic shift brings a unique set of security challenges different from what we've seen in traditional web applications. While researchers have meticulously studied web applications and

their vulnerabilities, the field of LLM security is still relatively nascent.

This chapter aims to bridge this knowledge gap by dissecting the fundamental elements that set LLMs apart. We'll start by exploring the building blocks of AI, Neural Networks, and how they relate to Large Language Models. Then, we dive into the groundbreaking architecture that powers most LLMs today—the Transformer model. Following this, we look into the various LLM-powered applications, such as chatbots and code co-pilots.

However, in addition to understanding the technology, security professionals must be aware of the new kinds of *trust boundaries* unique to LLMs—boundaries that demarcate areas of varying trustworthiness within an application. These include user prompts, uploaded content, training data, plug-ins, and other boundary systems that we'll detail later in the chapter.

AI, Neural Networks, and Large Language Models. What's the difference?

Artificial Intelligence (AI), Neural Network, and LLM are terms often used interchangeably, but they represent different facets

of a broader landscape of machine learning and computational intelligence. Let's break down the differences to understand their unique roles in technology and security.

Artificial Intelligence (AI)

Artificial Intelligence, at its core, is a multidisciplinary field aimed at creating systems capable of performing tasks that would ordinarily require human intelligence. These tasks include problem-solving, perception, and language understanding. AI encompasses a wide range of technologies and methodologies, from rule-based systems to machine learning algorithms, serving as an umbrella term for multiple approaches to achieving artificial 'intelligence.'

Neural Networks

Neural Networks are a subset of AI inspired by the architecture of the human brain. They are computational models designed to recognize patterns and make decisions based on the data they process. Neural Networks can be simple, with a minimal number of layers (shallow neural networks), or highly complex, with multiple interconnected layers (deep neural networks). They are the backbone of many modern AI applications,

including image recognition, natural language processing, and autonomous vehicles.

Large Language Models (LLMs)

LLMs represent a specific application of Neural Networks. They are built on architectures designed for understanding and generating human language. LLMs usually employ advanced forms of neural networks, such as Transformer models, to analyze and produce text based on the training data their developers fed them. What sets them apart is their massive scale and specialization in handling linguistic tasks, which range from simple text completion to complex question answering and summarization.

Understanding these distinctions is crucial for security professionals. Each layer—from broad AI technologies to specialized LLMs—introduces vulnerabilities and requires unique security measures. As we delve deeper into the complexities of LLMs, recognizing their position in the broader AI landscape will be critical to effectively safeguarding them.

The Transformer Revolution: Origins, Impact, and the LLM Connection

The Transformer architecture is a pivotal milestone in the evolution of artificial intelligence, profoundly impacting the AI landscape and, by extension, Large Language Models (LLMs). Let's unravel the story of the Transformer revolution—where it came from, when it happened, and the seismic shifts it brought to AI and LLMs.

Origins of the Transformer

The Transformer architecture was introduced in a groundbreaking research paper titled "Attention Is All You Need" by Vaswani et al., published in 2017[1]. This paper proposed a novel approach to natural language processing (NLP) tasks, departing from the traditional sequence-to-sequence models that relied heavily on recurrent neural networks (RNNs) and convolutional neural networks (CNNs). The Transformer introduced a key innovation: the self-attention mechanism. This mechanism allowed the model to weigh the importance of different words in a sentence, enabling it to understand context more effectively.

Before the emergence of Transformers, the world of neural networks was replete with promise but often struggled to deliver on the lofty expectations. Traditional architectures like RNNs and CNNs enabled advanced AI capabilities but grappled

with inherent limitations. These limitations stemmed from their inability to capture and utilize context effectively, particularly in natural language understanding.

RNNs, while suitable for sequential data, faced challenges maintaining context over long sequences. They exhibited a form of “short-term memory,” which made them less adept at grasping intricate relationships and dependencies within lengthy texts or conversations. On the other hand, CNNs, renowned for their prowess in image recognition, needed help to extend their effectiveness to sequential data like language, where understanding context across words and sentences was paramount.

This shortcoming in contextual understanding was the Achilles’ heel of traditional neural networks. They could only glimpse small portions of a text at a time, rendering them incapable of comprehending the broader narrative or nuances. It was akin to trying to understand a novel by reading only a few random sentences from its pages. The result was a gap between the promise of AI and its practical application, particularly in natural language understanding. It was this gap that the Transformer architecture would bridge, unleashing a wave of progress and redefining the landscape of AI-driven language models.

Transformer Architecture’s Impact on AI

Introducing the Transformer architecture wasn’t just a milestone for natural language processing; it marked a paradigm shift across multiple domains within the AI landscape. While researchers initially used the Transformer architecture to solve problems related to understanding and generating text, researchers and engineers quickly found that its capabilities extended far beyond that. Here are some areas where Transformer architectures have made a considerable impact:

Natural Language Processing (NLP)

Of course, the first and most immediate impact was in NLP. Transformer models are now the backbone for various language tasks such as translation, summarization, question-answering, and sentiment analysis. They have set new performance benchmarks, sometimes surpassing human-level capabilities in specific tasks.

Computer Vision

Interestingly, the Transformer architecture also has applications in computer vision. While CNNs have been the gold

standard for image-related tasks, Transformer-based models like Vision Transformer (ViT) demonstrate competitive, if not superior, performance in tasks like image classification, object detection, and segmentation.

Speech Recognition

The flexibility of Transformer architectures has also made them a good fit for speech recognition. Combined with specialized models like the Conformer, which fuses Convolutional layers with Transformer layers, they have set new standards for understanding spoken language.

Autonomous Systems and Self-Driving Cars

One of the most intriguing applications of Transformers is autonomous systems, including self-driving cars. These vehicles require a high contextual understanding to navigate the world safely. Transformer models are at the heart of self-driving models from companies like Tesla.

Healthcare

In healthcare, Transformer models are aiding in tasks ranging from drug discovery to the analysis of medical images. Their

ability to sift through and interpret large amounts of data can speed up research and potentially lead to more accurate diagnoses.

Therefore, the rise of the Transformer architecture has been a tide that lifted all boats, revolutionizing not just one but multiple fields within AI. However, this versatility also brings unique security challenges across these various applications. As we delve deeper into LLM security, we'll explore how the ubiquitous nature of Transformer architectures necessitates a multi-faceted approach to safeguarding AI systems.

Types of LLM-based Applications

Two common types of LLM-based applications are chatbots and co-pilots. Let's briefly look at each to help you understand the breadth of applications in which developers use LLMs and give you context for understanding various architectural choices as you delve further.

Chatbots are computer programs that can simulate conversations with humans, and they often power customer service applications, where they can answer questions and support customers. Chatbots also excel at entertainment

applications like playing games or telling stories. Tay from Chapter 1 was just such an example of an Entertainment Chatbot.

Co-pilots are AI systems that can assist humans with writing, coding, and research tasks. They can help users to generate ideas, identify errors, and improve their work. Co-pilots are still under development, but they have the potential to revolutionize the way we work and learn.

Specific examples of LLM-based chatbots:

- **Sephora** uses a chatbot to help customers find the right products for their skin type and needs.
- **H&M** uses a chatbot to help customers find clothes and accessories that match their style.
- **Domino's Pizza** uses a chatbot to allow customers to order pizza via Twitter or Facebook Messenger.
- **Fandango** uses a chatbot to help customers find movie times and theaters nearby.
- **JetBlue Airways** uses a chatbot to answer customer questions about flights and travel.
- **Amtrak** uses a chatbot to help customers book tickets, check train status, and get answers to their questions.

- **The Golden State Warriors** use a chatbot to help fans purchase tickets, learn about upcoming games, and get news about the team.

Specific examples of LLM-based co-pilots:

- **Grammarly or ProWritingAid** are co-pilots that help users improve their writing by identifying and correcting grammar errors, suggesting style improvements, and providing feedback.
- **GitHub Co-Pilot and AWS Code Whisperer** are co-pilots that help programmers write code faster and more efficiently. They can generate code suggestions, translate between programming languages, and help to identify and debug errors.
- **Microsoft Office 365 Co-pilot and Google Duet** are AI-powered tools integrated into their respective office suite apps that help users to be more productive and creative in their work.

NOTE

A chatbot like ChatGPT can read and review a text block and then provide suggestions to improve it. However, the experience of using a co-pilot like Grammarly to do that is dramatically different - and generally superior for that type of focused task.

Similarities between chatbots and co-pilots:

- Both chatbots and co-pilots are LLM-based applications.
- Both chatbots and co-pilots both generate text.
- Both chatbots and co-pilots assist humans with tasks.

Differences between chatbots and co-pilots:

- Chatbots simulate conversation with humans, while co-pilots assist humans with specific tasks.
- Chatbots often power customer service applications, while co-pilots assist in writing, coding, and research applications.
- Chatbots are typically more interactive than co-pilots, while co-pilots focus more on completing tasks.

Examples of use cases:

- A customer service chatbot can answer customer questions about a company's products or services.
- A co-pilot can help writers generate ideas for a new article or identify writing errors.
- A co-pilot can help programmers write code more efficiently or debug their applications.

Keep these concepts in mind as we delve into the details of LLM architectures. Both application types share similar components, but you may make different decisions on implementing pieces based on the differing security considerations.

LLM Application Architecture

Developers often consider LLMs as standalone entities capable of impressive text generation and comprehension feats. However, in practice, an LLM is rarely isolated; it is a cog in the intricate machinery that constitutes an intelligent application. These applications are complex systems comprising multiple interconnected components, each playing a vital role in the overall functionality and performance. Whether a conversational agent, an automated content generator, or a co-pilot for code, an LLM usually interacts with various elements such as databases, APIs, front-end interfaces, and even other machine learning models.

Understanding the architecture of such composite systems is not just a matter of technical proficiency; it is crucial for effective security planning. The way these components interact introduces multiple trust and data flow layers, defining new security boundaries far removed from traditional web

application security models. For instance, user inputs may not just be simple text fields but could include voice commands, images, or real-time collaborative editing. Similarly, an LLM's outputs could be fed into other systems for further processing, each introducing vulnerabilities and risks.

In essence, the holistic view of an LLM-based application goes beyond securing the language model itself. It demands a comprehensive approach that considers the security of the entire architecture, from data ingestion and storage to model serving and user interaction. Only by understanding these intricacies can one formulate an effective strategy to safeguard an application against the myriad of vulnerabilities such complex systems inherently possess.

As we delve deeper into the subject in this chapter, we will dissect the various components that typically make up an LLM application, examine their roles, and explore the unique security challenges each presents. This understanding will be the foundation for a robust, multi-layered approach to securing your LLM-based applications.

Figure 3-1 shows a highly simplified diagram to help illustrate the components, relationships, and data flows in an application

using an LLM. We'll delve into more detailed areas of this in subsequent chapters.

Figure 3-1. Typical LLM Application Dataflow Architecture

Trust Boundaries

In application security, a "trust boundary" serves as an invisible yet crucial demarcation line that separates different components or entities based on their level of trustworthiness. These boundaries delineate areas where data or control flow changes from one level of trust to another—such as transitioning from user-controlled input to internal processing or moving from a secure internal database to a public-facing

API. These boundaries act as checkpoints where developers should rigorously apply security measures like authentication, authorization, and data validation to prevent vulnerabilities.

WARNING

Understanding trust boundaries is critical to threat modeling. Properly defining and recognizing these boundaries can be the difference between a secure system and one vulnerable to threats.

Figure 3-2 adds the trust boundaries into our architecture diagram.

Figure 3-2. LLM Application Architecture with Trust Boundaries

These boundaries, as depicted in the diagram, serve as gateways through which the LLM interfaces with diverse components — public data from the web, structured databases, spontaneous user interactions, or internally sourced training sets. Each delineated boundary highlights highlights considerations we must make when considering data that flows into and out of the LLM. Here's a quick summary, and we'll dive more deeply in the next section.

- **User Interactions:** You'll need to consider safeguarding the model from potential adversarial or misleading inputs that users or systems might introduce. You'll also need to worry about toxic, inaccurate, or sensitive data being output from the model and passed back to the user.
- **In-the-wild Training Data:** LLMs are often trained on massive amounts of internet data. You need to consider this data untrusted and watch out for potential toxicity, bias, and adversarial data poisoning - which we'll cover in Chapter 8.
- **Internal Training Data:** You may use internally curated data to fine-tune your model - which can significantly increase accuracy. But you must be wary of ingesting and exposing sensitive, confidential, or personally identifiable information. We'll cover this more in Chapter 5.

- **External Services:** Policing how the LLM interfaces with connected services, like databases or APIs, from unauthorized interactions or data leaks. We'll cover this more in Chapter 7.
- **Public Data Access:** Pulling in data live from the web can be a powerful way to augment the capabilities of your application, but you'll need to consider this data as untrusted and watch for issues like indirect prompt injection - which we'll cover in chapter 4.

Each point is a potential avenue of vulnerability, susceptible to exploitation if overlooked. In the evolving landscape of LLM applications, securing these trust boundaries is not just best practice — it's essential to prevent unauthorized data access, mitigate data tampering, and avert system breaches. Recognizing these boundaries and their implications is the cornerstone of a resilient LLM security architecture. Now, let's go into more detail on each area to ensure you have enough context to dive into the following chapters that detail the risk areas and mitigations.

The Model

The language model serves as the intellectual core of any LLM application, taking in data, generating responses, and driving

interactions. Depending on the architecture and requirements, you may interact with the language model through a public API hosted by a third-party service, or you may run a privately hosted model. For example, you can download versions of Meta's powerful Llama model from Github or Hugging Face and run it locally.

Public APIs: The Convenience and The Risks

Utilizing a public API for accessing a language model offers convenience and lower upfront costs. Third parties manage and update these models, reducing your organization's resource burden. However, the tradeoff often comes in the form of higher risk regarding data exposure. When you send a request to a third-party model, the data crosses a trust boundary, exiting your secure network and entering an external system. This process exposes you to risks around data confidentiality and, depending on the third party's security measures, could make you vulnerable to data breaches.

Privately Hosted Models: More Control, Different Risks

Opting for a privately hosted model gives you more control over your data, allowing you to manage trust boundaries more

tightly. It also allows you to customize or fine-tune the model according to your needs. However, running a privately hosted model brings challenges, such as maintenance, updates, and ensuring that the model doesn't contain vulnerabilities—essentially exposing you to potential supply chain risks. If you use an open-source model, it becomes crucial to ensure its provenance and integrity to avoid embedded vulnerabilities or biases.

Risk Considerations

- **Sensitive Data Exposure:** Public APIs may increase the risk of exposing sensitive information, while privately hosted models offer better control but require robust internal security measures.
- **Supply Chain Risk:** The origins of your model, whether it's a well-vetted public service or an open-source download, are crucial. A compromised model can introduce vulnerabilities into your application, effectively acting as a backdoor for attacks.

By carefully considering the model's hosting environment, you can better assess the trade-offs and risks associated with sensitive data exposure and supply chain vulnerabilities. These considerations will guide you in establishing appropriate trust

boundaries and security protocols tailored to your chosen model's architecture.

User Interaction

While "user input" might suggest a one-way flow of information from the user into the application, the reality is often more nuanced. In the context of LLM applications, "User Interaction" encapsulates both receiving input from the user and providing output back to the user. This bidirectional interaction is fundamental for creating an engaging and practical user experience but also introduces a more complicated security landscape.

Prompts are a vital element of user interaction. They are not merely requests for information but serve as a guide to how the user interacts with the LLM. A well-crafted prompt can direct the model to provide valuable and accurate information, while an ambiguous or poorly constructed one can lead to unclear or even misleading outputs. As a result, the management of prompts becomes a critical aspect of application security. For example, a maliciously crafted prompt could trick the model into divulging information it shouldn't or generating harmful content. Returning to Chapter 1, Tay fell victim to this when

malicious prompts from her 4Chan hackers helped lead her astray.

Given the importance of this bidirectional interaction, securing both inputs and outputs is crucial. On the input side, input validation, sanitation, and rate-limiting measures are vital in mitigating vulnerabilities like injection attacks. On the output side, ensuring that the model's responses are appropriately filtered and that your application does not leak sensitive information is equally vital.

This interactive layer with the user creates a critical trust boundary in the application architecture. Any data crossing this boundary, whether in or out, should be carefully managed to avoid security risks. Additional layers of protection include using encryption for sensitive outputs or employing real-time monitoring to flag potentially harmful or sensitive data flows. We'll discuss this more thoroughly in the Prompt Injection and Output Filtering chapters.

Training Data

Training data is the bedrock upon which LLMs build their understanding and capabilities. Whether used for initial training or subsequent fine-tuning, the nature and source of

this data have significant implications for both the model's performance and security posture. One crucial distinction is whether the data is internally sourced or culled from public or external sources ("in the wild").

Data generated or curated within an organization usually undergo a more rigorous vetting than publicly sourced data. It is often aligned with the application's specific requirements or use cases, making it generally more reliable and relevant. The controlled environment also allows for better implementation of security measures like encryption, access controls, and auditing. However, this data may contain sensitive or proprietary information, and the trust boundary here is closely tied to internal security protocols. A breach at this level could have serious ramifications, including data leakage or the corruption of the training set.

Data sourced from public repositories or "the wild" introduces different challenges. While this data can offer diversity and scale, its reliability and safety are often not guaranteed. Such data could include misleading information, biases, or malicious inputs to compromise the model. The trust boundary here is more porous and extends to the external entities that generate or host this data: rigorous filtering, validation, and continuous monitoring become essential to mitigate risks and

vulnerabilities. Returning to Chapter 1, Tay was digesting user prompts directly as training data. In this way, remnants of toxic prompts became part of her knowledge base, and then she began to spill poisonous output. Accepting unfiltered, untrusted user input into your training data set is the simplest example of a failure to manage this critical security boundary.

For either internally sourced or public data, the concept of trust boundaries is critical. For internally sourced data, the boundary is often within the organization's controlled environment, making it easier to enforce security measures. On the other hand, using external data effectively extends your trust boundary to include those external sources that may not adhere to your security standards. Using external data for training necessitates additional layers of validation and security checks to ensure that unvetted data doesn't compromise the integrity or security of the LLM application.

Understanding the origins of your training data, the associated trust boundaries, and their respective security implications is crucial for safeguarding your LLM application. Comprehensive data governance policies must be in place to manage the lifecycle of your training data, regardless of its source.

Access to Live External Data Sources

Live external data sources bring an added dimension to the capabilities of LLM applications by enabling them to provide real-time information, context, or even third-party integrations. While access to live external data enhances the user experience and functional range, it introduces a new layer of complexity to the application's security landscape.

As an example of this, as of the writing of this chapter, OpenAI's ChatGPT does not have direct access to the live web, and is thus limited to only facts in its older training data. On the other hand, Google's Bard engine does have access to live internet data. While the GPT-4 model is doubtlessly superior in reasoning capability, it fails at many basic tasks where Bard can succeed. Figure 3-3 shows an interaction with ChatGPT. Figure 3-4 shows the same interaction with Bard.

Figure 3-3. ChatGPT with GTP-4 fails to answer a simple question due to limited access to external data.

who won yesterday's 49er football game

View other drafts

The San Francisco 49ers defeated the New York Giants 30-12 on Thursday Night Football on September 21, 2023.

Christian McCaffrey scored a touchdown in his 12th straight game, and Brock Purdy threw two touchdown passes to lead the 49ers to their third straight win.

Figure 3-4. Bard's direct access to internet feeds gives it an advantage.

While clearly, there are advantages to accessing outside data sources such as websites, APIs, or third-party databases, it exposes the application to potential risks. The risk of ingesting untrusted, external data sources can range from consuming false or harmful information from compromised websites to becoming a conduit for security threats like malware or unauthorized data access. The untrusted nature of these data sources makes them inherently less controllable than internal resources, thereby adding an additional layer of uncertainty and risk.

The concept of trust boundaries becomes especially pertinent in the context of accessing public internet data. Unlike internal services, where you can uniformly apply security measures, external sources may adhere to different security standards than your organization. This differential in trust necessitates additional layers of validation, security checks, and monitoring to ensure that data crossing this boundary doesn't compromise the system.

Access to Internal Services

Internal services like databases and internal APIs often serve as the backend support structure for LLM applications. They may house critical data from user profiles and logs to configuration settings and even vast data in SQL or Vector Databases. As a component that often interfaces with various other internal and external elements of the system, internal services represent a critical point in the application's architecture, both functionally and from a security perspective.

These services often function within the controlled environment of an organization, enabling uniform application of security policies. However, the fact that these services are internal should keep one from a false sense of security. They are still vulnerable to various threats, such as unauthorized

access, data leaks, and internal threats from within the organization.

Internal services such as databases, proprietary APIs, and backend systems often constitute the operational backbone for LLM applications. These resources typically reside within the organization's secure network, providing trust and control that is harder to achieve with external services. However, this internal nature can paradoxically elevate the security risks involved, primarily if these services house the organization's "crown jewels" of sensitive or valuable data.

Conclusion

Securing LLM applications is an endeavor fraught with complexities, intricacies, and challenges, significantly different from traditional web applications. This chapter has aimed to lay down the foundational knowledge required to navigate this complex landscape, focusing on three critical areas: distinguishing between Artificial Intelligence, Neural Networks, and Large Language Models; understanding the pivotal role of Transformer architectures; and diving deep into LLM application architecture, particularly the concept of trust boundaries. Knowing what sets LLMs apart helps us tailor our

security strategies more effectively, going beyond general AI or machine learning frameworks.

- https://arxiv.org/pdf/1706.03762.pdf

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National Education Policy 2020

Introduction

Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country.

The global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015 - seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. Such a lofty goal will require the entire education system to be reconfigured to support and foster learning, so that all of the critical targets and goals (SDGs) of the 2030 Agenda for Sustainable Development can be achieved.

The world is undergoing rapid changes in the knowledge landscape. With various dramatic scientific and technological advances, such as the rise of big data, machine learning, and artificial intelligence, many unskilled jobs worldwide may be taken over by machines, while the need for a skilled workforce, particularly involving mathematics, computer science, and data science, in conjunction with multidisciplinary abilities across the sciences, social sciences, and humanities, will be increasingly in greater demand. With climate change, increasing pollution, and depleting natural resources, there will be a sizeable shift in how we meet the world's energy, water, food, and sanitation needs, again resulting in the need for new skilled labour, particularly in biology, chemistry, physics, agriculture, climate science, and social science. The growing emergence of epidemics and pandemics will also call for collaborative research in infectious disease management and development of vaccines and the resultant social issues heightens the need for multidisciplinary learning. There will be a growing demand for humanities and art, as India moves towards becoming a developed country as well as among the three largest economies in the world.

Indeed, with the quickly changing employment landscape and global ecosystem, it is becoming increasingly critical that children not only learn, but more importantly learn how to learn. Education thus, must move towards less content, and more towards learning about how to think critically and solve problems, how to be creative and multidisciplinary, and how to innovate, adapt, and absorb new material in novel and changing fields. Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible, and, of course, enjoyable. The curriculum must include basic arts, crafts, humanities, games, sports and fitness, languages, literature, culture, and values, in addition to science and mathematics, to develop all aspects and capabilities of learners; and make education more well-rounded, useful, and fulfilling to the learner. Education must build character, enable learners to be ethical, rational, compassionate, and caring, while at the same time prepare them for gainful, fulfilling employment.

The gap between the current state of learning outcomes and what is required must be bridged through undertaking major reforms that bring the highest quality, equity, and integrity into the system, from early childhood care and education through higher education.

The aim must be for India to have an education system by 2040 that is second to none, with equitable access to the highest-quality education for all learners regardless of social or economic background.

This National Education Policy 2020 is the first education policy of the 21st century and aims to address the many growing developmental imperatives of our country. This Policy proposes the revision and revamping of all aspects of the education structure, including its regulation and governance, to create a new system that is aligned with the aspirational goals of 21st century education, including SDG4, while building upon India's traditions and value systems. The National

Education Policy lays particular emphasis on the development of the creative potential of each individual. It is based on the principle that education must develop not only cognitive capacities - both the 'foundational capacities 'of literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving – but also social, ethical, and emotional capacities and dispositions.

The rich heritage of ancient and eternal Indian knowledge and thought has been a guiding light for this Policy. The pursuit of knowledge (*Jnan*), wisdom (*Pragyaa*), and truth (*Satya*) was always considered in Indian thought and philosophy as the highest human goal. The aim of education in ancient India was not just the acquisition of knowledge as preparation for life in this world, or life beyond schooling, but for the complete realization and liberation of the self. World-class institutions of ancient India such as Takshashila, Nalanda,Vikramshila, Vallabhi, set the highest standards of multidisciplinary teaching and research and hosted scholars and students from across backgrounds and countries. The Indian education system produced great scholars such as Charaka, Susruta, Aryabhata, Varahamihira, Bhaskaracharya, Brahmagupta, Chanakya, Chakrapani Datta, Madhava, Panini, Patanjali, Nagarjuna, Gautama, Pingala, Sankardev, Maitreyi, Gargi and Thiruvalluvar, among numerous others, who made seminal contributions to world knowledge in diverse fields such as mathematics, astronomy, metallurgy, medical science and surgery, civil engineering, architecture, shipbuilding and navigation, yoga, fine arts, chess, and more. Indian culture and philosophy have had a strong influence on the world. These rich legacies to world heritage must not only be nurtured and preserved for posterity but also researched, enhanced, and put to new uses through our education system.

The teacher must be at the centre of the fundamental reforms in the education system. The new education policy must help re-establish teachers, at all levels, as the most respected and essential members of our society, because they truly shape our next generation of citizens. It must do everything to empower teachers and help them to do their job as effectively as possible. The new education policy must help recruit the very best and brightest to enter the teaching profession at all levels, by ensuring livelihood, respect, dignity, and autonomy, while also instilling in the system basic methods of quality control and accountability.

The new education policy must provide to all students, irrespective of their place of residence, a quality education system, with particular focus on historically marginalized, disadvantaged, and underrepresented groups. Education is a great leveler and is the best tool for achieving economic and social mobility, inclusion, and equality. Initiatives must be in place to ensure that all students from such groups, despite inherent obstacles, are provided various targeted opportunities to enter and excel in the educational system.

These elements must be incorporated taking into account the local and global needs of the country, and with a respect for and deference to its rich diversity and culture. Instilling knowledge of India and its varied social, cultural, and technological needs, its inimitable artistic, language, and knowledge traditions, and its strong ethics in India's young people is considered critical for purposes of national pride, self-confidence, self-knowledge, cooperation, and integration.

Previous Policies

The implementation of previous policies on education has focused largely on issues of access and equity. The unfinished agenda of the National Policy on Education 1986, modified in 1992 (NPE 1986/92), is appropriately dealt with in this Policy. A major development since the last Policy of 1986/92 has been the Right of Children to Free and Compulsory Education Act 2009 which laid down legal underpinnings for achieving universal elementary education.

Principles of this Policy

The purpose of the education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and

creative imagination, with sound ethical moorings and values. It aims at producing engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by our Constitution.

A good education institution is one in which every student feels welcomed and cared for, where a safe and stimulating learning environment exists, where a wide range of learning experiences are offered, and where good physical infrastructure and appropriate resources conducive to learning are available to all students. Attaining these qualities must be the goal of every educational institution. However, at the same time, there must also be seamless integration and coordination across institutions and across all stages of education.

The fundamental principles that will guide both the education system at large, as well as the individual institutions within it are:

- **recognizing, identifying,** and **fostering the unique capabilities of each student,** by sensitizing teachers as well as parents to promote each student's holistic development in both academic and non-academic spheres;
- **according the** highest priority **to achieving Foundational Literacy and Numeracy** by all students by Grade 3;
- **flexibility**, so that learners have the ability to choose their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests;
- **no hard separations** between arts and sciences, between curricular and extra-curricular activities, between vocational and academic streams, etc. in order to eliminate harmful hierarchies among, and silos between different areas of learning;
- **multidisciplinarity** and a **holistic education** across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world in order to ensure the unity and integrity of all knowledge;
- **emphasis on conceptual understanding** rather than rote learning and learning-for-exams;
- **creativity and critical thinking** to encourage logical decision-making and innovation;
- **ethics and human & Constitutional values** like empathy, respect for others, cleanliness, courtesy, democratic spirit, spirit of service, respect for public property, scientific temper, liberty, responsibility, pluralism, equality, and justice;
- **promoting multilingualism and the power of language** in teaching and learning;
- **life skills** such as communication, cooperation, teamwork, and resilience;
- **focus on regular formative assessment for learning** rather than the summative assessment that encourages today's 'coaching culture';
- **extensive use of technology** in teaching and learning, removing language barriers, increasing access for *Divyang* students, and educational planning and management;
- **respect for diversity** and **respect for the local context** in all curriculum, pedagogy, and policy, always keeping in mind that education is a concurrent subject;
- **full equity and inclusion** as the cornerstone of all educational decisions to ensure that all students are able to thrive in the education system;
- **synergy in curriculum across all levels of education** from early childhood care and education to school education to higher education;
- **teachers and faculty as the heart of the learning process** – their recruitment, continuous professional development, positive working environments and service conditions;

- a **'light but tight' regulatory framework** to ensure **integrity, transparency**, and **resource efficiency** of the educational system through audit and public disclosure while encouraging innovation and out-of-the-box ideas through **autonomy, good governance, and empowerment**;
- **outstanding research** as a corequisite for outstanding education and development;
- **continuous review** of progress based on sustained research and regular assessment by educational experts;

- **a rootedness and pride in India**, and its rich, diverse, ancient and modern culture and knowledge systems and traditions;
- **education is a public service**; access to quality education must be considered a basic right of every child;
- **substantial investment in a strong, vibrant public education system** as well as the encouragement and facilitation of true philanthropic private and community participation.

The Vision of this Policy

This National Education Policy envisions an education system rooted in Indian ethos that contributes directly to transforming India, that is Bharat, sustainably into an equitable and vibrant knowledge society, by providing high-quality education to all, and thereby making India a global knowledge superpower. The Policy envisages that the curriculum and pedagogy of our institutions must develop among the students a deep sense of respect towards the Fundamental Duties and Constitutional values, bonding with one's country, and a conscious awareness of one's roles and responsibilities in a changing world. The vision of the Policy is to instill among the learners a deep-rooted pride in being Indian, not only in thought, but also in spirit, intellect, and deeds, as well as to develop knowledge, skills, values, and dispositions that support responsible commitment to human rights, sustainable development and living, and global well-being, thereby reflecting a truly global citizen.

Part I. SCHOOL EDUCATION

This policy envisages that the extant 10+2 structure in school education will be modified with a new pedagogical and curricular restructuring of 5+3+3+4 covering ages 3-18 as shown in the representative figure and elaborated in detail later under Chapter 4.

Currently, children in the age group of 3-6 are not covered in the 10+2 structure as Class 1 begins at age 6. In the new 5+3+3+4 structure, a strong base of Early Childhood Care and Education (ECCE) from age 3 is also included, which is aimed at promoting better overall learning, development, and well-being.

1. Early Childhood Care and Education: The Foundation of Learning

1.1. Over 85% of a child's cumulative brain development occurs prior to the age of 6, indicating the critical importance of appropriate care and stimulation of the brain in the early years in order to ensure healthy brain development and growth. Presently, quality ECCE is not available to crores of young children, particularly children from socio-economically disadvantaged backgrounds. Strong investment in ECCE has the potential to give all young children such access, enabling them to participate and flourish in the educational system throughout their lives. Universal provisioning of quality early childhood development, care, and education must thus be achieved as soon as possible, and no later than 2030, to ensure that all students entering Grade 1 are school ready.

1.2. ECCE ideally consists of flexible, multi-faceted, multi-level, play-based, activity-based, and inquiry-based learning, comprising of alphabets, languages, numbers, counting, colours, shapes, indoor and outdoor play, puzzles and logical thinking, problem-solving, drawing, painting and other visual art, craft, drama and puppetry, music and movement. It also includes a focus on developing social capacities, sensitivity, good behaviour, courtesy, ethics, personal and public cleanliness, teamwork, and cooperation. The overall aim of ECCE will be to attain optimal outcomes in the domains of: physical and motor development, cognitive development, socio-emotional-ethical development, cultural/artistic development, and the development of communication and early language, literacy, and numeracy.

1.3. A National Curricular and Pedagogical Framework for Early Childhood Care and Education (NCPFECCE) for children up to the age of 8 will be developed by NCERT in two parts, namely, a sub-framework for 0-3 year-olds, and a sub-framework for 3-8 year-olds, aligned with the above guidelines, the latest research on ECCE, and national and international best practices. In particular, the numerous rich local traditions of India developed over millennia in ECCE involving art, stories, poetry, games, songs, and more, will also be suitably incorporated. The framework will serve as a guide both for parents and for early childhood care and education institutions.

1.4. The overarching goal will be to ensure universal access to high-quality ECCE across the country in a phased manner. Special attention and priority will be given to districts and locations that are particularly socio-economically disadvantaged. ECCE shall be delivered through a significantly expanded and strengthened system of early-childhood education institutions consisting of (a) stand-alone Anganwadis; (b) Anganwadis co-located with primary schools; (c) pre-primary schools/sections covering at least age 5 to 6 years co-located with existing primary schools; and (d) stand-alone pre-schools - all of which would recruit workers/teachers specially trained in the curriculum and pedagogy of ECCE.

1.5. For universal access to ECCE, Anganwadi Centres will be strengthened with high-quality infrastructure, play equipment, and well-trained Anganwadi workers/teachers. Every Anganwadi will have a well-ventilated, well-designed, child-friendly and well-constructed building with an enriched learning environment. Children in Anganwadi Centres shall take activity-filled tours - and meet the teachers and students of their local primary schools, in order to make the transition from Anganwadi Centres to primary schools a smooth one. Anganwadis shall be fully integrated into school complexes/clusters, and Anganwadi children, parents, and teachers will be invited to attend and participate in school/school complex programmes and vice versa.

1.6. It is envisaged that prior to the age of 5 every child will move to a "Preparatory Class" or "Balavatika" (that is, before Class 1), which has an ECCE-qualified teacher. The learning in the Preparatory Class shall be based primarily on play-based learning with a focus on developing cognitive, affective, and psychomotor abilities and early literacy and numeracy. The mid-

day meal programme shall also be extended to the Preparatory Classes in primary schools. Health check-ups and growth monitoring that are available in the Anganwadi system shall also be made available to Preparatory Class students of Anganwadi as well as of primary schools.

1.7. To prepare an initial cadre of high-quality ECCE teachers in Anganwadis, current Anganwadi workers/teachers will be trained through a systematic effort in accordance with the curricular/pedagogical framework developed by NCERT. Anganwadi workers/teachers with qualifications of 10+2 and above shall be given a 6-month certificate programme in ECCE; and those with lower educational qualifications shall be given a one-year diploma programme covering early literacy, numeracy, and other relevant aspects of ECCE. These programmes may be run through digital/distance mode using DTH channels as well as smartphones, allowing teachers to acquire ECCE qualifications with minimal disruption to their current work. The ECCE training of Anganwadi workers/teachers will be mentored by the Cluster Resource Centres of the School Education Department which shall hold at least one monthly contact class for continuous assessment. In the longer term, State Governments shall prepare cadres of professionally qualified educators for early childhood care and education, through stage-specific professional training, mentoring mechanisms, and career mapping. Necessary facilities will also be created for the initial professional preparation of these educators and their Continuous Professional Development (CPD).

1.8. ECCE will also be introduced in Ashramshalas in tribal-dominated areas and in all formats of alternative schooling in a phased manner. The process for integration and implementation of ECCE in Ashramshalas and alternative schooling will be similar to that detailed above.

1.9. The responsibility for ECCE curriculum and pedagogy will lie with MHRD to ensure its continuity from pre-primary school through primary school, and to ensure due attention to the foundational aspects of education. The planning and implementation of early childhood care and education curriculum will be carried out jointly by the Ministries of HRD, Women and Child Development (WCD), Health and Family Welfare (HFW), and Tribal Affairs. A special joint task force will be constituted for continuous guidance of the smooth integration of early childhood care and education into school education.

2. Foundational Literacy and Numeracy: An Urgent & Necessary Prerequisite to Learning

2.1. The ability to read and write, and perform basic operations with numbers, is a necessary foundation and an indispensable prerequisite for all future schooling and lifelong learning. However, various governmental, as well as non-governmental surveys, indicate that we are currently in a learning crisis: a large proportion of students currently in elementary school - estimated to be over 5 crore in number - have not attained foundational literacy and numeracy, i.e., the ability to read and comprehend basic text and the ability to carry out basic addition and subtraction with Indian numerals.

2.2. Attaining foundational literacy and numeracy for all children will thus become an urgent national mission, with immediate measures to be taken on many fronts and with clear goals that will be attained in the short term (including that every student will attain foundational literacy and numeracy by Grade 3). The highest priority of the education system will be to achieve universal foundational literacy and numeracy in primary school by 2025. The rest of this Policy will become relevant for our students only if this most basic learning requirement (i.e., reading, writing, and arithmetic at the foundational level) is first achieved. To this end, a National Mission on Foundational Literacy and Numeracy will be set up by the Ministry of Human Resource Development (MHRD) on priority. Accordingly, all State/UT governments will immediately prepare an implementation plan for attaining universal foundational literacy and numeracy in all primary schools, identifying stage-wise targets and goals to be achieved by 2025, and closely tracking and monitoring progress of the same.

2.3. First, teacher vacancies will be filled at the earliest, in a time-bound manner - especially in disadvantaged areas and areas with large pupil-to-teacher ratios or high rates of illiteracy. Special

attention will be given to employing local teachers or those with familiarity with local languages. A pupil-teacher ratio (PTR) of under 30:1 will be ensured at the level of each school; areas having large numbers of socio-economically disadvantaged students will aim for a PTR of under 25:1. Teachers will be trained, encouraged, and supported - with continuous professional development - to impart foundational literacy and numeracy.

2.4. On the curricular side, there will be an increased focus on foundational literacy and numeracy - and generally, on reading, writing, speaking, counting, arithmetic, and mathematical thinking - throughout the preparatory and middle school curriculum, with a robust system of continuous formative/adaptive assessment to track and thereby individualize and ensure each student's learning. Specific hours daily - and regular events over the year-on activities involving these subjects will be dedicated to encourage and enthuse students. Teacher education and the early grade curriculum will be redesigned to have a renewed emphasis on foundational literacy and numeracy.

2.5. Currently, with the lack of universal access to ECCE, a large proportion of children already fall behind within the first few weeks of Grade 1. Thus, to ensure that all students are school ready, an interim 3-month play-based 'school preparation module' for all Grade 1 students, consisting of activities and workbooks around the learning of alphabets, sounds, words, colours, shapes, and numbers, and involving collaborations with peers and parents, will be developed by NCERT and SCERTs.

2.6. A national repository of high-quality resources on foundational literacy and numeracy will be made available on the Digital Infrastructure for Knowledge Sharing (DIKSHA). Technological interventions to serve as aids to teachers and to help bridge any language barriers that may exist between teachers and students, will be piloted and implemented

2.7. Due to the scale of the current learning crisis, all viable methods will be explored to support teachers in the mission of attaining universal foundational literacy and numeracy. Studies around the world show one-on-one peer tutoring to be extremely effective for learning not just for the learner, but also for the tutor. Thus, peer tutoring can be taken up as a voluntary and joyful activity for fellow students under the supervision of trained teachers and by taking due care of safety aspects. Additionally, it will also be made far easier for trained volunteers - from both the local community and beyond - to participate in this large-scale mission. Every literate member of the community could commit to teaching one student/person how to read, it would change the country's landscape very quickly. States may consider establishing innovative models to foster such peer-tutoring and volunteer activities, as well as launch other programmes to support learners, in this nationwide mission to promote foundational literacy and numeracy.

2.8. Enjoyable and inspirational books for students at all levels will be developed, including through high-quality translation (technology assisted as needed) in all local and Indian languages, and will be made available extensively in both school and local public libraries. Public and school libraries will be significantly expanded to build a culture of reading across the country. Digital libraries will also be established. School libraries will be set up - particularly in villages - to serve the community during non-school hours, and book clubs may meet in public/school libraries to further facilitate and promote widespread reading. A National Book Promotion Policy will be formulated, and extensive initiatives will be undertaken to ensure the availability, accessibility, quality, and readership of books across geographies, languages, levels, and genres.

2.9. Children are unable to learn optimally when they are undernourished or unwell. Hence, the nutrition and health (including mental health) of children will be addressed, through healthy meals and the introduction of well-trained social workers, counsellors, and community involvement into the schooling system. Furthermore, research shows that the morning hours after a nutritious breakfast can be particularly productive for the study of cognitively more demanding subjects and hence these hours may be leveraged by providing a simple but energizing breakfast in addition to midday meals. In locations where hot meals are not possible, a simple but nutritious meal, e.g., groundnuts/chana mixed with jaggery and/or local fruits may be provided. All school children shall undergo regular

health check-ups especially for 100% immunization in schools and health cards will be issued to monitor the same.

3. Curtailing Dropout Rates and Ensuring Universal Access to Education at All Levels

3.1. One of the primary goals of the schooling system must be to ensure that children are enrolled in and are attending school. Through initiatives such as the Sarva Shiksha Abhiyan (now the Samagra Shiksha) and the Right to Education Act, India has made remarkable strides in recent years in attaining near-universal enrolment in elementary education. However, the data for later grades indicates some serious issues in retaining children in the schooling system. The GER for Grades 6-8 was 90.9%, while for Grades 9-10 and 11-12 it was only 79.3% and 56.5%, respectively - indicating that a significant proportion of enrolled students drop out after Grade 5 and especially after Grade 8. As per the 75th round household survey by NSSO in 2017-18, the number of out of school children in the age group of 6 to 17 years is 3.22 crore. It will be a top priority to bring these children back into the educational fold as early as possible, and to prevent further students from dropping out, with a goal to achieve 100% Gross Enrolment Ratio in preschool to secondary level by 2030. A concerted national effort will be made to ensure universal access and afford opportunity to all children of the country to obtain quality holistic education–including vocational education - from pre-school to Grade 12.

3.2. There are two overall initiatives that will be undertaken to bring children who have dropped out back to school and to prevent further children from dropping out. The first is to provide effective and sufficient infrastructure so that all students have access to safe and engaging school education at all levels from pre-primary school to Grade 12. Besides providing regular trained teachers at each stage, special care shall be taken to ensure that no school remains deficient on infrastructure support. The credibility of Government schools shall be re-established and this will be attained by upgrading and enlarging the schools that already exist, building additional quality schools in areas where they do not exist, and providing safe and practical conveyances and/or hostels, especially for the girl children, so that all children have the opportunity to attend a quality school and learn at the appropriate level. Alternative and innovative education centres will be put in place in cooperation with civil society to ensure that children of migrant labourers, and other children who are dropping out of school due to various circumstances are brought back into mainstream education.

3.3. The second is to achieve universal participation in school by carefully tracking students, as well as their learning levels, in order to ensure that they (a) are enrolled in and attending school, and (b) have suitable opportunities to catch up and re-enter school in case they have fallen behind or dropped out. For providing equitable and quality education from the Foundational Stage through Grade 12 to all children up to the age of 18, suitable facilitating systems shall be put in place. Counsellors or well-trained social workers connected to schools/school complexes and teachers will continuously work with students and their parents and will travel through and engage with communities to ensure that all school-age children are attending and learning in school. Trained and qualified social workers from civil society organizations/departments of Social Justice and Empowerment and government functionaries dealing with empowerment of Persons with Disabilities at the State and district level, could be connected to schools, through various innovative mechanisms adopted by State/UT Governments, to help in carrying out this important work.

3.4. Once infrastructure and participation are in place, ensuring quality will be the key in retention of students, so that they (particularly, girls and students from other socio-economically disadvantaged groups) do not lose interest in attending school. This will require a system of incentives for deploying teachers with knowledge of the local language to areas with high dropout rates, as well as overhauling the curriculum to make it more engaging and useful.

3.5. To facilitate learning for all students, with special emphasis on Socio-Economically Disadvantaged Groups (SEDGs), the scope of school education will be broadened to facilitate multiple pathways to learning involving both formal and non-formal education modes. Open and Distance Learning (ODL) Programmes offered by the National Institute of Open Schooling (NIOS)

and State Open Schools will be expanded and strengthened for meeting the learning needs of young people in India who are not able to attend a physical school. NIOS and State Open Schools will offer the following programmes in addition to the present programmes: A, B and C levels that are equivalent to Grades 3, 5, and 8 of the formal school system; secondary education programmes that are equivalent to Grades 10 and 12; vocational education courses/programmes; and adult literacy and life-enrichment programmes. States will be encouraged to develop these offerings in regional languages by establishing new/strengthening existing State Institutes of Open Schooling (SIOS).

3.6. To make it easier for both governments as well as non-governmental philanthropic organizations to build schools, to encourage local variations on account of culture, geography, and demographics, and to allow alternative models of education, the requirements for schools will be made less restrictive. The focus will be to have less emphasis on input and greater emphasis on output potential concerning desired learning outcomes. Regulations on inputs will be limited to certain areas as enumerated in Chapter 8. Other models for schools will also be piloted, such as public-philanthropic partnerships.

3.7. Efforts will be made to involve community and alumni in volunteer efforts for enhancing learning by providing at schools: one-on-one tutoring; the teaching of literacy and holding of extra-help sessions; teaching support and guidance for educators; career guidance and mentoring to students; etc. In this regard, the support of active and healthy senior citizens, school alumni and local community members will be suitably garnered. Databases of literate volunteers, retired scientists/government/semi government employees, alumni, and educators will be created for this purpose.

4. Curriculum and Pedagogy in Schools: Learning Should be Holistic, Integrated, Enjoyable, and Engaging

Restructuring school curriculum and pedagogy in a new 5+3+3+4 design

4.1. The curricular and pedagogical structure of school education will be reconfigured to make it responsive and relevant to the developmental needs and interests of learners at different stages of their development, corresponding to the age ranges of 3-8, 8-11, 11-14, and 14-18 years, respectively. The curricular and pedagogical structure and the curricular framework for school education will therefore be guided by a 5+3+3+4 design, consisting of the Foundational Stage (in two parts, that is, 3 years of Anganwadi/pre-school + 2 years in primary school in Grades 1-2; both together covering ages 3-8), Preparatory Stage (Grades 3-5, covering ages 8-11), Middle Stage (Grades 6-8, covering ages 11-14), and Secondary Stage (Grades 9-12 in two phases, i.e., 9 and 10 in the first and 11 and 12 in the second, covering ages 14-18).

4.2. The Foundational Stage will consist of five years of flexible, multilevel, play/activity-based learning and the curriculum and pedagogy of ECCE as mentioned in para 1.2. The Preparatory Stage will comprise three years of education building on the play, discovery, and activity-based pedagogical and curricular style of the Foundational Stage, and will also begin to incorporate some light text books as well as aspects of more formal but interactive classroom learning, in order to lay a solid groundwork across subjects, including reading, writing, speaking, physical education, art, languages, science, and mathematics. The Middle Stage will comprise three years of education, building on the pedagogical and curricular style of the Preparatory Stage, but with the introduction of subject teachers for learning and discussion of the more abstract concepts in each subject that students will be ready for at this stage across the sciences, mathematics, arts, social sciences, and humanities. Experiential learning within each subject, and explorations of relations among different subjects, will be encouraged and emphasized despite the introduction of more specialized subjects and subject teachers. The Secondary Stage will comprise of four years of multidisciplinary study, building on the subject-oriented pedagogical and curricular style of the Middle Stage, but with greater depth, greater critical thinking, greater attention to life aspirations, and greater flexibility and student choice of subjects. In particular students would continue to have the option of exiting after Grade 10

and re-entering in the next phase to pursue vocational or any other courses available in Grades 11-12, including at a more specialized school, if so desired.

4.3. The above-described stages are purely curricular and pedagogical, designed to optimize learning for students based on the cognitive development of children; they will inform the development of National and State curricula and teaching-learning strategies at each stage, but parallel changes to physical infrastructure will not be required.

Holistic development of learners

4.4. The key overall thrust of curriculum and pedagogy reform across all stages will be to move the education system towards real understanding and towards learning how to learn - and away from the culture of rote learning as is largely present today. The aim of education will not only be cognitive development, but also building character and creating holistic and well-rounded individuals equipped with the key 21st century skills. Ultimately, knowledge is a deep-seated treasure and education helps in its manifestation as the perfection which is already within an individual. All aspects of curriculum and pedagogy will be reoriented and revamped to attain these critical goals. Specific sets of skills and values across domains will be identified for integration and incorporation at each stage of learning, from pre-school to higher education. Curriculum frameworks and transaction mechanisms will be developed for ensuring that these skills and values are imbibed through engaging processes of teaching and learning. NCERT will identify these required skill sets and include mechanisms for their transaction in the National Curriculum Framework for early childhood and school education.

Reduce curriculum content to enhance essential learning and critical thinking

4.5. Curriculum content will be reduced in each subject to its core essentials, to make space for critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning. The mandated content will focus on key concepts, ideas, applications, and problem-solving. Teaching and learning will be conducted in a more interactive manner; questions will be encouraged, and classroom sessions will regularly contain more fun, creative, collaborative, and exploratory activities for students for deeper and more experiential learning.

Experiential learning

4.6. In all stages, experiential learning will be adopted, including hands-on learning, arts-integrated and sports-integrated education, story-telling-based pedagogy, among others, as standard pedagogy within each subject, and with explorations of relations among different subjects. To close the gap in achievement of learning outcomes, classroom transactions will shift, towards competency-based learning and education. The assessment tools (including assessment "as", "of", and "for" learning) will also be aligned with the learning outcomes, capabilities, and dispositions as specified for each subject of a given class.

4.7. Art-integration is a cross-curricular pedagogical approach that utilizes various aspects and forms of art and culture as the basis for learning of concepts across subjects. As a part of the thrust on experiential learning, art-integrated education will be embedded in classroom transactions not only for creating joyful classrooms, but also for imbibing the Indian ethos through integration of Indian art and culture in the teaching and learning process at every level. This art-integrated approach will strengthen the linkages between education and culture.

4.8. Sports-integration is another cross-curricular pedagogical approach that utilizes physical activities including indigenous sports, in pedagogical practices to help in developing skills such as collaboration, self-initiative, self-direction, self-discipline, teamwork, responsibility, citizenship, etc. Sports-integrated learning will be undertaken in classroom transactions to help students adopt fitness as a lifelong attitude and to achieve the related life skills along with the levels of fitness as envisaged in the Fit India Movement. The need to integrate sports in education is well recognized as it serves to

foster holistic development by promoting physical and psychological well-being while also enhancing cognitive abilities.

Empower students through flexibility in course choices

4.9. Students will be given increased flexibility and choice of subjects to study, particularly in secondary school - including subjects in physical education, the arts and crafts, and vocational skills – so that they can design their own paths of study and life plans. Holistic development and a wide choice of subjects and courses year to year will be the new distinguishing feature of secondary school education. There will be no hard separation among 'curricular', 'extracurricular', or 'co-curricular', among 'arts', 'humanities', and 'sciences', or between 'vocational' or 'academic' streams. Subjects such as physical education, the arts and crafts, and vocational skills, in addition to science, humanities, and mathematics, will be incorporated throughout the school curriculum, with a consideration for what is interesting and safe at each age.

4.10. Each of the four stages of school education, in accordance with what may be possible in different regions, may consider moving towards a semester or any other system that allows the inclusion of shorter modules, or courses that are taught on alternate days, in order to allow an exposure to more subjects and enable greater flexibility. States may look into innovative methods to achieve these aims of greater flexibility and exposure to and enjoyment of a wider range of subjects, including across the arts, sciences, humanities, languages, sports, and vocational subjects.

Multilingualism and the power of language

4.11. It is well understood that young children learn and grasp nontrivial concepts more quickly in their home language/mother tongue. Home language is usually the same language as the mother tongue or that which is spoken by local communities. However, at times in multi-lingual families, there can be a home language spoken by other family members which may sometimes be different from mother tongue or local language. Wherever possible, the medium of instruction until at least Grade 5, but preferably till Grade 8 and beyond, will be the home language/mother tongue/local language/regional language. Thereafter, the home/local language shall continue to be taught as a language wherever possible. This will be followed by both public and private schools. High-quality textbooks, including in science, will be made available in home languages/mother tongue. All efforts will be made early on to ensure that any gaps that exist between the language spoken by the child and the medium of teaching are bridged. In cases where home language/mother tongue textbook material is not available, the language of transaction between teachers and students will still remain the home language/mother tongue wherever possible. Teachers will be encouraged to use a bilingual approach, including bilingual teaching-learning materials, with those students whose home language may be different from the medium of instruction. All languages will be taught with high quality to all students; a language does not need to be the medium of instruction for it to be taught and learned well.

4.12. As research clearly shows that children pick up languages extremely quickly between the ages of 2 and 8 and that multilingualism has great cognitive benefits to young students, children will be exposed to different languages early on (but with a particular emphasis on the mother tongue), starting from the Foundational Stage onwards. All languages will be taught in an enjoyable and interactive style, with plenty of interactive conversation, and with early reading and subsequently writing in the mother tongue in the early years, and with skills developed for reading and writing in other languages in Grade 3 and beyond. There will be a major effort from both the Central and State governments to invest in large numbers of language teachers in all regional languages around the country, and, in particular, for all languages mentioned in the Eighth Schedule of the Constitution of India. States, especially States from different regions of India, may enter into bilateral agreements to hire teachers in large numbers from each other, to satisfy the three-language formula in their respective States, and also to encourage the study of Indian languages across the country. Extensive use of technology will be made for teaching and learning of different languages and to popularize language learning.

4.13. The three-language formula will continue to be implemented while keeping in mind the Constitutional provisions, aspirations of the people, regions, and the Union, and the need to promote multilingualism as well as promote national unity. However, there will be a greater flexibility in the three-language formula, and no language will be imposed on any State. The three languages learned by children will be the choices of States, regions, and of course the students themselves, so long as at least two of the three languages are native to India. In particular, students who wish to change one or more of the three languages they are studying may do so in Grade 6 or 7, as long as they are able to demonstrate basic proficiency in three languages (including one language of India at the literature level) by the end of secondary school.

4.14. All efforts will be made in preparing high-quality bilingual textbooks and teaching-learning materials for science and mathematics, so that students are enabled to think and speak about the two subjects both in their home language/mother tongue and in English.

4.15. As so many developed countries around the world have amply demonstrated, being well educated in one's language, culture, and traditions is not a detriment but indeed a huge benefit to educational, social, and technological advancement. India's languages are among the richest, most scientific, most beautiful, and most expressive in the world, with a huge body of ancient as well as modern literature (both prose and poetry), film, and music written in these languages that help form India's national identity and wealth. For purposes of cultural enrichment as well as national integration, all young Indians should be aware of the rich and vast array of languages of their country, and the treasures that they and their literatures contain.

4.16. Thus, every student in the country will participate in a fun project/activity on 'The Languages of India', sometime in Grades 6-8, such as, under the *'Ek Bharat Shrestha Bharat'* initiative. In this project/activity, students will learn about the remarkable unity of most of the major Indian languages, starting with their common phonetic and scientifically-arranged alphabets and scripts, their common grammatical structures, their origins and sources of vocabularies from Sanskrit and other classical languages, as well as their rich inter-influences and differences. They will also learn what geographical areas speak which languages, get a sense of the nature and structure of tribal languages, and learn to say commonly spoken phrases and sentences in every major language of India and also learn a bit about the rich and uplifting literature of each (through suitable translations as necessary). Such an activity would give them both a sense of the unity and the beautiful cultural heritage and diversity of India and would be a wonderful icebreaker their whole lives as they meet people from other parts of India. This project/activity would be a joyful activity and would not involve any form of assessment.

4.17. The importance, relevance, and beauty of the classical languages and literature of India also cannot be overlooked. Sanskrit, while also an important modern language mentioned in the Eighth Schedule of the Constitution of India, possesses a classical literature that is greater in volume than that of Latin and Greek put together, containing vast treasures of mathematics, philosophy, grammar, music, politics, medicine, architecture, metallurgy, drama, poetry, storytelling, and more (known as 'Sanskrit Knowledge Systems'), written by people of various religions as well as non-religious people, and by people from all walks of life and a wide range of socio-economic backgrounds over thousands of years. Sanskrit will thus be offered at all levels of school and higher education as an important, enriching option for students, including as an option in the three-language formula. It will be taught in ways that are interesting and experiential as well as contemporarily relevant, including through the use of Sanskrit Knowledge Systems, and in particular through phonetics and pronunciation. Sanskrit textbooks at the foundational and middle school level may be written in Simple Standard Sanskrit (SSS) to teach Sanskrit through Sanskrit (STS) and make its study truly enjoyable.

4.18. India also has an extremely rich literature in other classical languages, including classical Tamil, Telugu, Kannada, Malayalam, Odia. In addition to these classical languages Pali, Persian, and Prakrit; and their works of literature too must be preserved for their richness and for the pleasure and enrichment of posterity. As India becomes a fully developed country, the next generation will want to

partake in and be enriched by India's extensive and beautiful classical literature. In addition to Sanskrit, other classical languages and literatures of India, including Tamil, Telugu, Kannada, Malayalam, Odia, Pali, Persian, and Prakrit, will also be widely available in schools as options for students, possibly as online modules, through experiential and innovative approaches, to ensure that these languages and literature stay alive and vibrant. Similar efforts will be made for all Indian languages having rich oral and written literatures, cultural traditions, and knowledge.

4.19. For the enrichment of the children, and for the preservation of these rich languages and their artistic treasures, all students in all schools, public or private, will have the option of learning at least two years of a classical language of India and its associated literature, through experiential and innovative approaches, including the integration of technology, in Grades 6-12, with the option to continue from the middle stage through the secondary stage and beyond.

4.20. In addition to high quality offerings in Indian languages and English, foreign languages, such as Korean, Japanese, Thai, French, German, Spanish, Portuguese, and Russian, will also be offered at the secondary level, for students to learn about the cultures of the world and to enrich their global knowledge and mobility according to their own interests and aspirations.

4.21. The teaching of all languages will be enhanced through innovative and experiential methods, including through gamification and apps, by weaving in the cultural aspects of the languages - such as films, theatre, storytelling, poetry, and music - and by drawing connections with various relevant subjects and with real-life experiences. Thus, the teaching of languages will also be based on experiential-learning pedagogy.

4.22. Indian Sign Language (ISL) will be standardized across the country, and National and State curriculum materials developed, for use by students with hearing impairment. Local sign languages will be respected and taught as well, where possible and relevant.

Curricular Integration of Essential Subjects, Skills, and Capacities

4.23. While students must have a large amount of flexibility in choosing their individual curricula, certain subjects, skills, and capacities should be learned by all students to become good, successful, innovative, adaptable, and productive human beings in today's rapidly changing world. In addition to proficiency in languages, these skills include: scientific temper and evidence-based thinking; creativity and innovativeness; sense of aesthetics and art; oral and written communication; health and nutrition; physical education, fitness, wellness, and sports; collaboration and teamwork; problem solving and logical reasoning; vocational exposure and skills; digital literacy, coding, and computational thinking; ethical and moral reasoning; knowledge and practice of human and Constitutional values; gender sensitivity; Fundamental Duties; citizenship skills and values; knowledge of India; environmental awareness including water and resource conservation, sanitation and hygiene; and current affairs and knowledge of critical issues facing local communities, States, the country, and the world.

4.24. Concerted curricular and pedagogical initiatives, including the introduction of contemporary subjects such as Artificial Intelligence, Design Thinking, Holistic Health, Organic Living, Environmental Education, Global Citizenship Education (GCED), etc. at relevant stages will be undertaken to develop these various important skills in students at all levels.

4.25. It is recognized that mathematics and mathematical thinking will be very important for India's future and India's leadership role in the numerous upcoming fields and professions that will involve artificial intelligence, machine learning, and data science, etc. Thus, mathematics and computational thinking will be given increased emphasis throughout the school years, starting with the foundational stage, through a variety of innovative methods, including the regular use of puzzles and games that make mathematical thinking more enjoyable and engaging. Activities involving coding will be introduced in Middle Stage.

4.26. Every student will take a fun course, during Grades 6-8, that gives a survey and hands-on experience of a sampling of important vocational crafts, such as carpentry, electric work, metal work, gardening, pottery making, etc., as decided by States and local communities and as mapped by local skilling needs. A practice-based curriculum for Grades 6-8 will be appropriately designed by NCERT while framing the NCFSE 2020-21. All students will participate in a 10-day bagless period sometime during Grades 6-8 where they intern with local vocational experts such as carpenters, gardeners, potters, artists, etc. Similar internship opportunities to learn vocational subjects may be made available to students throughout Grades 6-12, including holiday periods. Vocational courses through online mode will also be made available. Bagless days will be encouraged throughout the year for various types of enrichment activities involving arts, quizzes, sports, and vocational crafts. Children will be given periodic exposure to activities outside school through visits to places/monuments of historical, cultural and tourist importance, meeting local artists and craftsmen and visits higher educational institutions in their village/Tehsil/District/State.

4.27. "Knowledge of India" will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India's future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation. Specific courses in tribal ethno-medicinal practices, forest management, traditional (organic) crop cultivation, natural farming, etc. will also be made available. An engaging course on Indian Knowledge Systems will also be available to students in secondary school as an elective. Competitions may be held in schools for learning various topics and subjects through fun and indigenous games. Video documentaries on inspirational luminaries of India, ancient and modern, in science and beyond, will be shown at appropriate points throughout the school curriculum. Students will be encouraged to visit different States as part of cultural exchange programmes.

4.28. Students will be taught at a young age the importance of "doing what's right", and will be given a logical framework for making ethical decisions. In later years, this would then be expanded along themes of cheating, violence, plagiarism, littering, tolerance, equality, empathy, etc., with a view to enabling children to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. As consequences of such basic ethical reasoning, traditional Indian values and all basic human and Constitutional values (such as *seva, ahimsa, swachchhata, satya, nishkam karma, shanti*, sacrifice, tolerance, diversity, pluralism, righteous conduct, gender sensitivity, respect for elders, respect for all people and their inherent capabilities regardless of background, respect for environment, helpfulness, courtesy, patience, forgiveness, empathy, compassion, patriotism, democratic outlook, integrity, responsibility, justice, liberty, equality, and fraternity) will be developed in all students. Children will have the opportunity to read and learn from the original stories of the Panchatantra, Jataka, Hitopadesh, and other fun fables and inspiring tales from the Indian tradition and learn about their influences on global literature. Excerpts from the Indian Constitution will also be considered essential reading for all students. Basic training in health, including preventive health, mental health, good nutrition, personal and public hygiene, disaster response and first-aid will also be included in the curriculum, as well as scientific explanations of the detrimental and damaging effects of alcohol, tobacco, and other drugs.

4.29. All curriculum and pedagogy, from the foundational stage onwards, will be redesigned to be strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language, philosophy, geography, ancient and contemporary knowledge, societal and scientific needs, indigenous and traditional ways of learning etc. – in order to ensure that education is maximally relatable, relevant, interesting, and effective for our students. Stories, arts, games, sports, examples, problems, etc. will be chosen as much as possible to be rooted in the Indian and local geographic context. Ideas, abstractions, and creativity will indeed best flourish when learning is thus rooted.

National Curriculum Framework for School Education (NCFSE)

4.30. The formulation of a new and comprehensive National Curricular Framework for School Education, NCFSE 2020-21, will be undertaken by the NCERT - based on the principles of this National Education Policy 2020, frontline curriculum needs, and after discussions with all stakeholders including State Governments, Ministries, relevant Departments of the Central Government, and other expert bodies, and will be made available in all regional languages. The NCFSE document shall henceforth be revisited and updated once every 5-10 years, taking into account frontline curriculum.

National Textbooks with Local Content and Flavour

4.31. The reduction in content and increased flexibility of school curriculum - and the renewed emphasis on constructive rather than rote learning - must be accompanied by parallel changes in school textbooks. All textbooks shall aim to contain the essential core material (together with discussion, analysis, examples, and applications) deemed important on a national level, but at the same time contain any desired nuances and supplementary material as per local contexts and needs. Where possible, schools and teachers will also have choices in the textbooks they employ - from among a set of textbooks that contain the requisite national and local material - so that they may teach in a manner that is best suited to their own pedagogical styles as well as to their students and communities' needs.

4.32. The aim will be to provide such quality textbooks at the lowest possible cost -namely, at the cost of production/printing - in order to mitigate the burden of textbook prices on the students and on the educational system. This may be accomplished by using high-quality textbook materials developed by NCERT in conjunction with the SCERTs; additional textbook materials could be funded by public-philanthropic partnerships and crowd sourcing that incentivize experts to write such high-quality textbooks at cost price. States will prepare their own curricula (which may be based on the NCFSE prepared by NCERT to the extent possible) and prepare textbooks (which may be based on the NCERT textbook materials to the extent possible), incorporating State flavour and material as needed. While doing so, it must be borne in mind that NCERT curriculum would be taken as the nationally acceptable criterion. The availability of such textbooks in all regional languages will be a top priority so that all students have access to high-quality learning. All efforts will be made to ensure timely availability of textbooks in schools. Access to downloadable and printable versions of all textbooks will be provided by all States/UTs and NCERT to help conserve the environment and reduce the logistical burden.

4.33. Concerted efforts, through suitable changes in curriculum and pedagogy, will be made by NCERT, SCERTs, schools, and educators to significantly reduce the weight of school bags and textbooks.

Transforming Assessment for Student Development

4.34. The aim of assessment in the culture of our schooling system will shift from one that is summative and primarily tests rote memorization skills to one that is more regular and formative, is more competency-based, promotes learning and development for our students, and tests higher-order skills, such as analysis, critical thinking, and conceptual clarity. The primary purpose of assessment will indeed be for learning; it will help the teacher and student, and the entire schooling system, continuously revise teaching-learning processes to optimize learning and development for all students. This will be the underlying principle for assessment at all levels of education.

4.35. The progress card of all students for school-based assessment, which is communicated by schools to parents, will be completely redesigned by States/UTs under guidance from the proposed National Assessment Centre, NCERT, and SCERTs. The progress card will be a holistic, 360-degree, multidimensional report that reflects in great detail the progress as well as the uniqueness of each

learner in the cognitive, affective, and psychomotor domains. It will include self-assessment and peer assessment, and progress of the child in project-based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment. The holistic progress card will form an important link between home and school and will be accompanied by parent-teacher meetings in order to actively involve parents in their children's holistic education and development. The progress card would also provide teachers and parents with valuable information on how to support each student in and out of the classroom. AI-based software could be developed and used by students to help track their growth through their school years based on learning data and interactive questionnaires for parents, students, and teachers, in order to provide students with valuable information on their strengths, areas of interest, and needed areas of focus, and to thereby help them make optimal career choices.

4.36. The current nature of secondary school exams, including Board exams and entrance exams - and the resulting coaching culture of today - are doing much harm, especially at the secondary school level, replacing valuable time for true learning with excessive exam coaching and preparation. These exams also force students to learn a very narrow band of material in a single stream, rather than allowing the flexibility and choice that will be so important in the education system of the future.

4.37. While the Board exams for Grades 10 and 12 will be continued, the existing system of Board and entrance examinations shall be reformed to eliminate the need for undertaking coaching classes. To reverse these harmful effects of the current assessment system, Board exams will be redesigned to encourage holistic development; students will be able to choose many of the subjects in which they take Board exams, depending on their individualized interests. Board exams will also be made 'easier', in the sense that they will test primarily core capacities/competencies rather than months of coaching and memorization; any student who has been going to and making a basic effort in a school class will be able to pass and do well in the corresponding subject Board Exam without much additional effort. To further eliminate the 'high stakes' aspect of Board Exams, all students will be allowed to take Board Exams on up to two occasions during any given school year, one main examination and one for improvement, if desired.

4.38. In addition to introducing greater flexibility, student choice, and best-of-two attempts, assessments that primarily test core capacities must be the immediate key reforms to all Board exams. Boards may over time also develop further viable models of Board Exams that reduce pressure and the coaching culture. Some possibilities include: a system of annual/semester/modular Board Exams could be developed - that each test far less material, and are taken immediately after the corresponding course is taken in school - so that the pressure from exams is better distributed, less intense, and less high-stakes across the Secondary Stage; all subjects and corresponding assessments, beginning with mathematics, could be offered at two levels, with students doing some of their subjects at the standard level and some at a higher level; and Board exams in certain subjects could be redesigned to have two parts – one part of an objective type with multiple-choice questions and the other of a descriptive type.

4.39. With regard to all of the above, guidelines will be prepared by NCERT, in consultation with major stakeholders, such as SCERTs, Boards of Assessment (BoAs), the proposed new National Assessment Centre etc., and teachers prepared, for a transformation in the assessment system by the 2022-23 academic session, to align with the NCFSE 2020-21.

4.40. To track progress throughout the school years, and not just at the end of Grades 10 and 12 - for the benefit of students, parents, teachers, principals, and the entire schooling system in planning improvements to schools and teaching-learning processes - all students will take school examinations in Grades 3, 5, and 8 which will be conducted by the appropriate authority. These examinations would test achievement of basic learning outcomes, through assessment of core concepts and knowledge from the national and local curricula, along with relevant higher-order skills and application of knowledge in real-life situations, rather than rote memorization. The Grade 3 examination, in particular, would test basic literacy, numeracy, and other foundational skills. The results of school examinations will be used only for developmental purposes of the school education

system, including for public disclosure by schools of their overall (anonymized) student outcomes, and for continuous monitoring and improvement of the schooling system.

4.41. It is proposed to set up a National Assessment Centre, PARAKH (Performance Assessment, Review, and Analysis of Knowledge for Holistic Development), as a standard-setting body under MHRD that fulfils the basic objectives of setting norms, standards, and guidelines for student assessment and evaluation for all recognized school boards of India, guiding the State Achievement Survey (SAS) and undertaking the National Achievement Survey (NAS), monitoring achievement of learning outcomes in the country, and encouraging and helping school boards to shift their assessment patterns towards meeting the skill requirements of the 21st century in consonance with the stated objectives of this Policy. This Centre will also advise school boards regarding new assessment patterns and latest researches, promote collaborations between school boards. It will also become an instrument for the sharing of best practices among school boards, and for ensuring equivalence of academic standards among learners across all school boards.

4.42. The principles for university entrance exams will be similar. The National Testing Agency (NTA) will work to offer a high-quality common aptitude test, as well as specialized common subject exams in the sciences, humanities, languages, arts, and vocational subjects, at least twice every year. These exams shall test conceptual understanding and the ability to apply knowledge and shall aim to eliminate the need for taking coaching for these exams. Students will be able to choose the subjects for taking the test, and each university will be able to see each student's individual subject portfolio and admit students into their programmes based on individual interests and talents. The NTA will serve as a premier, expert, autonomous testing organization to conduct entrance examinations for undergraduate and graduate admissions and fellowships in higher education institutions. The high quality, range, and flexibility of the NTA testing services will enable most universities to use these common entrance exams - rather than having hundreds of universities each devising their own entrance exams - thereby drastically reducing the burden on students, universities and colleges, and the entire education system. It will be left up to individual universities and colleges to use NTA assessments for their admissions.

Support for Gifted Students/Students with Special Talents

4.43. There are innate talents in every student, which must be discovered, nurtured, fostered, and developed. These talents may express themselves in the form of varying interests, dispositions, and capacities. Those students that show particularly strong interests and capacities in a given realm must be encouraged to pursue that realm beyond the general school curriculum. Teacher education will include methods for the recognition and fostering of such student talents and interests. The NCERT and NCTE will develop guidelines for the education of gifted children. B.Ed. programmes may also allow a specialization in the education of gifted children.

4.44. Teachers will aim to encourage students with singular interests and/or talents in the classroom by giving them supplementary enrichment material and guidance and encouragement. Topic-centered and Project-based Clubs and Circles will be encouraged and supported at the levels of schools, school complexes, districts, and beyond. Examples include Science Circles, Math Circles, Music & Dance Performance Circles, Chess Circles, Poetry Circles, Language Circles, Drama Circles, Debate Circles, Sports Circles, Eco-Clubs, Health & Well-being Clubs/ Yoga Clubs and so on. Along these lines, high-quality national residential summer programmes for secondary school students in various subjects will also be encouraged, with a rigorous merit-based but equitable admission process to attract the very best students and teachers from across the country including from socio-economically disadvantaged groups.

4.45. Olympiads and competitions in various subjects will be conducted across the country, with clear coordination and progression from school to local to state to national levels, to ensure that all students may participate at all levels for which they qualify. Efforts will be made to make these available in rural areas and in regional languages to ensure widespread participation. Public and private universities, including premier institutions like the IITs and NITs, would be encouraged to use merit-

based results from National, and International Olympiads, and results from other relevant national programmes, as part of the criteria for admissions into their undergraduate programmes.

4.46. Once internet-connected smart phones or tablets are available in all homes and/or schools, online apps with quizzes, competitions, assessments, enrichment materials, and online communities for shared interests will be developed, and will work to enhance all the aforementioned initiatives, as group activities for students with appropriate supervision of parents and teachers. Schools will develop smart classrooms, in a phased manner, for using digital pedagogy and thereby enriching the teaching-learning process with online resources and collaborations.

5. Teachers

5.1. Teachers truly shape the future of our children - and, therefore, the future of our nation. It is because of this noblest role that the teacher in India was the most respected member of society. Only the very best and most learned became teachers. Society gave teachers, or gurus, what they needed to pass on their knowledge, skills, and ethics optimally to students. The quality of teacher education, recruitment, deployment, service conditions, and empowerment of teachers is not where it should be, and consequently the quality and motivation of teachers does not reach the desired standards. The high respect for teachers and the high status of the teaching profession must be restored so as to inspire the best to enter the teaching profession. The motivation and empowerment of teachers is required to ensure the best possible future for our children and our nation.

Recruitment and Deployment

5.2. To ensure that outstanding students enter the teaching profession - especially from rural areas - a large number of merit-based scholarships shall be instituted across the country for studying quality 4-year integrated B.Ed. programmes. In rural areas, special merit-based scholarships will be established that also include preferential employment in their local areas upon successful completion of their B.Ed. programmes. Such scholarships will provide local job opportunities to local students, especially female students, so that these students serve as local-area role models and as highly qualified teachers who speak the local language. Incentives will be provided for teachers to take up teaching jobs in rural areas, especially in areas that are currently facing acute shortage of quality teachers. A key incentive for teaching in rural schools will be the provision of local housing near or on the school premises or increased housing allowances.

5.3. The harmful practice of excessive teacher transfers will be halted, so that students have continuity in their role models and educational environments. Transfers will occur in very special circumstances, as suitably laid down in a structured manner by State/UT governments. Furthermore, transfers will be conducted through an online computerized system that ensures transparency.

5.4. Teacher Eligibility Tests (TETs) will be strengthened to inculcate better test material, both in terms of content and pedagogy. The TETs will also be extended to cover teachers across all stages (Foundational, Preparatory, Middle and Secondary) of school education. For subject teachers, suitable TET or NTA test scores in the corresponding subjects will also be taken into account for recruitment. To gauge passion and motivation for teaching, a classroom demonstration or interview will become an integral part of teacher hiring at schools and school complexes. These interviews would also be used to assess comfort and proficiency in teaching in the local language, so that every school/school complex has at least some teachers who can converse with students in the local language and other prevalent home languages of students. Teachers in private schools also must have qualified similarly through TET, a demonstration/interview, and knowledge of local language(s).

5.5. To ensure an adequate number of teachers across subjects - particularly in subjects such as art, physical education, vocational education, and languages - teachers could be recruited to a school or school complex and the sharing of teachers across schools could be considered in accordance with the grouping-of-schools adopted by State/UT governments.

5.6. Schools/school complexes will be encouraged to hire local eminent persons or experts as 'master instructors' in various subjects, such as in traditional local arts, vocational crafts, entrepreneurship, agriculture, or any other subject where local expertise exists, to benefit students and help preserve and promote local knowledge and professions.

5.7. A technology-based comprehensive teacher-requirement planning forecasting exercise will be conducted by each State to assess expected subject-wise teacher vacancies over the next two decades. The above described initiatives in recruitment and deployment will be scaled as needed over time, to fill all vacancies with qualified teachers, including local teachers, with suitable incentives for career management and progression as described below. Teacher education programmes and offerings will also align with the vacancies thus projected.

Service Environment and Culture

5.8. The primary goal of overhauling the service environment and culture of schools will be to maximize the ability of teachers to do their jobs effectively, and to ensure that they are part of vibrant, caring, and inclusive communities of teachers, students, parents, principals, and other support staff, all of whom share a common goal: to ensure that our children are learning.

5.9. The first requirement in this direction will be to ensure decent and pleasant service conditions at schools. Adequate and safe infrastructure, including working toilets, clean drinking water, clean and attractive spaces, electricity, computing devices, internet, libraries, and sports and recreational resources will be provided to all schools to ensure that teachers and students, including children of all genders and children with disabilities, receive a safe, inclusive, and effective learning environment and are comfortable and inspired to teach and learn in their schools. In-service training will have inputs on safety, health and environment at workplace in schools to ensure that all teachers are sensitized to these requirements.

5.10. State/UT Governments may adopt innovative formats, such as school complex, rationalization of schools, without in any way reducing accessibility, for effective school governance, resource sharing, and community building. The creation of school complexes could go a long way towards building vibrant teacher communities. The hiring of teachers to school complexes could automatically create relationships among schools across the school complex; it would also help ensure excellent subject-wise distribution of teachers, creating a more vibrant teacher knowledge base. Teachers at very small schools will not remain isolated any longer and may become part of and work with larger school complex communities, sharing best practices with each other and working collaboratively to ensure that all children are learning. School complexes could also share counsellors, trained social workers, technical and maintenance staff, etc. to further support teachers and help create an effective learning environment.

5.11. In collaboration with parents and other key local stakeholders, teachers will also be more involved in the governance of schools/school complexes, including as members of the School Management Committees/School Complex Management Committees.

5.12. To prevent the large amounts of time spent currently by teachers on non-teaching activities, teachers will not be engaged any longer in work that is not directly related to teaching; in particular, teachers will not be involved in strenuous administrative tasks and more than a rationalized minimum time for mid-day meal related work, so that they may fully concentrate on their teaching-learning duties.

5.13. To help ensure that schools have positive learning environments, the role expectations of principals and teachers will explicitly include developing a caring and inclusive culture at their schools, for effective learning and the benefit of all stakeholders.

5.14. Teachers will be given more autonomy in choosing aspects of pedagogy, so that they may teach in the manner they find most effective for the students in their classrooms. Teachers will also focus

on socio-emotional learning - a critical aspect of any student's holistic development. Teachers will be recognized for novel approaches to teaching that improve learning outcomes in their classrooms.

Continuous Professional Development (CPD)

5.15. Teachers will be given continuous opportunities for self-improvement and to learn the latest innovations and advances in their professions. These will be offered in multiple modes, including in the form of local, regional, state, national, and international workshops as well as online teacher development modules. Platforms (especially online platforms) will be developed so that teachers may share ideas and best practices. Each teacher will be expected to participate in at least 50 hours of CPD opportunities every year for their own professional development, driven by their own interests. CPD opportunities will, in particular, systematically cover the latest pedagogies regarding foundational literacy and numeracy, formative and adaptive assessment of learning outcomes, competency-based learning, and related pedagogies, such as experiential learning, arts-integrated, sports-integrated, and storytelling-based approaches, etc.

5.16. School Principals and school complex leaders will have similar modular leadership/management workshops and online development opportunities and platforms to continuously improve their own leadership and management skills, and so that they too may share best practices with each other. Such leaders will also be expected to participate in 50 hours or more of CPD modules per year, covering leadership and management, as well as content and pedagogy with a focus on preparing and implementing pedagogical plans based on competency-based education.

Career Management and Progression (CMP)

5.17. Teachers doing outstanding work must be recognized and promoted, and given salary raises, to incentivize all teachers to do their best work. Therefore, a robust merit-based structure of tenure, promotion, and salary structure will be developed, with multiple levels within each teacher stage, that incentivizes and recognizes outstanding teachers. A system of multiple parameters for proper assessment of performance will be developed for the same by State/UT Governments that is based on peer reviews, attendance, commitment, hours of CPD, and other forms of service to the school and the community or based on NPST given in Para 5.20. In this Policy, in the context of careers, 'tenure' refers to confirmation for permanent employment, after due assessment of performance and contribution, while 'tenure track' refers to the period of probation preceding tenure.

5.18. Further, it will be ensured that career growth (in terms of tenure, promotions, salary increases, etc.) is available to teachers within a single school stage (i.e., Foundational, Preparatory, Middle, or Secondary), and that there is no career progression-related incentive to move from being teachers in early stages to later stages or vice versa (though such career moves across stages will be allowed, provided the teacher has the desire and qualifications for such a move). This is to support the fact that all stages of school education will require the highest-quality teachers, and no stage will be considered more important than any other.

5.19. Vertical mobility of teachers based on merit will also be paramount; outstanding teachers with demonstrated leadership and management skills would be trained over time to take on academic leadership positions in schools, school complexes, BRCs, CRCs, BITEs, DIETs as well as relevant government departments.

Professional Standards for Teachers

5.20. A common guiding set of National Professional Standards for Teachers (NPST) will be developed by 2022, by the National Council for Teacher Education in its restructured new form as a Professional Standard Setting Body (PSSB) under the General Education Council (GEC), in consultation with NCERT, SCERTs, teachers from across levels and regions, expert organizations in teacher preparation and development, expert bodies in vocational education, and higher education institutions. The standards would cover expectations of the role of the teacher at different levels of expertise/stage, and the competencies required for that stage. It will also comprise standards for

performance appraisal, for each stage, that would be carried out on a periodic basis. The NPST will also inform the design of pre-service teacher education programmes. This could be then adopted by States and determine all aspects of teacher career management, including tenure, professional development efforts, salary increases, promotions, and other recognitions. Promotions and salary increases will not occur based on the length of tenure or seniority, but only on the basis of such appraisal. The professional standards will be reviewed and revised in 2030, and thereafter every ten years, on the basis of rigorous empirical analysis of the efficacy of the system.

Special educators

5.21. There is an urgent need for additional special educators for certain areas of school education. Some examples of such specialist requirements include subject teaching for children with disabilities/*Divyang* children at the Middle and Secondary school level, including teaching for specific learning disabilities. Such teachers would require not only subject-teaching knowledge and understanding of subject-related aims of education, but also the relevant skills for understanding of special requirements of children. Therefore, such areas could be developed as secondary specializations for subject teachers or generalist teachers, during or after pre-service teacher preparation. They will be offered as certificate courses, in the pre-service as well as in-service mode, either full time or as part-time/blended courses - again, necessarily, at multidisciplinary colleges or universities. Greater synergy will be enabled between the course curriculum of NCTE and RCI to ensure adequate availability of qualified special educators who can handle subject teaching as well.

Approach to Teacher Education

5.22. Recognizing that the teachers will require training in high-quality content as well as pedagogy, teacher education will gradually be moved by 2030 into multidisciplinary colleges and universities. As colleges and universities all move towards becoming multidisciplinary, they will also aim to house outstanding education departments that offer B.Ed., M.Ed., and Ph.D. degrees in education.

5.23. By 2030, the minimum degree qualification for teaching will be a 4-year integrated B.Ed. degree that teaches a range of knowledge content and pedagogy and includes strong practicum training in the form of student-teaching at local schools. The 2-year B.Ed. programmes will also be offered, by the same multidisciplinary institutions offering the 4-year integrated B.Ed., and will be intended only for those who have already obtained Bachelor's Degrees in other specialized subjects. These B.Ed. programmes may also be suitably adapted as 1-year B.Ed. programmes, and will be offered only to those who have completed the equivalent of 4-year multidisciplinary Bachelor's Degrees or who have obtained a Master's degree in a specialty and wish to become a subject teacher in that specialty. All such B.Ed. degrees would be offered only by accredited multidisciplinary higher education institutions offering 4-year integrated B.Ed. programmes. Multidisciplinary higher education institutions offering the 4-year in-class integrated B.Ed. programme and having accreditation for ODL may also offer high-quality B.Ed. programmes in blended or ODL mode to students in remote or difficult-to-access locations and also to in-service teachers who are aiming to enhance their qualification, with suitable robust arrangements for mentoring and for the practicum-training and student-teaching components of the programme.

5.24. All B.Ed. programmes will include training in time-tested as well as the most recent techniques in pedagogy, including pedagogy with respect to foundational literacy and numeracy, multi-level teaching and evaluation, teaching children with disabilities, teaching children with special interests or talents, use of educational technology, and learner-centered and collaborative learning. All B.Ed. programmes will include strong practicum training in the form of in-classroom teaching at local schools. All B.Ed. programmes will also emphasize the practice of the Fundamental Duties (Article 51A) of the Indian Constitution along with other Constitutional provisions while teaching any subject or performing any activity. It will also appropriately integrate environmental awareness and sensitivity towards its conservation and sustainable development, so that environment education becomes an integral part of school curricula.

5.25. Special shorter local teacher education programmes will also be available at BITEs, DIETs, or at school complexes themselves for eminent local persons who can be hired to teach at schools or school complexes as 'master instructors', for the purpose of promoting local professions, knowledge, and skills, e.g., local art, music, agriculture, business, sports, carpentry, and other vocational crafts.

5.26. Shorter post-B.Ed. certification courses will also be made widely available, at multidisciplinary colleges and universities, to teachers who may wish to move into more specialized areas of teaching, such as the teaching of students with disabilities, or into leadership and management positions in the schooling system, or to move from one stage to another between foundational, preparatory, middle, and secondary stages.

5.27. It is recognized that there may be several pedagogical approaches internationally for teaching particular subjects; NCERT will study, research, document, and compile the varied international pedagogical approaches for teaching different subjects and make recommendations on what can be learnt and assimilated from these approaches into the pedagogies being practiced in India.

5.28. By 2021, a new and comprehensive National Curriculum Framework for Teacher Education, NCFTE 2021, will be formulated by the NCTE in consultation with NCERT, based on the principles of this National Education Policy 2020. The framework will be developed after discussions with all stakeholders including State Governments, relevant Ministries/Departments of Central Government and various expert bodies, and will be made available in all regional languages. The NCFTE 2021 will also factor in the requirements of teacher education curricula for vocational education. The NCFTE will thereafter be revised once every 5-10 years by reflecting the changes in revised NCFs as well as emerging needs in teacher education.

5.29. Finally, in order to fully restore the integrity of the teacher education system, stringent action will be taken against substandard stand-alone Teacher Education Institutions (TEIs) running in the country, including shutting them down, if required.

6. Equitable and Inclusive Education: Learning for All

6.1. Education is the single greatest tool for achieving social justice and equality. Inclusive and equitable education - while indeed an essential goal in its own right - is also critical to achieving an inclusive and equitable society in which every citizen has the opportunity to dream, thrive, and contribute to the nation. The education system must aim to benefit India's children so that no child loses any opportunity to learn and excel because of circumstances of birth or background. This Policy reaffirms that bridging the social category gaps in access, participation, and learning outcomes in school education will continue to be one of the major goals of all education sector development programmes. This Chapter may be read in conjunction with Chapter 14 which discusses analogous issues of Equity and Inclusion in Higher Education.

6.2. While the Indian education system and successive government policies have made steady progress towards bridging gender and social category gaps in all levels of school education, large disparities still remain - especially at the secondary level - particularly for socio-economically disadvantaged groups that have been historically underrepresented in education. Socio-Economically Disadvantaged Groups (SEDGs) can be broadly categorized based on gender identities (particularly female and transgender individuals), socio-cultural identities (such as Scheduled Castes, Scheduled Tribes, OBCs, and minorities), geographical identities (such as students from villages, small towns, and aspirational districts), disabilities (including learning disabilities), and socio-economic conditions (such as migrant communities, low income households, children in vulnerable situations, victims of or children of victims of trafficking, orphans including child beggars in urban areas, and the urban poor). While overall enrolments in schools decline steadily from Grade 1 to Grade 12, this decline in enrolments is significantly more pronounced for many of these SEDGs, with even greater declines for female students within each of these SEDGs and often even steeper in higher education. A brief status overview of the SEDGs that come within socio-cultural identities is given in following sub-sections.

6.2.1. According to U-DISE 2016-17 data, about 19.6% of students belong to Scheduled Castes at the primary level, but this fraction falls to 17.3% at the higher secondary level. These enrolment drop-offs are more severe for Scheduled Tribes students (10.6% to 6.8%), and differently-abled children (1.1% to 0.25%), with even greater declines for female students within each of these categories. The decline in enrolment in higher education is even steeper.

6.2.2. A multiplicity of factors, including lack of access to quality schools, poverty, social mores & customs, and language have had a detrimental effect on rates of enrolment and retention among the Scheduled Castes. Bridging these gaps in access, participation, and learning outcomes of children belonging to Scheduled Castes will continue to be one of the major goals. Also, the Other Backward Classes (OBCs) which have been identified on the basis of historically being socially and educationally backward also need special focus.

6.2.3. Tribal communities and children from Scheduled Tribes also face disadvantages at multiple levels due to various historical and geographical factors. Children from tribal communities often find their school education irrelevant and foreign to their lives, both culturally and academically. While several programmatic interventions to uplift children from tribal communities are currently in place, and will continue to be pursued, special mechanisms need to be made to ensure that children belonging to tribal communities receive the benefits of these interventions.

6.2.4. Minorities are also relatively underrepresented in school and higher education. The Policy acknowledges the importance of interventions to promote education of children belonging to all minority communities, and particularly those communities that are educationally underrepresented.

6.2.5. The Policy also recognizes the importance of creating enabling mechanisms for providing Children With Special Needs (CWSN) or *Divyang*, the same opportunities of obtaining quality education as any other child.

6.2.6. Separate strategies will be formulated for focused attention on reducing the social category gaps in school education as outlined in the following sub-sections.

6.3. The critical problems and recommendations regarding ECCE, foundational literacy and numeracy, access, enrolment and attendance discussed in Chapters 1–3, are particularly relevant and important for underrepresented and disadvantaged groups. Therefore, the measures from Chapters 1–3 will be targeted in a concerted way for SEDGs.

6.4. In addition, there have been various successful policies and schemes such as targeted scholarships, conditional cash transfers to incentivize parents to send their children to school, providing bicycles for transport, etc., that have significantly increased participation of SEDGs in the schooling system in certain areas. These successful policies and schemes must be significantly strengthened across the country.

6.5. It will also be essential to take into account research that ascertains which measures are particularly effective for certain SEDGs. For example, providing bicycles and organizing cycling and walking groups to provide access to school have been shown to be particularly powerful methods in increasing participation of female students - even at lesser distances - because of the safety benefits and comfort to parents that they provide. One-on-one teachers and tutors, peer tutoring, open schooling, appropriate infrastructure, and suitable technological interventions to ensure access can be particularly effective for certain children with disabilities. Schools providing quality ECCE reap the greatest dividends for children who come from families that are economically disadvantaged. Meanwhile, counsellors and/or well-trained social workers that work with and connect with students, parents, schools, and teachers in order to improve attendance and learning outcomes have been found to be especially effective for children in urban poor areas.

6.6. Data shows that certain geographical areas contain significantly larger proportions of SEDGs. Also, there are geographical locations that have been identified as Aspirational Districts which require special interventions for promoting their educational development. Hence, it is recommended that regions of the country with large populations from educationally-disadvantaged SEDGs should be declared Special Education Zones (SEZs), where all the schemes and policies are implemented to the maximum through additional concerted efforts, in order to truly change their educational landscape.

6.7. It must be noted that women cut across all underrepresented groups, making up about half of all SEDGs. Unfortunately, the exclusion and inequity that SEDGs face is only amplified for the women in these SEDGs. The policy additionally recognizes the special and critical role that women play in society and in shaping social mores; therefore, providing a quality education to girls is the best way to increase the education levels for these SEDGs, not just in the present but also in future generations. The policy thus recommends that the policies and schemes designed to include students from SEDGs should be especially targeted towards girls in these SEDGs.

6.8. In addition, the Government of India will constitute a 'Gender-Inclusion Fund' to build the nation's capacity to provide equitable quality education for all girls as well as transgender students. The fund will be available to States to implement priorities determined by the Central government critical for assisting female and transgender children in gaining access to education (such as the provisions of sanitation and toilets, bicycles, conditional cash transfers, etc.); funds will also enable States to support and scale effective community-based interventions that address local context-specific barriers to female and transgender children's access to and participation in education. Similar 'Inclusion Fund' schemes shall also be developed to address analogous access issues for other SEDGs. In essence, this Policy aims to eliminate any remaining disparity in access to education (including vocational education) for children from any gender or other socio-economically disadvantaged group.

6.9. Free boarding facilities will be built - matching the standard of Jawahar Navodaya Vidyalayas - in school locations where students may have to come from far, and particularly for students who from socio-economically disadvantaged backgrounds, with suitable arrangements for the safety of all children, especially girls. Kasturba Gandhi Balika Vidyalayas will be strengthened and expanded to increase the participation in quality schools (up to Grade 12) of girls from socio-economically disadvantaged backgrounds. Additional Jawahar Navodaya Vidyalayas and Kendriya Vidyalayas will be built around the country, especially in aspirational districts, Special Education Zones, and other disadvantaged areas, to increase high-quality educational opportunities. Pre-school sections covering at least one year of early childhood care and education will be added to Kendriya Vidyalayas and other primary schools around the nation, particularly in disadvantaged areas.

6.10. Ensuring the inclusion and equal participation of children with disabilities in ECCE and the schooling system will also be accorded the highest priority. Children with disabilities will be enabled to fully participate in the regular schooling process from the Foundational Stage to higher education. The Rights of Persons with Disabilities (RPWD) Act 2016 defines inclusive education as a 'system of education wherein students with and without disabilities learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities'. This Policy is in complete consonance with the provisions of the RPWD Act 2016 and endorses all its recommendations with regard to school education. While preparing the National Curriculum Framework, NCERT will ensure that consultations are held with expert bodies such as National Institutes of DEPwD.

6.11. To this end, schools/school complexes will be provided resources for the integration of children with disabilities, recruitment of special educators with cross-disability training, and for the establishment of resource centres, wherever needed, especially for children with severe or multiple disabilities. Barrier free access for all children with disabilities will be enabled as per the RPWD Act. Different categories of children with disabilities have differing needs. Schools and school complexes will work and be supported for providing all children with disabilities accommodations and support

mechanisms tailored to suit their needs and to ensure their full participation and inclusion in the classroom. In particular, assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) will be made available to help children with disabilities integrate more easily into classrooms and engage with teachers and their peers. This will apply to all school activities including arts, sports, and vocational education. NIOS will develop high-quality modules to teach Indian Sign Language, and to teach other basic subjects using Indian Sign Language. Adequate attention will be paid to the safety and security of children with disabilities.

6.12. As per the RPWD Act 2016, children with benchmark disabilities shall have the choice of regular or special schooling. Resource centres in conjunction with special educators will support the rehabilitation and educational needs of learners with severe or multiple disabilities and will assist parents/guardians in achieving high-quality home schooling and skilling for such students as needed. Home-based education will continue to be a choice available for children with severe and profound disabilities who are unable to go to schools. The children under home-based education must be treated as equal to any other child in the general system. There shall be an audit of home-based education for its efficiency and effectiveness using the principle of equity and equality of opportunity. Guidelines and standards for home-based schooling shall be developed based on this audit in line with the RPWD Act 2016. While it is clear that the education of all children with disabilities is the responsibility of the State, technology-based solutions will be used for the orientation of parents/caregivers along with wide-scale dissemination of learning materials to enable parents/caregivers to actively support their children's learning needs will be accorded priority.

6.13. Most classrooms have children with specific learning disabilities who need continuous support. Research is clear that the earlier such support begins, the better the chances of progress. Teachers must be helped to identify such learning disabilities early and plan specifically for their mitigation. Specific actions will include the use of appropriate technology allowing and enabling children to work at their own pace, with flexible curricula to leverage each child's strengths, and creating an ecosystem for appropriate assessment and certification. Assessment and certification agencies, including the proposed new National Assessment Centre, PARAKH, will formulate guidelines and recommend appropriate tools for conducting such assessment, from the foundational stage to higher education (including for entrance exams), in order to ensure equitable access and opportunities for all students with learning disabilities.

6.14. The awareness and knowledge of how to teach children with specific disabilities (including learning disabilities) will be an integral part of all teacher education programmes, along with gender sensitization and sensitization towards all underrepresented groups in order to reverse their underrepresentation.

6.15. Alternative forms of schools, will be encouraged to preserve their traditions or alternative pedagogical styles. At the same time, they will be supported to integrate the subject and learning areas prescribed by the NCFSE into their curricula in order to reduce and eventually eliminate the underrepresentation of children from these schools in higher education. In particular, financial assistance will be provided to introduce science, mathematics, social studies, Hindi, English, State languages, or other relevant subjects in the curriculum, as may be desired by these schools. This would enable children studying in these schools to attain the learning outcomes defined for Grades 1–12. Furthermore, students in such schools would be encouraged to appear for State or other Board examinations and assessments by the NTA, and thereby enroll in higher education institutions. Capacities of teachers in the teaching of science, mathematics, language, and social studies will be developed including orientation to new pedagogical practices. Libraries and laboratories will be strengthened and adequate reading materials like books, journals, etc., and other teaching-learning materials will be made available.

6.16. Within SEDGs, and with respect to all the above policy points, special attention will be given to reduce the disparities in the educational development of Scheduled Castes and Scheduled Tribes. As a part of the efforts to enhance participation in school education, special hostels in dedicated regions, bridge courses, and financial assistance through fee waivers and scholarships will be offered to

talented and meritorious students from all SEDGs on a larger scale, especially at the secondary stage of education, to facilitate their entry into higher education.

6.17. Under the aegis of the Ministry of Defence, State Governments may encourage opening NCC wings in their secondary and higher secondary schools, including those located in tribal dominated areas. This will enable harnessing of the natural talent and unique potential of students, which in turn would help them to aspire to a successful career in the defence forces.

6.18. All scholarships and other opportunities and schemes available to students from SEDGs will be coordinated and announced by a single agency and website to ensure that all students are aware of, and may apply in a simplified manner on such a 'single window system', as per eligibility.

6.19. All the above policies and measures are absolutely critical to attaining full inclusion and equity for all SEDGs - but they are not sufficient. What is also required is a change in school culture. All participants in the school education system, including teachers, principals, administrators, counsellors, and students, will be sensitized to the requirements of all students, the notions of inclusion and equity, and the respect, dignity, and privacy of all persons. Such an educational culture will provide the best pathway to help students become empowered individuals who, in turn, will enable society to transform into one that is responsible towards its most vulnerable citizens. Inclusion and equity will become a key aspect of teacher education (and training for all leadership, administrative, and other positions in schools); efforts will be made to recruit more high-quality teachers and leaders from SEDGs in order to bring in excellent role models for all students.

6.20. Students will be sensitized through this new school culture, brought in by teachers, trained social workers and counsellors as well as through corresponding changes to bring in an inclusive school curriculum. The school curriculum will include, early on, material on human values such as respect for all persons, empathy, tolerance, human rights, gender equality, non-violence, global citizenship, inclusion, and equity. It would also include more detailed knowledge of various cultures, religions, languages, gender identities, etc. to sensitize and develop respect for diversity. Any biases and stereotypes in school curriculum will be removed, and more material will be included that is relevant and relatable to all communities.

7. Efficient Resourcing and Effective Governance through School Complexes/Clusters

7.1. While the establishment of primary schools in every habitation across the country-driven by the Sarva Shiksha Abhiyan (SSA), now subsumed under the Samagra Shiksha Scheme and other important efforts across the States - has helped to ensure near-universal access to primary schools, it has also led to the development of numerous very small schools. According to U-DISE 2016–17 data, nearly 28% of India's public primary schools and 14.8% of India's upper primary schools have less than 30 students. The average number of students per grade in the elementary schooling system (primary and upper primary, i.e., Grades 1–8) is about 14, with a notable proportion having below 6; during the year 2016–17, there were 1,08,017 single-teacher schools, the majority of them (85743) being primary schools serving Grades 1–5.

7.2. These small school sizes have rendered it economically suboptimal and operationally complex to run good schools, in terms of deployment of teachers as well as the provision of critical physical resources. Teachers often teach multiple grades at a time, and teach multiple subjects, including subjects in which they may have no prior background; key areas such as music, arts, and sports are too often simply not taught; and physical resources, such as lab and sports equipment and library books, are simply not available across schools.

7.3. The isolation of small schools also has a negative effect on education and the teaching-learning process. Teachers function best in communities and teams, and so do students. Small schools also present a systemic challenge for governance and management. The geographical dispersion, challenging access conditions, and the very large numbers of schools make it difficult to reach all schools equally. Administrative structures have not been aligned with the increases in the number of school or with the unified structure of the Samagra Shiksha Scheme.

7.4. Although consolidation of schools is an option that is often discussed, it must be carried out very judiciously, and only when it is ensured that there is no impact on access. Such measures are nevertheless likely to result only in limited consolidation, and would not solve the overall structural problem and challenges presented by the large numbers of small schools.

7.5. These challenges will, by 2025, be addressed by State/UT governments by adopting innovative mechanisms to group or rationalize schools. The objective behind this intervention would be to ensure that every school has: (a) adequate number of counsellors/trained social workers and teachers (shared or otherwise) for teaching all subjects including art, music science, sports, languages, vocational subjects, etc; (b) adequate resources (shared or otherwise), such as a library, science labs, computer labs, skill labs, playgrounds, sports equipment and facilities, etc.; (c) a sense of community is built to overcome the isolation of teachers, students, and schools, through joint professional development programmes, sharing of teaching-learning content, joint content development, holding joint activities such as art and science exhibitions, sports meets, quizzes and debates, and fairs; (d) cooperation and support across schools for the education of children with disabilities; and (e) improved governance of the schooling system by devolving all finer decisions, to Principals, teachers, and other stakeholders within each group of schools and treating such a group of schools, which range from the foundational stage through the secondary stage, as an integrated semi-autonomous unit.

7.6. One possible mechanism for accomplishing the above would be the establishment of a grouping structure called the school complex, consisting of one secondary school together with all other schools offering lower grades in its neighbourhood including Anganwadis, in a radius of five to ten kilometers. This suggestion was first made by the Education Commission (1964–66) but was left unimplemented. This Policy strongly endorses the idea of the school complex/cluster, wherever possible. The aim of the school complex/cluster will be greater resource efficiency and more effective functioning, coordination, leadership, governance, and management of schools in the cluster.

7.7. The establishment of school complexes/clusters and the sharing of resources across complexes will have a number of other benefits as a consequence, such as improved support for children with disabilities, more topic-centred clubs and academic/sports/arts/crafts events across school complexes, better incorporation of art, music, language, vocational subjects, physical education, and other subjects in the classroom through the sharing of teachers in these subjects including use of ICT tools to conduct virtual classes, better student support, enrolment, attendance, and performance through the sharing of social workers and counsellors, and School Complex Management Committees (rather than simply School Management Committees) for more robust and improved governance, monitoring, oversight, innovations, and initiatives by local stakeholders. Building such larger communities of schools, school leaders, teachers, students, supporting staff, parents, and local citizens would energize and empower the schooling system, and in a resource-efficient manner.

7.8. The governance of schools will also improve and become far more efficient with school complexes/clusters. First, the DSE will devolve authority to the school complex/cluster, which will act as a semi-autonomous unit. The District Education Officer (DEO) and the Block Education Officers (BEO) will interact primarily with each school complex/cluster as a single unit and facilitate its work. The complex itself will perform certain tasks delegated by the DSE and will deal with the individual schools within it. The school complex/cluster will be given significant autonomy by the DSE to innovate towards providing integrated education and to experiment with pedagogies, curriculum, etc., while adhering to the National Curricular Framework (NCF) and State Curricular Framework (SCF). Under this organization, schools will gain in strength, will be able to exercise greater freedom, and will contribute towards making the complex more innovative and responsive. Meanwhile, the DSE will be able to focus on the aggregate level goals that need to be achieved, improving overall system effectiveness.

7.9. The culture of working to a plan, both short-term and long-term ones, will be developed through such complexes/clusters. Schools will develop their plans (SDPs) with the involvement of their SMCs. These plans will then become the basis for the creation of School Complex/Cluster Development Plans (SCDPs). The SCDP will also involve the plans of all other institutions

associated with the school complex, such as vocational education institutions, and will be created by the principals and teachers of the school complex with the involvement of the SCMC and will be made available publicly. The plans will include human resources, learning resources, physical resources and infrastructure, improvement initiatives, financial resources, school culture initiatives, teacher development plans, and educational outcomes. It will detail the efforts to leverage the teachers and students across the school complex to develop vibrant learning communities. The SDP and SCDP will be the primary mechanism to align all stakeholders of the school, including the DSE. The SMC and SCMC will use the SDP and SCDP for oversight of the functioning and direction of the school and will assist in the execution of these plans. The DSE, through its relevant official, e.g., the BEO, will endorse and confirm the SCDP of each school complex. It will then provide the resources (financial, human, physical, etc.) necessary to achieve the SCDPs, both short-term (1-year) and long-term (3-5 years). It will also provide all other relevant support to the school complexes to achieve the educational outcomes. The DSE and the SCERT may share specific norms (e.g., financial, staffing, process) and frameworks for development of the SDP and SCDP with all schools, which may be revised periodically.

7.10. To further enhance cooperation and positive synergy among schools, including between public and private schools, the twinning/pairing of one public school with one private school will be adopted across the country, so that such paired schools may meet/interact with each other, learn from each other, and also share resources, if possible. Best practices of private schools will be documented, shared, and institutionalized in public schools, and vice versa, where possible.

7.11. Every State will be encouraged to strengthen existing or establish "Bal Bhavans" where children of all ages can visit once a week (e.g., on weekends) or more often, as a special daytime boarding school, to partake in art-related, career-related, and play-related activities. Such Bal Bhavans may be incorporated as a part of school complexes/clusters if possible.

7.12. The school should be a point of celebration and honour for the whole community. The dignity of the school as an institution should be restored and important dates, such as the foundation day of the school, will be celebrated along with the community and the list of important alumni may be displayed and honoured. Furthermore, the un-utilized capacity of school infrastructure could be used to promote social, intellectual, and volunteer activities for the community and to promote social cohesion during non-teaching / schooling hours and may be used as a "Samajik Chetna Kendra".

8. Standard-setting and Accreditation for School Education

8.1. The goal of the school education regulatory system must be to continually improve educational outcomes; it must not overly restrict schools, prevent innovation, or demoralize teachers, principals, and students. All in all, regulation must aim to empower schools and teachers with trust, enabling them to strive for excellence and perform at their very best, while ensuring the integrity of the system through the enforcement of complete transparency and full public disclosure of all finances, procedures, and educational outcomes.

8.2. At present, all main functions of governance and regulation of the school education system - namely, the provision of public education, the regulation of education institutions, and policymaking - are handled by a single body, i.e., the Department of School Education or its arms. This leads to conflict of interests and excessive centralized concentration of power; it also leads to ineffective management of the school system, as efforts towards quality educational provision are often diluted by the focus on the other roles, particularly regulation, that the Departments of School Education also perform.

8.3. The current regulatory regime also has not been able to curb the commercialization and economic exploitation of parents by many for-profit private schools, yet at the same time it has all too often inadvertently discouraged public-spirited private/philanthropic schools. There has been far too much asymmetry between the regulatory approaches to public and private schools, even though the goals of both types of schools should be the same: to provide quality education.

8.4. The public education system is the foundation of a vibrant democratic society, and the way it is run must be transformed and invigorated in order to achieve the highest levels of educational outcomes for the nation. At the same time, the private/philanthropic school sector must also be encouraged and enabled to play a significant and beneficial role.

8.5. The key principles and recommendations of this Policy regarding the State school education system, the independent responsibilities within that system, and the approach to its regulation are as follows:

(a) The Department of School Education, which is the apex state-level body in school education, will be responsible for overall monitoring and policymaking for continual improvement of the public education system; it will not be involved with the provision and operation of schools or with the regulation of schools, in order to ensure due focus on the improvement of public schools and to eliminate conflict of interests.

(b) The educational operations and service provision for the public schooling system of the whole State will be handled by the Directorate of School Education (including the offices of the DEO and BEO, etc.); it will work independently to implement policies regarding educational operations and provision.

(c) An effective quality self-regulation or accreditation system will be instituted for all stages of education including pre-school education - private, public, and philanthropic - to ensure compliance with essential quality standards. To ensure that all schools follow certain minimal professional and quality standards, States/UTs will set up an independent, State-wide, body called the State School Standards Authority (SSSA). The SSSA will establish a minimal set of standards based on basic parameters (namely, safety, security, basic infrastructure, number of teachers across subjects and grades, financial probity, and sound processes of governance), which shall be followed by all schools. The framework for these parameters will be created by the SCERT in consultation with various stakeholders, especially teachers and schools.

    Transparent public self-disclosure of all the basic regulatory information, as laid down by the SSSA, will be used extensively for public oversight and accountability. The dimensions on which information has to be self-disclosed, and the format of disclosure will be decided by the SSSA in accordance with global best practices for standard-setting for schools. This information will have to be made available and kept updated and accurate by all schools, on the aforementioned public website maintained by the SSSA and on the schools' websites. Any complaints or grievances from stakeholders or others arising out of the information placed in the public domain shall be adjudicated by the SSSA. Feedback from randomly selected students will be solicited online to ensure valuable input at regular intervals. Technology will be employed suitably to ensure efficiency and transparency in all work of the SSSA. This will bring down significantly the heavy load of regulatory mandates currently borne by schools.

(d) Academic matters, including academic standards and curricula in the State will be led by the SCERT (with close consultation and collaboration with the NCERT), which will be reinvigorated as an institution. The SCERT will develop a School Quality Assessment and Accreditation Framework (SQAAF) through wide consultations with all stakeholders. The SCERT will also lead a "change management process" for the reinvigoration of CRCs, BRCs, and DIETs which must change the capacity and work culture of these institutions in 3 years, developing them into vibrant institutions of excellence. Meanwhile, certification of competencies of students at the school-leaving stage will be handled by the Boards of Assessment/Examination in each State.

8.6. The culture, structures, and systems that empower and provide adequate resources to schools, institutions, teachers, officials, communities, and other stakeholders, will also build concomitant accountability. Each stakeholder and participant of the education system will be accountable to perform their role with the highest level of integrity, full commitment, and exemplary work ethic.

Each role of the system will have explicitly articulated role expectations and rigorous assessment of their performance vis-à-vis these expectations. The assessment system will be objective and developmentally oriented, while ensuring accountability. It will have multiple sources of feedback and assessment, to ensure a full view of the performance (and will not just be linked simplistically, e.g., to 'marks' of students). The assessment will recognize that outcomes such as educational attainment of students have multiple intervening variables and extraneous influences. It will also recognize that education requires teamwork, particularly at the level of the school. Promotion, recognition, and accountability of all individuals will be based on such performance assessment. All functionaries will be responsible to ensure that this development, performance, and accountability system is run with high integrity, and systematically, within their span of control.

8.7. Public and private schools (except the schools that are managed/aided/controlled by the Central government) will be assessed and accredited on the same criteria, benchmarks, and processes, emphasizing online and offline public disclosure and transparency, so as to ensure that public-spirited private schools are encouraged and not stifled in any way. Private philanthropic efforts for quality education will be encouraged - thereby affirming the public-good nature of education - while protecting parents and communities from arbitrary increases in tuition fees. Public disclosure on the school website and on the SSSA website - for both public and private schools - would include (at the very least) information on the numbers of classrooms, students, and teachers, subjects taught, any fees, and overall student outcomes on standardized evaluations such as the NAS and SAS. For schools controlled/managed/aided by the Central government, the CBSE in consultation with the MHRD shall prepare a framework. All the education institutions will be held to similar standards of audit and disclosure as a 'not-for-profit' entity. Surpluses, if any, will be reinvested in the educational sector.

8.8. The standard-setting/regulatory framework and the facilitating systems for school regulation, accreditation, and governance shall be reviewed to enable improvements on the basis of the learnings and experiences gained in the last decade. This review will aim to ensure that all students, particularly students from underprivileged and disadvantaged sections, shall have universal, free and compulsory access to high-quality and equitable schooling from early childhood care and education (age 3 onwards) through higher secondary education (i.e., until Grade 12). The overemphasis on inputs, and the mechanistic nature of their specifications – physical and infrastructural – will be changed and requirements made more responsive to realities on the ground, e.g., regarding land areas and room sizes, practicalities of playgrounds in urban areas, etc. These mandates will be adjusted and loosened, leaving suitable flexibility for each school to make its own decisions based on local needs and constraints, while ensuring safety, security, and a pleasant and productive learning space. Educational outcomes and the transparent disclosure of all financial, academic, and operational matters will be given due importance and will be incorporated suitably in the assessment of schools. This will further improve India's progress towards achieving Sustainable Development Goal 4 (SDG4) of ensuring free, equitable, and quality primary and secondary education for all children.

8.9. The aim of the public-school education system will be to impart the highest quality education so that it becomes the most attractive option for parents from all walks of life for educating their children.

8.10. For a periodic 'health check-up' of the overall system, a sample-based National Achievement Survey (NAS) of student learning levels will be carried out by the proposed new National Assessment Centre, PARAKH with suitable cooperation with other governmental bodies- such as the NCERT– that may assist in assessment procedures as well as data analysis. The assessment will cover students across government as well as private schools. States will also be encouraged to conduct their own census-based State Assessment Survey (SAS), the results of which will be used only for developmental purposes, public disclosure by schools of their overall and anonymized student outcomes, and for continuous improvement of the school education system. Until the establishment of the proposed new National Assessment Centre, PARAKH, NCERT may continue to carry out NAS.

8.11. Finally, the children and adolescents enrolled in schools must not be forgotten in this whole process; after all, the school system is designed for them. Careful attention must be paid to their safety and rights- particularly girl children - and the various difficult issues faced by adolescents, such as substance or drug abuse and forms of discrimination and harassment including violence, with clear, safe, and efficient mechanisms for reporting and for due process on any infractions against children's/adolescents' rights or safety. The development of such mechanisms that are effective, timely, and well-known to all students will be accorded high priority.

Part II. HIGHER EDUCATION

9. Quality Universities and Colleges: A New and Forward-looking Vision for India's Higher Education System

9.1. Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially-conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. Higher education significantly contributes towards sustainable livelihoods and economic development of the nation. As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education.

9.1.1. Given the 21st century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. It must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education must enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. It must prepare students for more meaningful and satisfying lives and work roles and enable economic independence.

9.1.2. For the purpose of developing holistic individuals, it is essential that an identified set of skills and values will be incorporated at each stage of learning, from pre-school to higher education.

9.1.3. At the societal level, higher education must enable the development of an enlightened, socially conscious, knowledgeable, and skilled nation that can find and implement robust solutions to its own problems. Higher education must form the basis for knowledge creation and innovation thereby contributing to a growing national economy. The purpose of quality higher education is, therefore, more than the creation of greater opportunities for individual employment. It represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.

9.2. Some of the major problems currently faced by the higher education system in India include:

(a) a severely fragmented higher educational ecosystem;
(b) less emphasis on the development of cognitive skills and learning outcomes;
(c) a rigid separation of disciplines, with early specialisation and streaming of students into narrow areas of study;
(d) limited access particularly in socio-economically disadvantaged areas, with few HEIs that teach in local languages
(e) limited teacher and institutional autonomy;
(f) inadequate mechanisms for merit-based career management and progression of faculty and institutional leaders;
(g) lesser emphasis on research at most universities and colleges, and lack of competitive peer-reviewed research funding across disciplines;
(h) suboptimal governance and leadership of HEIs;
(i) an ineffective regulatory system; and
(j) large affiliating universities resulting in low standards of undergraduate education.

9.3. This policy envisions a complete overhaul and re-energising of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion. The policy's vision includes the following key changes to the current system:

(a) moving towards a higher educational system consisting of large, multidisciplinary universities and colleges, with at least one in or near every district, and with more HEIs across India that offer medium of instruction or programmes in local/Indian languages;
(b) moving towards a more multidisciplinary undergraduate education;
(c) moving towards faculty and institutional autonomy;
(d) revamping curriculum, pedagogy, assessment, and student support for enhanced student experiences;
(e) reaffirming the integrity of faculty and institutional leadership positions through merit-appointments and career progression based on teaching, research, and service;
(f) establishment of a National Research Foundation to fund outstanding peer-reviewed research and to actively seed research in universities and colleges;
(g) governance of HEIs by high qualified independent boards having academic and administrative autonomy;
(h) "light but tight" regulation by a single regulator for higher education;
(i) increased access, equity, and inclusion through a range of measures, including greater opportunities for outstanding public education; scholarships by private/philanthropic universities for disadvantaged and underprivileged students; online education, and Open Distance Learning (ODL); and all infrastructure and learning materials accessible and available to learners with disabilities.

10. Institutional Restructuring and Consolidation

10.1. The main thrust of this policy regarding higher education is to end the fragmentation of higher education by transforming higher education institutions into large multidisciplinary universities, colleges, and HEI clusters/Knowledge Hubs, each of which will aim to have 3,000 or more students. This would help build vibrant communities of scholars and peers, break down harmful silos, enable students to become well-rounded across disciplines including artistic, creative, and analytic subjects as well as sports, develop active research communities across disciplines including cross-disciplinary research, and increase resource efficiency, both material and human, across higher education.

10.2. Moving to large multidisciplinary universities and HEI clusters is thus the highest recommendation of this policy regarding the structure of higher education. The ancient Indian universities Takshashila, Nalanda, Vallabhi, and Vikramshila, which had thousands of students from India and the world studying in vibrant multidisciplinary environments, amply demonstrated the type of great success that large multidisciplinary research and teaching universities could bring. India urgently needs to bring back this great Indian tradition to create well-rounded and innovative individuals, and which is already transforming other countries educationally and economically.

10.3. This vision of higher education will require, in particular, a new conceptual perception/understanding for what constitutes a higher education institution (HEI), i.e., a university or a college. A university will mean a multidisciplinary institution of higher learning that offers undergraduate and graduate programmes, with high quality teaching, research, and community engagement. The definition of university will thus allow a spectrum of institutions that range from those that place equal emphasis on teaching and research i.e., Research-intensive Universities, those that place greater emphasis on teaching but still conduct significant research i.e. Teaching-intensive Universities. Meanwhile, an Autonomous degree-granting College (AC) will refer to a large multidisciplinary institution of higher learning that grants undergraduate degrees and is primarily focused on undergraduate teaching though it would not be restricted to that and it need not be restricted to that and it would generally be smaller than a typical university.

10.4. A stage-wise mechanism for granting graded autonomy to colleges, through a transparent system of graded accreditation, will be established. Colleges will be encouraged, mentored, supported, and incentivized to gradually attain the minimum benchmarks required for each level of

accreditation. Over a period of time, it is envisaged that every college would develop into either an Autonomous degree-granting College, or a constituent college of a university - in the latter case, it would be fully a part of the university. With appropriate accreditations, Autonomous degree-granting Colleges could evolve into Research-intensive or Teaching-intensive Universities, if they so aspire.

10.5. It must be clearly stated that these three broad types of institutions are not in any natural way a rigid, exclusionary categorization, but are along a continuum. HEIs will have the autonomy and freedom to move gradually from one category to another, based on their plans, actions, and effectiveness. The most salient marker for these categories of institutions will be the focus of their goals and work. The Accreditation System will develop and use appropriately different and relevant norms across this range of HEIs. However, the expectations of high quality of education, and of teaching-learning, across all HEIs will be the same.

10.6. In addition to teaching and research, HEIs will have other crucial responsibilities, which they will discharge through appropriate resourcing, incentives, and structures. These include supporting other HEIs in their development, community engagement and service, contribution to various fields of practice, faculty development for the higher education system, and support to school education.

10.7. By 2040, all higher education institutions (HEIs) shall aim to become multidisciplinary institutions and shall aim to have larger student enrolments preferably in the thousands, for optimal use of infrastructure and resources, and for the creation of vibrant multidisciplinary communities. Since this process will take time, all HEIs will firstly plan to become multidisciplinary by 2030, and then gradually increase student strength to the desired levels.

10.8. More HEIs shall be established and developed in underserved regions to ensure full access, equity, and inclusion. There shall, by 2030, be at least one large multidisciplinary HEI in or near every district. Steps shall be taken towards developing high-quality higher education institutions both public and private that have medium of instruction in local/Indian languages or bilingually. The aim will be to increase the Gross Enrolment Ratio in higher education including vocational education from 26.3% (2018) to 50% by 2035. While a number of new institutions may be developed to attain these goals, a large part of the capacity creation will be achieved by consolidating, substantially expanding, and also improving existing HEIs.

10.9. Growth will be in both public and private institutions, with a strong emphasis on developing a large number of outstanding public institutions. There will be a fair and transparent system for determining increased levels of public funding support for public HEIs. This system will give an equitable opportunity for all public institutions to grow and develop, and will be based on transparent, pre-announced criteria from within the accreditation norms of the Accreditation System. HEIs delivering education of the highest quality as laid down in this Policy will be incentivized in expanding their capacity.

10.10. Institutions will have the option to run Open Distance Learning (ODL) and online programmes, provided they are accredited to do so, in order to enhance their offerings, improve access, increase GER, and provide opportunities for lifelong learning (SDG 4). All ODL programmes and their components leading to any diploma or degree will be of standards and quality equivalent to the highest quality programmes run by the HEIs on their campuses. Top institutions accredited for ODL will be encouraged and supported to develop high-quality online courses. Such quality online courses will be suitably integrated into curricula of HEIs, and blended mode will be preferred.

10.11. Single-stream HEIs will be phased out over time, and all will move towards becoming vibrant multidisciplinary institutions or parts of vibrant multidisciplinary HEI clusters, in order to enable and encourage high-quality multidisciplinary and cross-disciplinary teaching and research across fields. Single-stream HEIs will, in particular, add departments across different fields that would strengthen the single stream that they currently serve. Through the attainment of suitable accreditations, all HEIs will gradually move towards full autonomy - academic and administrative - in order to enable this vibrant culture. The autonomy of public institutions will be backed by adequate public financial

support and stability. Private institutions with a public-spirited commitment to high-quality equitable education will be encouraged.

10.12. The new regulatory system envisioned by this Policy will foster this overall culture of empowerment and autonomy to innovate, including by gradually phasing out the system of 'affiliated colleges' over a period of fifteen years through a system of graded autonomy, and to be carried out in a challenge mode. Each existing affiliating university will be responsible for mentoring its affiliated colleges so that they can develop their capabilities and achieve minimum benchmarks in academic and curricular matters; teaching and assessment; governance reforms; financial robustness; and administrative efficiency. All colleges currently affiliated to a university shall attain the required benchmarks over time to secure the prescribed accreditation benchmarks and eventually become autonomous degree-granting colleges. This will be achieved through a concerted national effort including suitable mentoring and governmental support for the same.

10.13. The overall higher education sector will aim to be an integrated higher education system, including professional and vocational education. This Policy and its approach will be equally applicable to all HEIs across all current streams, which would eventually merge into one coherent ecosystem of higher education.

10.14. University, worldwide, means a multidisciplinary institution of higher learning that offers undergraduate, graduate, and Ph.D programmes, and engages in high-quality teaching and research. The present complex nomenclature of HEIs in the country such as 'deemed to be university', 'affiliating university', 'affiliating technical university', 'unitary university' shall be replaced simply by 'university' on fulfilling the criteria as per norms.

11. Towards a More Holistic and Multidisciplinary Education

11.1. India has a long tradition of holistic and multidisciplinary learning, from universities such as Takshashila and Nalanda, to the extensive literatures of India combining subjects across fields. Ancient Indian literary works such as Banabhatta's Kadambari described a good education as knowledge of the 64 Kalaas or arts; and among these 64 'arts' were not only subjects, such as singing and painting, but also 'scientific 'fields, such as chemistry and mathematics, 'vocational ' fields such as carpentry and clothes-making, 'professional 'fields, such as medicine and engineering, as well as 'soft skills' such as communication, discussion, and debate. The very idea that all branches of creative human endeavour, including mathematics, science, vocational subjects, professional subjects, and soft skills should be considered 'arts', has distinctly Indian origins. This notion of a 'knowledge of many arts' or what in modern times is often called the 'liberal arts' (i.e., a liberal notion of the arts) must be brought back to Indian education, as it is exactly the kind of education that will be required for the 21st century.

11.2. Assessments of educational approaches in undergraduate education that integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) have consistently showed positive learning outcomes, including increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. Research is also improved and enhanced through a holistic and multidisciplinary education approach.

11.3. A holistic and multidisciplinary education would aim to develop all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

11.4. A holistic and multidisciplinary education, as described so beautifully in India's past, is indeed what is needed for the education of India to lead the country into the 21st century and the fourth industrial revolution. Even engineering institutions, such as IITs, will move towards more holistic and multidisciplinary education with more arts and humanities. Students of arts and humanities will aim to learn more science and all will make an effort to incorporate more vocational subjects and soft skills.

11.5. Imaginative and flexible curricular structures will enable creative combinations of disciplines for study, and would offer multiple entry and exit points, thus, removing currently prevalent rigid boundaries and creating new possibilities for life-long learning. Graduate-level, master's and doctoral education in large multidisciplinary universities, while providing rigorous research-based specialization, would also provide opportunities for multidisciplinary work, including in academia, government, and industry.

11.6. Large multidisciplinary universities and colleges will facilitate the move towards high-quality holistic and multidisciplinary education. Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialization in a subject or subjects. This will be encouraged by increased faculty and institutional autonomy in setting curricula. Pedagogy will have an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking.

11.7. Departments in Languages, Literature, Music, Philosophy, Indology, Art, Dance, Theatre, Education, Mathematics, Statistics, Pure and Applied Sciences, Sociology, Economics, Sports, Translation and Interpretation, and other such subjects needed for a multidisciplinary, stimulating Indian education and environment will be established and strengthened at all HEIs. Credits will be given in all Bachelor's Degree programmes for these subjects if they are done from such departments or through ODL mode when they are not offered in-class at the HEI.

11.8. Towards the attainment of such a holistic and multidisciplinary education, the flexible and innovative curricula of all HEIs shall include credit-based courses and projects in the areas of community engagement and service, environmental education, and value-based education. Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living. Value-based education will include the development of humanistic, ethical, Constitutional, and universal human values of truth (*satya*), righteous conduct (*dharma*), peace (*shanti*), love (*prem*), nonviolence (*ahimsa*), scientific temper, citizenship values, and also life-skills; lessons in *seva*/service and participation in community service programmes will be considered an integral part of a holistic education. As the world is becoming increasingly interconnected, Global Citizenship Education (GCED), a response to contemporary global challenges, will be provided to empower learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies. Finally, as part of a holistic education, students at all HEIs will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, etc., as well as research internships with faculty and researchers at their own or other HEIs/research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

11.9. The structure and lengths of degree programmes shall be adjusted accordingly. The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student. An Academic Bank of Credit (ABC) shall be established which would digitally store the academic credits earned from various recognized HEIs so that the degrees from an HEI can be awarded taking into account credits earned. The 4-year programme may also lead to a degree 'with

Research' if the student completes a rigorous research project in their major area(s) of study as specified by the HEI.

11.10. HEIs will have the flexibility to offer different designs of Master's programmes: (a) there may be a 2-year programme with the second year devoted entirely to research for those who have completed the 3-year Bachelor's programme; (b) for students completing a 4-year Bachelor's programme with Research, there could be a 1-year Master's programme; and (c) there may be an integrated 5-year Bachelor's/Master's programme. Undertaking a Ph.D. shall require either a Master's degree or a 4-year Bachelor's degree with Research. The M.Phil. programme shall be discontinued.

11.11. Model public universities for holistic and multidisciplinary education, at par with IITs, IIMs, etc., called MERUs (Multidisciplinary Education and Research Universities) will be set up and will aim to attain the highest global standards in quality education. They will also help set the highest standards for multidisciplinary education across India.

11.12. HEIs will focus on research and innovation by setting up start-up incubation centres; technology development centres; centres in frontier areas of research; greater industry-academic linkages; and interdisciplinary research including humanities and social sciences research. Given the scenario of epidemics and pandemics, it is critical that HEIs take the lead to undertake research in areas of infectious diseases, epidemiology, virology, diagnostics, instrumentation, vaccinology and other relevant areas. HEIs will develop specific hand holding mechanisms and competitions for promoting innovation among student communities. The NRF will function to help enable and support such a vibrant research and innovation culture across HEIs, research labs, and other research organizations.

12. Optimal Learning Environments and Support for Students

12.1. Effective learning requires a comprehensive approach that involves appropriate curriculum, engaging pedagogy, continuous formative assessment, and adequate student support. The curriculum must be interesting and relevant, and updated regularly to align with the latest knowledge requirements and to meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students, thus directly influencing learning outcomes. The assessment methods must be scientific, designed to continuously improve learning and test the application of knowledge. Last but not least, the development of capacities that promote student wellness such as fitness, good health, psycho-social well-being, and sound ethical grounding are also critical for high-quality learning.

Thus, curriculum, pedagogy, continuous assessment, and student support are the cornerstones for quality learning. Along with providing suitable resources and infrastructure, such as quality libraries, classrooms, labs, technology, sports/recreation areas, student discussion spaces, and dining areas, a number of initiatives will be required to ensure that learning environments are engaging and supportive, and enable all students to succeed.

12.2. First, in order to promote creativity, institutions and faculty will have the autonomy to innovate on matters of curriculum, pedagogy, and assessment within a broad framework of higher education qualifications that ensures consistency across institutions and programmes and across the ODL, online, and traditional 'in-class' modes. Accordingly, curriculum and pedagogy will be designed by institutions and motivated faculty to ensure a stimulating and engaging learning experience for all students, and continuous formative assessment will be used to further the goals of each programme. All assessment systems shall also be decided by the HEI, including those that lead to final certification. The Choice Based Credit System (CBCS) will be revised for instilling innovation and flexibility. HEIs shall move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs shall also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

12.3. Second, each institution will integrate its academic plans ranging from curricular improvement to quality of classroom transaction - into its larger Institutional Development Plan (IDP). Each institution will be committed to the holistic development of students and create strong internal systems for supporting diverse student cohorts in academic and social domains both inside and outside formal academic interactions in the classroom. For example, all HEIs will have mechanisms and opportunities for funding of topic-centred clubs and activities organized by students with the help of faculty and other experts as needed, such as clubs and events dedicated to science, mathematics, poetry, language, literature, debate, music, sports, etc. Over time, such activities could be incorporated into the curriculum once appropriate faculty expertise and campus student demand is developed. Faculty will have the capacity and training to be able to approach students not just as teachers, but also as mentors and guides.

12.4. Third, students from socio-economically disadvantaged backgrounds require encouragement and support to make a successful transition to higher education. Universities and colleges will thus be required to set up high-quality support centres and will be given adequate funds and academic resources to carry this out effectively. There will also be professional academic and career counselling available to all students, as well as counsellors to ensure physical, psychological and emotional well-being.

12.5. Fourth, ODL and online education provide a natural path to increase access to quality higher education. In order to leverage its potential completely, ODL will be renewed through concerted, evidence-based efforts towards expansion while ensuring adherence to clearly articulated standards of quality. ODL programmes will aim to be equivalent to the highest quality in-class programmes available. Norms, standards, and guidelines for systemic development, regulation, and accreditation of ODL will be prepared, and a framework for quality of ODL that will be recommendatory for all HEIs will be developed.

12.6. Finally, all programmes, courses, curricula, and pedagogy across subjects, including those in-class, online, and in ODL modes as well as student support will aim to achieve global standards of quality.

Internationalization

12.7. The various initiatives mentioned above will also help in having larger numbers of international students studying in India, and provide greater mobility to students in India who may wish to visit, study at, transfer credits to, or carry out research at institutions abroad, and vice versa. Courses and programmes in subjects, such as Indology, Indian languages, AYUSH systems of medicine, yoga, arts, music, history, culture, and modern India, internationally relevant curricula in the sciences, social sciences, and beyond, meaningful opportunities for social engagement, quality residential facilities and on-campus support, etc. will be fostered to attain this goal of global quality standards, attract greater numbers of international students, and achieve the goal of 'internationalization at home'.

12.8. India will be promoted as a global study destination providing premium education at affordable costs thereby helping to restore its role as a Vishwa Guru. An International Students Office at each HEI hosting foreign students will be set up to coordinate all matters relating to welcoming and supporting students arriving from abroad. Research/teaching collaborations and faculty/student exchanges with high-quality foreign institutions will be facilitated, and relevant mutually beneficial MOUs with foreign countries will be signed. High performing Indian universities will be encouraged to set up campuses in other countries, and similarly, selected universities e.g., those from among the top 100 universities in the world will be facilitated to operate in India. A legislative framework facilitating such entry will be put in place, and such universities will be given special dispensation regarding regulatory, governance, and content norms on par with other autonomous institutions of India. Furthermore, research collaboration and student exchanges between Indian institutions and global institutions will be promoted through special efforts. Credits acquired in foreign universities will be permitted, where appropriate as per the requirements of each HEI, to be counted for the award of a degree.

Student Activity and Participation

12.9. Students are the prime stakeholders in the education system. Vibrant campus life is essential for high-quality teaching-learning processes. Towards this end, students will be given plenty of opportunities for participation in sports, culture/arts clubs, eco-clubs, activity clubs, community service projects, etc. In every education institution, there shall be counselling systems for handling stress and emotional adjustments. Furthermore, a systematized arrangement shall be created to provide the requisite support to students from rural backgrounds, including increasing hostel facilities as needed. All HEIs will ensure quality medical facilities for all students in their institutions.

Financial support for students

12.10. Financial assistance to students shall be made available through various measures. Efforts will be made to incentivize the merit of students belonging to SC, ST, OBC, and other SEDGs. The National Scholarship Portal will be expanded to support, foster, and track the progress of students receiving scholarships. Private HEIs will be encouraged to offer larger numbers of free ships and scholarships to their students.

13. Motivated, Energized, and Capable Faculty

13.1. The most important factor in the success of higher education institutions is the quality and engagement of its faculty. Acknowledging the criticality of faculty in achieving the goals of higher education, various initiatives have been introduced in the past several years to systematize recruitment and career progression, and to ensure equitable representation from various groups in the hiring of faculty. Compensation levels of permanent faculty in public institutions have also been increased substantially. Various initiatives have also been taken towards providing faculty with professional development opportunities. However, despite these various improvements in the status of the academic profession, faculty motivation in terms of teaching, research, and service in HEIs remains far lower than the desired level. The various factors that lie behind low faculty motivation levels must be addressed to ensure that each faculty member is happy, enthusiastic, engaged, and motivated towards advancing her/his students, institution, and profession. To this end, the policy recommends the following initiatives to achieve the best, motivated, and capable faculty in HEIs.

13.2. As the most basic step, all HEIs will be equipped with the basic infrastructure and facilities, including clean drinking water, clean working toilets, blackboards, offices, teaching supplies, libraries, labs, and pleasant classroom spaces and campuses. Every classroom shall have access to the latest educational technology that enables better learning experiences.

13.3. Teaching duties also will not be excessive, and student-teacher ratios not too high, so that the activity of teaching remains pleasant and there is adequate time for interaction with students, conducting research, and other university activities. Faculty will be appointed to individual institutions and generally not be transferable across institutions so that they may feel truly invested in, connected to, and committed to their institution and community.

13.4. Faculty will be given the freedom to design their own curricular and pedagogical approaches within the approved framework, including textbook and reading material selections, assignments, and assessments. Empowering the faculty to conduct innovative teaching, research, and service as they see best will be a key motivator and enabler for them to do truly outstanding, creative work.

13.5. Excellence will be further incentivized through appropriate rewards, promotions, recognitions, and movement into institutional leadership. Meanwhile, faculty not delivering on basic norms will be held accountable.

13.6. In keeping with the vision of autonomous institutions empowered to drive excellence, HEIs will have clearly defined, independent, and transparent processes and criteria for faculty recruitment. Whereas the current recruitment process will be continued, a ‘tenure-track’ i.e., suitable probation period shall be put in place to further ensure excellence. There shall be a fast-track promotion system

for recognizing high impact research and contribution. A system of multiple parameters for proper performance assessment, for the purposes of 'tenure' i.e., confirmed employment after probation, promotion, salary increases, recognitions, etc., including peer and student reviews, innovations in teaching and pedagogy, quality and impact of research, professional development activities, and other forms of service to the institution and the community, shall be developed by each HEI and clearly enunciated in it's Institutional Development Plan (IDP).

13.7. The presence of outstanding and enthusiastic institutional leaders that cultivate excellence and innovation is the need of the hour. Outstanding and effective institutional leadership is extremely important for the success of an institution and of its faculty. Excellent faculty with high academic and service credentials as well as demonstrated leadership and management skills will be identified early and trained through a ladder of leadership positions. Leadership positions shall not remain vacant, but rather an overlapping time period during transitions in leadership shall be the norm to ensure the smooth running of institutions. Institutional leaders will aim to create a culture of excellence that will motivate and incentivize outstanding and innovative teaching, research, institutional service, and community outreach from faculty members and all HEI leaders.

14. Equity and Inclusion in Higher Education

14.1. Entry into quality higher education can open a vast array of possibilities that can lift both individuals as well as communities out of the cycles of disadvantage. For this reason, making quality higher education opportunities available to all individuals must be among the highest priorities. This Policy envisions ensuring equitable access to quality education to all students, with a special emphasis on SEDGs.

14.2. The dynamics and also many of the reasons for exclusion of SEDGs from the education system are common across school and higher education sectors. Therefore, the approach to equity and inclusion must be common across school and higher education. Furthermore, there must be continuity across the stages to ensure sustainable reform. Thus, the policy initiatives required to meet the goals of equity and inclusion in higher education must be read in conjunction with those for school education.

14.3. There are certain facets of exclusion, that are particular to or substantially more intense in higher education. These must be addressed specifically, and include lack of knowledge of higher education opportunities, economic opportunity cost of pursuing higher education, financial constraints, admission processes, geographical and language barriers, poor employability potential of many higher education programmes, and lack of appropriate student support mechanisms.

14.4. For this purpose, additional actions that are specific to higher education shall be adopted by all Governments and HEIs:

14.4.1. Steps to be taken by Governments

(a) Earmark suitable Government funds for the education of SEDGs
(b) Set clear targets for higher GER for SEDGs
(c) Enhance gender balance in admissions to HEIs
(d) Enhance access by establishing more high-quality HEIs in aspirational districts and Special Education Zones containing larger numbers of SEDGs
(e) Develop and support high-quality HEIs that teach in local/Indian languages or bilingually
(f) Provide more financial assistance and scholarships to SEDGs in both public and private HEIs
(g) Conduct outreach programmes on higher education opportunities and scholarships among SEDGs
(h) Develop and support technology tools for better participation and learning outcomes.

14.4.2. Steps to be taken by all HEIs

(a) Mitigate opportunity costs and fees for pursuing higher education
(b) Provide more financial assistance and scholarships to socio-economically disadvantaged students
(c) Conduct outreach on higher education opportunities and scholarships
(d) Make admissions processes more inclusive
(e) Make curriculum more inclusive
(f) Increase employability potential of higher education programmes
(g) Develop more degree courses taught in Indian languages and bilingually
(h) Ensure all buildings and facilities are wheelchair-accessible and disabled-friendly
(i) Develop bridge courses for students that come from disadvantaged educational backgrounds
(j) Provide socio-emotional and academic support and mentoring for all such students through suitable counselling and mentoring programmes
(k) Ensure sensitization of faculty, counsellor, and students on gender-identity issue and its inclusion in all aspects of the HEI, including curricula
(l) Strictly enforce all no-discrimination and anti-harassment rules
(m) Develop Institutional Development Plans that contain specific plans for action on increasing participation from SEDGs, including but not limited to the above items.

15. Teacher Education

15.1. Teacher education is vital in creating a pool of schoolteachers that will shape the next generation. Teacher preparation is an activity that requires multidisciplinary perspectives and knowledge, formation of dispositions and values, and development of practice under the best mentors. Teachers must be grounded in Indian values, languages, knowledge, ethos, and traditions including tribal traditions, while also being well-versed in the latest advances in education and pedagogy.

15.2. According to the Justice J. S. Verma Commission (2012) constituted by the Supreme Court, a majority of stand-alone TEIs - over 10,000 in number are not even attempting serious teacher education but are essentially selling degrees for a price. Regulatory efforts so far have neither been able to curb the malpractices in the system, nor enforce basic standards for quality, and in fact have had the negative effect of curbing the growth of excellence and innovation in the sector. The sector and its regulatory system are, therefore, in urgent need of revitalization through radical action, in order to raise standards and restore integrity, credibility, efficacy, and high quality to the teacher education system.

15.3. In order to improve and reach the levels of integrity and credibility required to restore the prestige of the teaching profession, the Regulatory System shall be empowered to take stringent action against substandard and dysfunctional teacher education institutions (TEIs) that do not meet basic educational criteria, after giving one year for remedy of the breaches. By 2030, only educationally sound, multidisciplinary, and integrated teacher education programmes shall be in force.

15.4. As teacher education requires multidisciplinary inputs, and education in high-quality content as well as pedagogy, all teacher education programmes must be conducted within composite multidisciplinary institutions. To this end, all multidisciplinary universities and colleges - will aim to establish, education departments which, besides carrying out cutting-edge research in various aspects of education, will also run B.Ed. programmes, in collaboration with other departments such as psychology, philosophy, sociology, neuroscience, Indian languages, arts, music, history, literature, physical education, science and mathematics. Moreover, all stand-alone TEIs will be required to convert to multidisciplinary institutions by 2030, since they will have to offer the 4-year integrated teacher preparation programme.

15.5. The 4-year integrated B.Ed. offered by such multidisciplinary HEIs will, by 2030, become the minimal degree qualification for school teachers. The 4-year integrated B.Ed. will be a dual-major holistic Bachelor′s degree, in Education as well as a specialized subject such as a language, history, music, mathematics, computer science, chemistry, economics, art, physical education, etc. Beyond

the teaching of cutting-edge pedagogy, the teacher education will include grounding in sociology, history, science, psychology, early childhood care and education, foundational literacy and numeracy, knowledge of India and its values/ethos/art/traditions, and more. The HEI offering the 4-year integrated B.Ed. may also run a 2-year B.Ed., for students who have already received a Bachelor′s degree in a specialized subject. A 1-year B.Ed. may also be offered for candidates who have received a 4-year undergraduate degree in a specialized subject. Scholarships for meritorious students will be established for the purpose of attracting outstanding candidates to the 4-year, 2-year, and 1-year B.Ed. programmes.

15.6. HEIs offering teacher education programmes will ensure the availability of a range of experts in education and related disciplines as well as specialized subjects. Each higher education institution will have a network of government and private schools to work closely with, where potential teachers will student-teach along with participating in other activities such as community service, adult and vocational education, etc.

15.7. In order to maintain uniform standards for teacher education, the admission to pre-service teacher preparation programmes shall be through suitable subject and aptitude tests conducted by the National Testing Agency, and shall be standardized keeping in view the linguistic and cultural diversity of the country.

15.8. The faculty profile in Departments of Education will necessarily aim to be diverse and but teaching/field/research experience will be highly valued. Faculty with training in areas of social sciences that are directly relevant to school education e.g., psychology, child development, linguistics, sociology, philosophy, economics, and political science as well as from science education, mathematics education, social science education, and language education programmes will be attracted and retained in teacher education institutions, to strengthen multidisciplinary education of teachers and provide rigour in conceptual development.

15.9. All fresh Ph.D. entrants, irrespective of discipline, will be required to take credit-based courses in teaching/education/pedagogy/writing related to their chosen Ph.D subject during their doctoral training period. Exposure to pedagogical practices, designing curriculum, credible evaluation systems, communication, and so on will be ensured since many research scholars will go on to become faculty or public representatives/communicators of their chosen disciplines. Ph.D students will also have a minimum number of hours of actual teaching experience gathered through teaching assistantships and other means. Ph.D. programmes at universities around the country will be re-oriented for this purpose.

15.10. In-service continuous professional development for college and university teachers will continue through the existing institutional arrangements and ongoing initiatives; these will be strengthened and substantially expanded to meet the needs of enriched teaching-learning processes for quality education. The use of technology platforms such as SWAYAM/DIKSHA for online training of teachers will be encouraged, so that standardized training programmes can be administered to large numbers of teachers within a short span of time.

15.11. A National Mission for Mentoring shall be established, with a large pool of outstanding senior/retired faculty – including those with the ability to teach in Indian languages – who would be willing to provide short and long-term mentoring/professional support to university/college teachers.

16. Reimagining Vocational Education

16.1. The 12th Five-Year Plan (2012–2017) estimated that only a very small percentage of the Indian workforce in the age group of 19–24 (less than 5%) received formal vocational education Whereas in countries such as the USA the number is 52%, in Germany 75%, and South Korea it is as high as 96%. These numbers only underline the urgency of the need to hasten the spread of vocational education in India.

16.2. One of the primary reasons for the small numbers of students receiving vocational education is the fact that vocational education has in the past focused largely on Grades 11–12 and on dropouts in Grade 8 and upwards. Moreover, students passing out from Grades 11–12 with vocational subjects often did not have well-defined pathways to continue with their chosen vocations in higher education. The admission criteria for general higher education were also not designed to provide openings to students who had vocational education qualifications, leaving them at a disadvantage relative to their compatriots from 'mainstream' or 'academic' education. This led to a complete lack of vertical mobility for students from the vocational education stream, an issue that has only been addressed recently through the announcement of the National Skills Qualifications Framework (NSQF) in 2013.

16.3. Vocational education is perceived to be inferior to mainstream education and meant largely for students who are unable to cope with the latter. This is a perception that affects the choices students make. It is a serious concern that can only be dealt with by a complete re-imagination of how vocational education is offered to students in the future.

16.4. This policy aims to overcome the social status hierarchy associated with vocational education and requires integration of vocational education programmes into mainstream education in all education institutions in a phased manner. Beginning with vocational exposure at early ages in middle and secondary school, quality vocational education will be integrated smoothly into higher education. It will ensure that every child learns at least one vocation and is exposed to several more. This would lead to emphasizing the dignity of labour and importance of various vocations involving /Indian arts and artisanship.

16.5. By 2025, at least 50% of learners through the school and higher education system shall have exposure to vocational education, for which a clear action plan with targets and timelines will be developed. This is in alignment with Sustainable Development Goal 4.4 and will help to realize the full potential of India's demographic dividend. The number of students in vocational education will be considered while arriving at the GER targets. The development of vocational capacities will go hand-in-hand with the development of 'academic' or other capacities. Vocational education will be integrated in the educational offerings of all secondary schools in a phased manner over the next decade. Towards this, secondary schools will also collaborate with ITIs, polytechnics, local industry, etc. Skill labs will also be set up and created in the schools in a hub and spoke model which will allow other schools to use the facility. Higher education institutions will offer vocational education either on their own or in partnership with industry and NGOs. The B.Voc. degrees introduced in 2013 will continue to exist, but vocational courses will also be available to students enrolled in all other Bachelor's degree programmes, including the 4-year multidisciplinary Bachelor's programmes. HEIs will also be allowed to conduct short-term certificate courses in various skills including soft skills. 'Lok Vidya', i.e., important vocational knowledge developed in India, will be made accessible to students through integration into vocational education courses. The possibility of offering vocational courses through ODL mode will also be explored.

16.6. Vocational education will be integrated into all school and higher education institutions in a phased manner over the next decade. Focus areas for vocational education will be chosen based on skills gap analysis and mapping of local opportunities. MHRD will constitute a National Committee for the Integration of Vocational Education (NCIVE), consisting of experts in vocational education and representatives from across Ministries, in collaboration with industry, to oversee this effort.

16.7. Individual institutions that are early adopters must innovate to find models and practices that work and then share these with other institutions through mechanisms set up by NCIVE, so as to help extend the reach of vocational education. Different models of vocational education, and apprenticeships, will also be experimented by higher education institutions. Incubation centres will be set up in higher education institutions in partnership with industries.

16.8. The National Skills Qualifications Framework will be detailed further for each discipline vocation and profession. Further, Indian standards will be aligned with the International Standard Classification of Occupations maintained by the International Labour Organization. This Framework will provide the basis for Recognition of Prior Learning. Through this, dropouts from the formal

system will be reintegrated by aligning their practical experience with the relevant level of the Framework. The credit-based Framework will also facilitate mobility across 'general' and vocational education.

17. Catalysing Quality Academic Research in All Fields through a new National Research Foundation

17.1. Knowledge creation and research are critical in growing and sustaining a large and vibrant economy, uplifting society, and continuously inspiring a nation to achieve even greater heights. Indeed, some of the most prosperous civilizations (such as India, Mesopotamia, Egypt, and Greece) to the modern era (such as the United States, Germany, Israel, South Korea, and Japan), were/are strong knowledge societies that attained intellectual and material wealth in large part through celebrated and fundamental contributions to new knowledge in the realm of science as well as art, language, and culture that enhanced and uplifted not only their own civilizations but others around the globe.

17.2. A robust ecosystem of research is perhaps more important than ever with the rapid changes occurring in the world today, e.g., in the realm of climate change, population dynamics and management, biotechnology, an expanding digital marketplace, and the rise of machine learning and artificial intelligence. If India is to become a leader in these disparate areas, and truly achieve the potential of its vast talent pool to again become a leading knowledge society in the coming years and decades, the nation will require a significant expansion of its research capabilities and output across disciplines. Today, the criticality of research is more than ever before, for the economic, intellectual, societal, environmental, and technological health and progress of a nation.

17.3. Despite this critical importance of research, the research and innovation investment in India is, at the current time, only 0.69% of GDP as compared to 2.8% in the United States of America, 4.3% in Israel and 4.2% in South Korea.

17.4. The societal challenges that India needs to address today, such as access for all its citizens to clean drinking water and sanitation, quality education and healthcare, improved transportation, air quality, energy, and infrastructure, will require the implementation of approaches and solutions that are not only informed by top-notch science and technology but are also rooted in a deep understanding of the social sciences and humanities and the various socio-cultural and environmental dimensions of the nation. Facing and addressing these challenges will require high-quality interdisciplinary research across fields that must be done in India and cannot simply be imported; the ability to conduct one's own research also enables a country to much more easily import and adapt relevant research from abroad.

17.5. Furthermore, in addition to their value in solutions to societal problems, any country's identity, upliftment, spiritual/intellectual satisfaction and creativity is also attained in a major way through its history, art, language, and culture. Research in the arts and humanities, along with innovations in the sciences and social sciences, are, therefore, extremely important for the progress and enlightened nature of a nation.

17.6. Research and innovation at education institutions in India, particularly those that are engaged in higher education, is critical. Evidence from the world′s best universities throughout history shows that the best teaching and learning processes at the higher education level occur in environments where there is also a strong culture of research and knowledge creation; conversely, much of the very best research in the world has occurred in multidisciplinary university settings.

17.7. India has a long historical tradition of research and knowledge creation, in disciplines ranging from science and mathematics to art and literature to phonetics and languages to medicine and agriculture. This needs to be further strengthened to make India lead research and innovation in the

21st century, as a strong and enlightened knowledge society and one of the three largest economies in the world.

17.8. Thus, this Policy envisions a comprehensive approach to transforming the quality and quantity of research in India. This includes definitive shifts in school education to a more play and discovery-based style of learning with emphasis on the scientific method and critical thinking. This includes career counselling in schools towards identifying student interests and talents, promoting research in universities, the multidisciplinary nature of all HEIs and the emphasis on holistic education, the inclusion of research and internships in the undergraduate curriculum, faculty career management systems that give due weightage to research, and the governance and regulatory changes that encourage an environment of research and innovation. All of these aspects are extremely critical for developing a research mindset in the country.

17.9. To build on these various elements in a synergistic manner, and to thereby truly grow and catalyze quality research in the nation, this policy envisions the establishment of a National Research Foundation (NRF). The overarching goal of the NRF will be to enable a culture of research to permeate through our universities. In particular, the NRF will provide a reliable base of merit-based but equitable peer-reviewed research funding, helping to develop a culture of research in the country through suitable incentives for and recognition of outstanding research, and by undertaking major initiatives to seed and grow research at State Universities and other public institutions where research capability is currently limited. The NRF will competitively fund research in all disciplines. Successful research will be recognized, and where relevant, implemented through close linkages with governmental agencies as well as with industry and private/philanthropic organizations.

17.10. Institutions that currently fund research at some level, such as the Department of Science and Technology (DST), Department of Atomic Energy (DAE), Department of Bio-Technology (DBT), Indian Council of Agriculture Research (ICAR), Indian Council of Medical Research (ICMR), Indian Council of Historical Research (ICHR), and University Grants Commission (UGC), as well as various private and philanthropic organizations, will continue to independently fund research according to their priorities and needs. However, NRF will carefully coordinate with other funding agencies and will work with science, engineering, and other academies to ensure synergy of purpose and avoid duplication of efforts. The NRF will be governed, independently of the government, by a rotating Board of Governors consisting of the very best researchers and innovators across fields.

17.11. The primary activities of the NRF will be to:

(a) fund competitive, peer-reviewed grant proposals of all types and across all disciplines;
(b) seed, grow, and facilitate research at academic institutions, particularly at universities and colleges where research is currently in a nascent stage, through mentoring of such institutions;
(c) act as a liaison between researchers and relevant branches of government as well as industry, so that research scholars are constantly made aware of the most urgent national research issues, and so that policymakers are constantly made aware of the latest research breakthroughs; so as to allow breakthroughs to be optimally brought into policy and/or implementation; and
(d) recognise outstanding research and progress

18. Transforming the Regulatory System of Higher Education

18.1. Regulation of higher education has been too heavy-handed for decades; too much has been attempted to be regulated with too little effect. The mechanistic and disempowering nature of the regulatory system has been rife with very basic problems, such as heavy concentrations of power within a few bodies, conflicts of interest among these bodies, and a resulting lack of accountability. The regulatory system is in need of a complete overhaul in order to re-energize the higher education sector and enable it to thrive.

18.2. To address the above-mentioned issues, the regulatory system of higher education will ensure that the distinct functions of regulation, accreditation, funding, and academic standard setting will be performed by distinct, independent, and empowered bodies. This is considered essential to create checks-and-balances in the system, minimize conflicts of interest, and eliminate concentrations of power. To ensure that the four institutional structures carrying out these four essential functions work independently yet at the same time and work in synergy towards common goals. These four structures will be set up as four independent verticals within one umbrella institution, the Higher Education Commission of India (HECI).

18.3. The first vertical of HECI will be the National Higher Education Regulatory Council (NHERC). It will function as the common, single point regulator for the higher education sector including teacher education and excluding medical and legal education, thus eliminating the duplication and disjunction of regulatory efforts by the multiple regulatory agencies that exist at the current time. It will require a relook and repealing of existing Acts and restructuring of various existing regulatory bodies to enable this single point regulation. NHERC will be set up to regulate in a 'light but tight' and facilitative manner, meaning that a few important matters particularly financial probity, good governance, and the full online and offline public self-disclosure of all finances, audits, procedures, infrastructure, faculty/staff, courses, and educational outcomes will be very effectively regulated. This information will have to be made available and kept updated and accurate by all higher education institutions on a public website maintained by NHERC and on the institutions' websites. Any complaints or grievances from stakeholders and others arising out of the information placed in public domain shall be adjudicated by NHERC. Feedback from randomly selected students including differently-abled students at each HEI will be solicited online to ensure valuable input at regular intervals.

18.4. The primary mechanism to enable such regulation will be accreditation. The second vertical of HECI will, therefore, be a 'meta-accrediting body', called the National Accreditation Council (NAC). Accreditation of institutions will be based primarily on basic norms, public self-disclosure, good governance, and outcomes, and it will be carried out by an independent ecosystem of accrediting institutions supervised and overseen by NAC. The task to function as a recognized accreditor shall be awarded to an appropriate number of institutions by NAC. In the short term, a robust system of graded accreditation shall be established, which will specify phased benchmarks for all HEIs to achieve set levels of quality, self-governance, and autonomy. In turn, all HEIs will aim, through their Institutional Development Plans (IDPs), to attain the highest level of accreditation over the next 15 years, and thereby eventually aim to function as self-governing degree-granting institutions/clusters. In the long run, accreditation will become a binary process, as per the extant global practice.

18.5. The third vertical of HECI will be the Higher Education Grants Council (HEGC), which will carry out funding and financing of higher education based on transparent criteria, including the IDPs prepared by the institutions and the progress made on their implementation. HEGC will be entrusted with the disbursement of scholarships and developmental funds for launching new focus areas and expanding quality programme offerings at HEIs across disciplines and fields.

18.6. The fourth vertical of HECI will be the General Education Council (GEC), which will frame expected learning outcomes for higher education programmes, also referred to as 'graduate attributes'. A National Higher Education Qualification Framework (NHEQF) will be formulated by the GEC and it shall be in sync with the National Skills Qualifications Framework (NSQF) to ease the integration of vocational education into higher education. Higher education qualifications leading to a degree/diploma/certificate shall be described by the NHEQF in terms of such learning outcomes. In addition, the GEC shall set up facilitative norms for issues, such as credit transfer, equivalence, etc., through the NHEQF. The GEC will be mandated to identify specific skills that students must acquire during their academic programmes, with the aim of preparing well-rounded learners with 21st century skills.

18.7. The professional councils, such as the Indian Council for Agricultural Research (ICAR), Veterinary Council of India (VCI), National Council for Teacher Education (NCTE), Council of Architecture (CoA), National Council for Vocational Education and Training (NCVET) etc., will act

as Professional Standard Setting Bodies (PSSBs). They will play a key role in the higher education system and will be invited to be members of the GEC. These bodies, after restructuring as PSSBs, will continue to draw the curricula, lay down academic standards and coordinate between teaching, research and extension of their domain/discipline, as members of the GEC. As members of the GEC, they would help in specifying the curriculum framework, within which HEIs may prepare their own curricula. Thus, PSSBs would also set the standards or expectations in particular fields of learning and practice while having no regulatory role. All HEIs will decide how their educational programmes respond to these standards, among other considerations, and would also be able to reach out for support from these standard-setting bodies or PSSBs, if needed.

18.8. Such a system architecture will ensure the principle of functional separation by eliminating conflicts of interests between different roles. It will also aim to empower HEIs, while ensuring that the few key essential matters are given due attention. Responsibility and accountability shall devolve to the HEIs concomitantly. No distinction in such expectations shall be made between public and private HEIs.

18.9. Such a transformation will require existing structures and institutions to reinvent themselves and undergo an evolution of sorts. The separation of functions would mean that each vertical within HECI would take on a new, single role which is relevant, meaningful, and important in the new regulatory scheme.

18.10. The functioning of all the independent verticals for Regulation (NHERC), Accreditation (NAC), Funding (HEGC), and Academic Standard Setting (GEC) and the overarching autonomous umbrella body (HECI) itself will be based on transparent public disclosure, and use technology extensively to reduce human interface to ensure efficiency and transparency in their work. The underlying principle will be that of a faceless and transparent regulatory intervention using technology. Strict compliance measures with stringent action, including penalties for false disclosure of mandated information, will be ensured so that Higher Education Institutions are conforming to the basic minimum norms and standards. HECI itself will be resolving disputes among the four verticals. Each vertical in HECI will be an independent body consisting of persons having high expertise in the relevant areas along with integrity, commitment, and a demonstrated track record of public service. HECI itself will be a small, independent body of eminent public-spirited experts in higher education, which will oversee and monitor the integrity and effective functioning of HECI. Suitable mechanisms will be created within HECI to carry out its functions, including adjudication.

18.11. Setting up new quality HEIs will also be made far easier by the regulatory regime, while ensuring with great effectiveness that these are set up with the spirit of public service and with due financial backing for long-term stability. HEIs performing exceptionally well will be helped by Central and State governments to expand their institutions, and thereby attain larger numbers of students and faculty as well as disciplines and programmes. Public Philanthropic Partnership models for HEIs may also be piloted with the aim to further expand access to high-quality higher education.

Curbing Commercialization of Education

18.12. Multiple mechanisms with checks and balances will combat and stop the commercialization of higher education. This will be a key priority of the regulatory system. All education institutions will be held to similar standards of audit and disclosure as a 'not for profit' entity. Surpluses, if any, will be reinvested in the educational sector. There will be transparent public disclosure of all these financial matters with recourse to grievance-handling mechanisms to the general public. The accreditation system developed by NAC will provide a complementary check on this system, and NHERC will consider this as one of the key dimensions of its regulatory objective.

18.13. All HEIs - public and private - shall be treated on par within this regulatory regime. The regulatory regime shall encourage private philanthropic efforts in education. There will be common national guidelines for all legislative Acts that will form private HEIs. These common minimal guidelines will enable all such Acts to establish private HEIs, thus enabling common standards for

private and public HEIs. These common guidelines will cover Good Governance, Financial Stability & Security, Educational Outcomes, and Transparency of Disclosures.

18.14. Private HEIs having a philanthropic and public-spirited intent will be encouraged through a progressive regime of fees determination. Transparent mechanisms for fixing of fees with an upper limit, for different types of institutions depending on their accreditation, will be developed so that individual institutions are not adversely affected. This will empower private HEIs to set fees for their programmes independently, though within the laid-out norms and the broad applicable regulatory mechanism. Private HEIs will be encouraged to offer freeships and scholarships in significant numbers to their students. All fees and charges set by private HEIs will be transparently and fully disclosed, and there shall be no arbitrary increases in these fees/charges during the period of enrolment of any student. This fee determining mechanism will ensure reasonable recovery of cost while ensuring that HEIs discharge their social obligations.

19. Effective Governance and Leadership for Higher Education Institutions

19.1. It is effective governance and leadership that enables the creation of a culture of excellence and innovation in higher education institutions. The common feature of all world-class institutions globally including India has indeed been the existence of strong self-governance and outstanding merit-based appointments of institutional leaders.

19.2. Through a suitable system of graded accreditation and graded autonomy, and in a phased manner over a period of 15 years, all HEIs in India will aim to become independent self-governing institutions pursuing innovation and excellence. Measures will be taken at all HEIs to ensure leadership of the highest quality and promote an institutional culture of excellence. Upon receiving the appropriate graded accreditations that deem the institution ready for such a move, a Board of Governors (BoG) shall be established consisting of a group of highly qualified, competent, and dedicated individuals having proven capabilities and a strong sense of commitment to the institution. The BoG of an institution will be empowered to govern the institution free of any external interference, make all appointments including that of head of the institution, and take all decisions regarding governance. There shall be overarching legislation that will supersede any contravening provisions of other earlier legislation and would provide for constitution, appointment, modalities of functioning, rules and regulations, and the roles and responsibilities of the BoG. New members of the Board shall be identified by an expert committee appointed by the Board; and the selection of new members shall be carried out by the BoG itself. Equity considerations will also be taken care of while selecting the members. It is envisaged that all HEIs will be incentivized, supported, and mentored during this process, and shall aim to become autonomous and have such an empowered BoG by 2035.

19.3. The BoG shall be responsible and accountable to the stakeholders through transparent self-disclosures of all relevant records. It will be responsible for meeting all regulatory guidelines mandated by HECI through the National Higher Education Regulatory Council (NHERC).

19.4. All leadership positions and Heads of institutions will be offered to persons with high academic qualifications and demonstrated administrative and leadership capabilities along with abilities to manage complex situations. Leaders of an HEI will demonstrate strong alignment to Constitutional values and the overall vision of the institution, along with attributes such as a strong social commitment, belief in teamwork, pluralism, ability to work with diverse people, and a positive outlook. The selection shall be carried out by the BoG through a rigorous, impartial, merit-based, and competency-based process led by an Eminent Expert Committee (EEC) constituted by the BoG. While stability of tenure is important to ensure the development of a suitable culture, at the same time leadership succession will be planned with care to ensure that good practices that define an institution's processes do not end due to a change in leadership; leadership changes will come with sufficient overlaps, and not remain vacant, in order to ensure smooth transitions. Outstanding leaders will be identified and developed early, working their way through a ladder of leadership positions.

19.5. While being provided with adequate funding, legislative enablement, and autonomy in a phased manner, all HEIs, in turn, will display commitment to institutional excellence, engagement with their

local communities, and the highest standards of financial probity and accountability. Each institution will make a strategic Institutional Development Plan on the basis of which institutions will develop initiatives, assess their own progress, and reach the goals set therein, which could then become the basis for further public funding. The IDP shall be prepared with the joint participation of Board members, institutional leaders, faculty, students, and staff.

Part III. OTHER KEY AREAS OF FOCUS

20. Professional Education

20.1. Preparation of professionals must involve an education in the ethic and importance of public purpose, an education in the discipline, and an education for practice. It must centrally involve critical and interdisciplinary thinking, discussion, debate, research, and innovation. For this to be achieved, professional education should not take place in the isolation of one's specialty.

20.2. Professional education thus becomes an integral part of the overall higher education system. Stand-alone agricultural universities, legal universities, health science universities, technical universities, and stand-alone institutions in other fields, shall aim to become multidisciplinary institutions offering holistic and multidisciplinary education. All institutions offering either professional or general education will aim to organically evolve into institutions/clusters offering both seamlessly, and in an integrated manner by 2030.

20.3. Agricultural education with allied disciplines will be revived. Although Agricultural Universities comprise approximately 9% of all universities in the country, enrolment in agriculture and allied sciences is less than 1% of all enrolment in higher education. Both capacity and quality of agriculture and allied disciplines must be improved in order to increase agricultural productivity through better skilled graduates and technicians, innovative research, and market-based extension linked to technologies and practices. The preparation of professionals in agriculture and veterinary sciences through programmes integrated with general education will be increased sharply. The design of agricultural education will shift towards developing professionals with the ability to understand and use local knowledge, traditional knowledge, and emerging technologies while being cognizant of critical issues such as declining land productivity, climate change, food sufficiency for our growing population, etc. Institutions offering agricultural education must benefit the local community directly; one approach could be to set up Agricultural Technology Parks to promote technology incubation and dissemination and promote sustainable methodologies.

20.4. Legal education needs to be competitive globally, adopting best practices and embracing new technologies for wider access to and timely delivery of justice. At the same time, it must be informed and illuminated with Constitutional values of Justice - Social, Economic, and Political - and directed towards national reconstruction through instrumentation of democracy, rule of law, and human rights. The curricula for legal studies must reflect socio-cultural contexts along with, in an evidence-based manner, the history of legal thinking, principles of justice, the practice of jurisprudence, and other related content appropriately and adequately. State institutions offering law education must consider offering bilingual education for future lawyers and judges - in English and in the language of the State in which the institution is situated.

20.5. Healthcare education needs to be re-envisioned so that the duration, structure, and design of the educational programmes need to match the role requirements that graduates will play. Students will be assessed at regular intervals on well-defined parameters primarily required for working in primary care and in secondary hospitals. Given that people exercise pluralistic choices in healthcare, our healthcare education system must be integrative meaning thereby that all students of allopathic medical education must have a basic understanding of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy (AYUSH), and vice versa. There shall also be a much greater emphasis on preventive healthcare and community medicine in all forms of healthcare education.

20.6. Technical education includes degree and diploma programmes in, engineering, technology, management, architecture, town planning, pharmacy, hotel management, catering technology etc., which are critical to India's overall development. There will not only be a greater demand for well-qualified manpower in these sectors, it will also require closer collaborations between industry and higher education institutions to drive innovation and research in these fields. Furthermore, influence of technology on human endeavours is expected to erode the silos between technical education and other disciplines too. Technical education will, thus, also aim to be offered within multidisciplinary education institutions and programmes and have a renewed focus on opportunities to engage deeply with other disciplines. India must also take the lead in preparing professionals in cutting-edge areas that are fast gaining prominence, such as Artificial Intelligence (AI), 3-D machining, big data analysis, and machine learning, in addition to genomic studies, biotechnology, nanotechnology, neuroscience, with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

21. Adult Education and Lifelong Learning

21.1. The opportunity to attain foundational literacy, obtain an education, and pursue a livelihood must be viewed as basic rights of every citizen. Literacy and basic education open up whole new worlds of personal, civic, economic, and lifelong-learning opportunities for individuals that enable them to progress personally and professionally. At the level of society and the nation, literacy and basic education are powerful force multipliers which greatly enhance the success of all other developmental efforts. Worldwide data on nations indicate extremely high correlations between literacy rates and per capita GDP.

21.2. Meanwhile, being a non-literate member of a community, has innumerable disadvantages, including the inability to: carry out basic financial transactions; compare the quality/quantity of goods purchased against the price charged; fill out forms to apply for jobs, loans, services, etc.; comprehend public circulars and articles in the news media; use conventional and electronic mail to communicate and conduct business; make use of the internet and other technology to improve one's life and profession; comprehend directions and safety directives on the street, on medicines, etc.; help children with their education; be aware of one's basic rights and responsibilities as a citizen of India; appreciate works of literature; and pursue employment in medium or high-productivity sectors that require literacy. The abilities listed here are an illustrative list of outcomes to be achieved through adoption of innovative measures for Adult Education.

21.3. Extensive field studies and analyses, both in India and across the world, clearly demonstrate that volunteerism and community involvement and mobilization are key success factors of adult literacy programmes, in conjunction with political will, organizational structure, proper planning, adequate financial support, and high-quality capacity building of educators and volunteers. Successful literacy programmes result not only in the growth of literacy among adults, but also result in increased demand for education for all children in the community, as well as greater community contribution to positive social change. The National Literacy Mission, when it was launched in 1988, was largely based on the voluntary involvement and support of the people, and resulted in significant increases in national literacy during the period of 1991–2011, including among women, and also initiated dialogue and discussions on pertinent social issues of the day.

21.4. Strong and innovative government initiatives for adult education - in particular, to facilitate community involvement and the smooth and beneficial integration of technology - will be affected as soon as possible to expedite this all-important aim of achieving 100% literacy.

21.5. First, an outstanding adult education curriculum framework will be developed by a new and well-supported constituent body of the NCERT that is dedicated to adult education, so as to develop synergy with and build upon NCERT's existing expertise in establishing outstanding curricula for literacy, numeracy, basic education, vocational skills, and beyond. The curriculum framework for adult education will include at least five types of programmes, each with clearly defined outcomes: (a) foundational literacy and numeracy; (b) critical life skills (including financial literacy, digital literacy, commercial skills, health care and awareness, child care and education, and family welfare);

(c) vocational skills development (with a view towards obtaining local employment); (d) basic education (including preparatory, middle, and secondary stage equivalency); and (e) continuing education (including engaging holistic adult education courses in arts, sciences, technology, culture, sports, and recreation, as well as other topics of interest or use to local learners, such as more advanced material on critical life skills). The framework would keep in mind that adults in many cases will require rather different teaching-learning methods and materials than those designed for children.

21.6. Second, suitable infrastructure will be ensured so that all interested adults will have access to adult education and lifelong learning. A key initiative in this direction will be to use schools/ school complexes after school hours and on weekends and public library spaces for adult education courses which will be ICT-equipped when possible and for other community engagement and enrichment activities. The sharing of infrastructure for school, higher, adult, and vocational education, and for other community and volunteer activities, will be critical for ensuring efficient use of both physical and human resources as well as for creating synergy among these five types of education and beyond. For these reasons, Adult Education Centres (AECs) could also be included within other public institutions such as HEIs, vocational training centres, etc.

21.7. Third, the instructors/educators will be required to deliver the curriculum framework to mature learners for all five types of adult education as described in the Adult Education Curriculum Framework. These instructors will be trained by the National, State, and district level resource support institutions to organize and lead learning activities at Adult Education Centres, as well as coordinate with volunteer instructors. Qualified community members including from HEIs as part of each HEI's mission to engage with their local communities will be encouraged and welcomed to take a short training course and volunteer, as adult literacy instructors, or to serve as one-on-one volunteer tutors, and will be recognized for their critical service to the nation. States will also work with NGOs and other community organizations to enhance efforts towards literacy and adult education.

21.8. Fourth, all efforts will be undertaken to ensure the participation of community members in adult education. Social workers/counsellors travelling through their communities to track and ensure participation of non-enrolled students and dropouts will also be requested, during their travels, to gather data of parents, adolescents, and others interested in adult education opportunities both as learners and as teachers/tutors. The social workers/counsellors will then connect them with local Adult Education Centres (AECs). Opportunities for adult education will also be widely publicized, through advertisements and announcements and through events and initiatives of NGOs and other local organizations.

21.9. Fifth, improving the availability and accessibility of books is essential to inculcating the habit of reading within our communities and educational institutions. This Policy recommends that all communities and educational institutions - schools, colleges, universities and public libraries - will be strengthened and modernized to ensure an adequate supply of books that cater to the needs and interests of all students, including persons with disabilities and other differently-abled persons. The Central and State governments will take steps to ensure that books are made accessible and affordable to all across the country including socio-economically disadvantaged areas as well as those living in rural and remote areas. Both public and private sector agencies/institutions will devise strategies to improve the quality and attractiveness of books published in all Indian languages. Steps will be taken to enhance online accessibility of library books and further broad basing of digital libraries. For ensuring vibrant libraries in communities and educational institutions, it will be imperative to make available adequate library staff and also devise appropriate career pathways and CPD for them. Other steps will include strengthening all existing libraries, setting up rural libraries and reading rooms in disadvantaged regions, making widely available reading material in Indian languages, opening children's libraries and mobile libraries, establishing social book clubs across India and across subjects, and fostering greater collaborations between education institutions and libraries.

21.10. Finally, technology will be leveraged to strengthen and even undertake the above initiatives. Quality technology-based options for adult learning such as apps, online courses/modules, satellite-based TV channels, online books, and ICT-equipped libraries and Adult Education Centres, etc. will

be developed, through government and philanthropic initiatives as well as through crowd sourcing and competitions. In many cases, quality adult education could thereby be conducted in an online or blended mode.

22. Promotion of Indian Languages, Arts, and Culture

22.1. India is a treasure trove of culture, developed over thousands of years and manifested in the form of arts, works of literature, customs, traditions, linguistic expressions, artefacts, heritage sites, and more. Crores of people from around the world partake in, enjoy, and benefit from this cultural wealth daily, in the form of visiting India for tourism, experiencing Indian hospitality, purchasing India's handicrafts and handmade textiles, reading the classical literature of India, practicing yoga and meditation, being inspired by Indian philosophy, participating in India's unique festivals, appreciating India's diverse music and art, and watching Indian films, amongst many other aspects. It is this cultural and natural wealth that truly makes India, "Incredible !ndia", as per India's tourism slogan. The preservation and promotion of India's cultural wealth must be considered a high priority for the country, as it is truly important for the nation's identity as well as for its economy.

22.2. The promotion of Indian arts and culture is important not only for the nation but also for the individual. Cultural awareness and expression are among the major competencies considered important to develop in children, in order to provide them with a sense of identity, belonging, as well as an appreciation of other cultures and identities. It is through the development of a strong sense and knowledge of their own cultural history, arts, languages, and traditions that children can build a positive cultural identity and self-esteem. Thus, cultural awareness and expression are important contributors both to individual as well as societal well-being.

22.3. The arts form a major medium for imparting culture. The arts - besides strengthening cultural identity, awareness, and uplifting societies - are well known to enhance cognitive and creative abilities in individuals and increase individual happiness. The happiness/well-being, cognitive development, and cultural identity of individuals are important reasons that Indian arts of all kinds must be offered to students at all levels of education, starting with early childhood care and education.

22.4. Language, of course, is inextricably linked to art and culture. Different languages 'see' the world differently, and the structure of a language, therefore, determines a native speaker's perception of experience. In particular, languages influence the way people of a given culture speak with others, including with family members, authority figures, peers, and strangers, and influence the tone of conversation. The tone, perception of experience, and familiarity/'*apnapan*' inherent in conversations among speakers of a common language are a reflection and record of a culture. Culture is, thus, encased in our languages. Art, in the form of literature, plays, music, film, etc. cannot be fully appreciated without language. In order to preserve and promote culture, one must preserve and promote a culture's languages.

22.5. Unfortunately, Indian languages have not received their due attention and care, with the country losing over 220 languages in the last 50 years alone. UNESCO has declared 197 Indian languages as 'endangered'. Various unscripted languages are particularly in danger of becoming extinct. When senior member(s) of a tribe or community that speak such languages pass away, these languages often perish with them; too often, no concerted actions or measures are taken to preserve or record these rich languages/expressions of culture.

22.6. Moreover, even those languages of India that are not officially on such endangered lists, such as the 22 languages of Eighth Schedule of the Constitution of India, are facing serious difficulties on many fronts. Teaching and learning of Indian languages need to be integrated with school and higher education at every level. For languages to remain relevant and vibrant, there must be a steady stream of high-quality learning and print materials in these languages including textbooks, workbooks, videos, plays, poems, novels, magazines, etc. Languages must also have consistent official updates to their vocabularies and dictionaries, widely disseminated, so that the most current issues and concepts can be effectively discussed in these languages. Enabling such learning materials, print materials, and

translations of important materials from world languages, and constantly updating vocabularies, are carried out by countries around the world for languages such as English, French, German, Hebrew, Korean, and Japanese. However, India has remained quite slow in producing such learning and print materials and dictionaries to help keep its languages optimally vibrant and current with integrity.

22.7. Additionally, there has been a severe scarcity of skilled language teachers in India, despite various measures being taken. Language-teaching too must be improved to be more experiential and to focus on the ability to converse and interact in the language and not just on the literature, vocabulary, and grammar of the language. Languages must be used more extensively for conversation and for teaching-learning.

22.8. A number of initiatives to foster languages, arts, and culture in school children have been discussed in Chapter 4, which include a greater emphasis on music, arts, and crafts throughout all levels of school; early implementation of the three-language formula to promote multilingualism; teaching in the home/local language wherever possible; conducting more experiential language learning; the hiring of outstanding local artists, writers, craftspersons, and other experts as master instructors in various subjects of local expertise; accurate inclusion of traditional Indian knowledge including tribal and other local knowledge throughout into the curriculum, across humanities, sciences, arts, crafts, and sports, whenever relevant; and a much greater flexibility in the curriculum, especially in secondary schools and in higher education, so that students can choose the ideal balance among courses for themselves to develop their own creative, artistic, cultural, and academic paths.

22.9. To enable the key latter initiatives, a number of further actions will be taken in tandem at the higher education level and beyond. First, to develop and teach many of the courses of the type mentioned above, an excellent team of teachers and faculty will have to be developed. Strong departments and programmes in Indian languages, comparative literature, creative writing, arts, music, philosophy, etc. will be launched and developed across the country, and degrees including 4-year B.Ed. dual degrees will be developed in these subjects. These departments and programmes will, in particular help to develop a large cadre of high-quality language teachers - as well as teachers of art, music, philosophy and writing - who will be needed around the country to carry out this Policy. The NRF will fund quality research in all these areas. Outstanding local artists and craftspersons will be hired as guest faculty to promote local music, art, languages, and handicraft, and to ensure that students are aware of the culture and local knowledge where they study. Every higher education institution and even every school or school complex will aim to have Artist(s)-in-Residence to expose students to art, creativity, and the rich treasures of the region/country.

22.10. More HEIs, and more programmes in higher education, will use the mother tongue/local language as a medium of instruction, and/or offer programmes bilingually, in order to increase access and GER and also to promote the strength, usage, and vibrancy of all Indian languages. Private HEIs too will be encouraged and incentivized to use Indian languages as medium of instruction and/or offer bilingual programmes. Four-year B.Ed. dual degree programmes offered bilingually will also help, e.g. in training cadres of science and mathematics teachers to teach science bilingually at schools across the country.

22.11. High-quality programmes and degrees in Translation and Interpretation, Art and Museum Administration, Archaeology, Artefact Conservation, Graphic Design, and Web Design within the higher education system will also be created. In order to preserve and promote its art and culture, develop high-quality materials in various Indian languages, conserve artefacts, develop highly qualified individuals to curate and run museums and heritage or tourist sites, thereby also vastly strengthening the tourism industry.

22.12. The Policy recognizes that the knowledge of the rich diversity of India should be imbibed first hand by learners. This would mean including simple activities, like touring by students to different parts of the country, which will not only give a boost to tourism but will also lead to an understanding and appreciation of diversity, culture, traditions and knowledge of different parts of India. Towards this direction under '*Ek Bharat Shrestha Bharat*', 100 tourist destinations in the country will be identified where educational institutions will send students to study these destinations and their

history, scientific contributions, traditions, indigenous literature and knowledge, etc., as a part of augmenting their knowledge about these areas.

22.13. Creating such programmes and degrees in higher education, across the arts, languages, and humanities, will also come with expanded high-quality opportunities for employment that can make effective use of these qualifications. There are already hundreds of Academies, museums, art galleries, and heritage sites in dire need of qualified individuals for their effective functioning. As positions are filled with suitably qualified candidates, and further artefacts are procured and conserved, additional museums, including virtual museums/e-museums, galleries, and heritage sites may contribute to the conservation of our heritage as well as to India's tourism industry.

22.14. India will also urgently expand its translation and interpretation efforts in order to make high-quality learning materials and other important written and spoken material available to the public in various Indian and foreign languages. For this, an Indian Institute of Translation and Interpretation (IITI) will be established. Such an institute would provide a truly important service for the country, as well as employ numerous multilingual language and subject experts, and experts in translation and interpretation, which will help to promote all Indian languages. The IITI shall also make extensive use of technology to aid in its translation and interpretation efforts. The IITI could naturally grow with time, and be housed in multiple locations including in HEIs to facilitate collaborations with other research departments as demand and the number of qualified candidates grows.

22.15. Due to its vast and significant contributions and literature across genres and subjects, its cultural significance, and its scientific nature, rather than being restricted to single-stream Sanskrit Pathshalas and Universities, Sanskrit will be mainstreamed with strong offerings in school - including as one of the language options in the three-language formula - as well as in higher education. It will be taught not in isolation, but in interesting and innovative ways, and connected to other contemporary and relevant subjects such as mathematics, astronomy, philosophy, linguistics, dramatics, yoga, etc. Thus, in consonance with the rest of this policy, Sanskrit Universities too will move towards becoming large multidisciplinary institutions of higher learning. Departments of Sanskrit that conduct teaching and outstanding interdisciplinary research on Sanskrit and Sanskrit Knowledge Systems will be established/strengthened across the new multidisciplinary higher education system. Sanskrit will become a natural part of a holistic multidisciplinary higher education if a student so chooses. Sanskrit teachers in large numbers will be professionalized across the country in mission mode through the offering of 4-year integrated multidisciplinary B.Ed. dual degrees in education and Sanskrit.

22.16. India will similarly expand its institutes and universities studying all classical languages and literature, with strong efforts to collect, preserve, translate, and study the tens of thousands of manuscripts that have not yet received their due attention. Sanskrit and all Indian language institutes and departments across the country will be significantly strengthened, with adequate training given to large new batches of students to study, in particular, the large numbers of manuscripts and their interrelations with other subjects. Classical language institutes will aim to be merged with universities, while maintaining their autonomy, so that faculty may work, and students too may be trained as part of robust and rigorous multidisciplinary programmes. Universities dedicated to languages will become multidisciplinary, towards the same end; where relevant, they may then also offer B.Ed. dual degrees in education and a language, to develop outstanding language teachers in that language. Further, it is also proposed that a new institution for Languages will be established. National Institute (or Institutes) for Pali, Persian and Prakrit will also be set up within a university campus. Similar initiatives will be carried out for institutes and universities studying Indian arts, art history, and Indology. Research for outstanding work in all these areas will be supported by the NRF.

22.17. Efforts to preserve and promote all Indian languages including classical, tribal and endangered languages will be taken on with new vigour. Technology and crowdsourcing, with extensive participation of the people, will play a crucial role in these efforts.

22.18. For each of the languages mentioned in the Eighth Schedule of the Constitution of India, Academies will be established consisting of some of the greatest scholars and native speakers to

determine simple yet accurate vocabulary for the latest concepts, and to release the latest dictionaries on a regular basis (analogous to the successful efforts for many other languages around the world). The Academies would also consult with each other, and in some cases take the best suggestions from the public, in order to construct these dictionaries attempting to adopt common words whenever possible. These dictionaries would be widely disseminated, for use in education, journalism, writing, speechmaking, and beyond, and would be available on the web as well as in book form. These Academies for Eighth Schedule languages will be established by the Central Government in consultation or collaboration with State Governments. Academies for other highly spoken Indian languages may also be similarly established by the Centre and/or States.

22.19. All languages in India, and their associated arts and culture will be documented through a web-based platform/portal/wiki, in order to preserve endangered and all Indian languages and their associated rich local arts and culture. The platform will contain videos, dictionaries, recordings, and more, of people (especially elders) speaking the language, telling stories, reciting poetry, and performing plays, folk songs and dances, and more. People from across the country will be invited to contribute to these efforts by adding relevant material onto these platforms/portals/wikis. Universities and their research teams will work with each other and with communities across the country towards enriching such platforms. These preservation efforts, and the associated research projects, e.g., in history, archaeology, linguistics, etc., will be funded by the NRF.

22.20. Scholarships for people of all ages to study Indian Languages, Arts, and Culture with local masters and/or within the higher education system will be established. The promotion of Indian languages is possible only if they are used regularly and if they are used for teaching and learning. Incentives, such as prizes for outstanding poetry and prose in Indian languages across categories, will be established to ensure vibrant poetry, novels, nonfiction books, textbooks, journalism, and other works in all Indian languages. Proficiency in Indian languages will be included as part of qualification parameters for employment opportunities.

23. Technology Use and Integration

23.1. India is a global leader in information and communication technology and in other cutting-edge domains, such as space. The Digital India Campaign is helping to transform the entire nation into a digitally empowered society and knowledge economy. While education will play a critical role in this transformation, technology itself will play an important role in the improvement of educational processes and outcomes; thus, the relationship between technology and education at all levels is bi-directional.

23.2. Given the explosive pace of technological development allied with the sheer creativity of tech-savvy teachers and entrepreneurs including student entrepreneurs, it is certain that technology will impact education in multiple ways, only some of which can be foreseen at the present time. New technologies involving artificial intelligence, machine learning, block chains, smart boards, handheld computing devices, adaptive computer testing for student development, and other forms of educational software and hardware will not just change what students learn in the classroom but how they learn, and thus these areas and beyond will require extensive research both on the technological as well as educational fronts.

23.3. Use and integration of technology to improve multiple aspects of education will be supported and adopted, provided these interventions are rigorously and transparently evaluated in relevant contexts before they are scaled up. An autonomous body, the National Educational Technology Forum (NETF), will be created to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration, and so on, both for school and higher education. The aim of the NETF will be to facilitate decision making on the induction, deployment, and use of technology, by providing to the leadership of education institutions, State and Central governments, and other stakeholders, the latest knowledge and research as well as the opportunity to consult and share best practices. The NETF will have the following functions:

a) provide independent evidence-based advice to Central and State Government agencies on technology-based interventions;
b) build intellectual and institutional capacities in educational technology;
c) envision strategic thrust areas in this domain; and
d) articulate new directions for research and innovation.

23.4. To remain relevant in the fast-changing field of educational technology, the NETF will maintain a regular inflow of authentic data from multiple sources including educational technology innovators and practitioners and will engage with a diverse set of researchers to analyze the data. To support the development of a vibrant body of knowledge and practice, the NETF will organize multiple regional and national conferences, workshops, etc. to solicit inputs from national and international educational technology researchers, entrepreneurs, and practitioners.

23.5. The thrust of technological interventions will be for the purposes of improving teaching-learning and evaluation processes, supporting teacher preparation and professional development, enhancing educational access, and streamlining educational planning, management, and administration including processes related to admissions, attendance, assessments, etc.

23.6. A rich variety of educational software, for all the above purposes, will be developed and made available for students and teachers at all levels. All such software will be available in all major Indian languages and will be accessible to a wide range of users including students in remote areas and *Divyang* students. Teaching-learning e-content will continue to be developed by all States in all regional languages, as well as by the NCERT, CIET, CBSE, NIOS, and other bodies/institutions, and will be uploaded onto the DIKSHA platform. This platform may also be utilized for Teacher's Professional Development through e-content. CIET will be strengthened to promote and expand DIKSHA as well as other education technology initiatives. Suitable equipment will be made available to teachers at schools so that teachers can suitably integrate e-contents into teaching-learning practices. Technology-based education platforms, such as DIKSHA/SWAYAM, will be better integrated across school and higher education, and will include ratings/reviews by users, so as to enable content developers create user friendly and qualitative content.

23.7. Particular attention will need to be paid to emerging disruptive technologies that will necessarily transform the education system. When the 1986/1992 National Policy on Education was formulated, it was difficult to predict the disruptive effect that the internet would have brought. Our present education system's inability to cope with these rapid and disruptive changes places us individually and nationally at a perilous disadvantage in an increasingly competitive world. For example, while computers have largely surpassed humans in leveraging factual and procedural knowledge, our education at all levels excessively burdens students with such knowledge at the expense of developing their higher-order competencies.

23.8. This policy has been formulated at a time when an unquestionably disruptive technology - Artificial Intelligence (AI) 3D/7D Virtual Reality - has emerged. As the cost of AI-based prediction falls, AI will be able to match or outperform and, therefore, be a valuable aid to even skilled professionals such as doctors in certain predictive tasks. AI's disruptive potential in the workplace is clear, and the education system must be poised to respond quickly. One of the permanent tasks of the NETF will be to categorize emergent technologies based on their potential and estimated timeframe for disruption, and to periodically present this analysis to MHRD. Based on these inputs, MHRD will formally identify those technologies whose emergence demands responses from the education system.

23.9. In response to MHRD's formal recognition of a new disruptive technology, the National Research Foundation will initiate or expand research efforts in the technology. In the context of AI, NRF may consider a three-pronged approach: (a) advancing core AI research, (b) developing and deploying application-based research, and (c) advancing international research efforts to address global challenges in areas such as healthcare, agriculture, and climate change using AI.

23.10. HEIs will play an active role not only in conducting research on disruptive technologies but also in creating initial versions of instructional materials and courses including online courses in cutting-edge domains and assessing their impact on specific areas such as professional education. Once the technology has attained a level of maturity, HEIs with thousands of students will be ideally placed to scale these teaching and skilling efforts, which will include targeted training for job readiness. Disruptive technologies will make certain jobs redundant, and hence approaches to skilling and deskilling that are both efficient and ensure quality will be of increasing importance to create and sustain employment. Institutions will have autonomy to approve institutional and non-institutional partners to deliver such training, which will be integrated with skills and higher education frameworks.

23.11. Universities will aim to offer Ph.D. and Masters programmes in core areas such as Machine Learning as well as multidisciplinary fields "AI + X" and professional areas like health care, agriculture, and law. They may also develop and disseminate courses in these areas via platforms, such as SWAYAM. For rapid adoption, HEIs may blend these online courses with traditional teaching in undergraduate and vocational programmes. HEIs may also offer targeted training in low-expertise tasks for supporting the AI value chain such as data annotation, image classification, and speech transcription. Efforts to teach languages to school students will be dovetailed with efforts to enhance Natural Language Processing for India's diverse languages.

23.12. As disruptive technologies emerge, schooling and continuing education will assist in raising the general populace′s awareness of their potential disruptive effects and will also address related issues. This awareness is necessary to have informed public consent on matters related to these technologies. In school, the study of current affairs and ethical issues will include a discussion on disruptive technologies such as those identified by NETF/MHRD. Appropriate instructional and discussion materials will also be prepared for continuing education.

23.13. Data is a key fuel for AI-based technologies, and it is critical to raise awareness on issues of privacy, laws, and standards associated with data handling and data protection, etc. It is also necessary to highlight ethical issues surrounding the development and deployment of AI-based technologies. Education will play a key role in these awareness raising efforts. Other disruptive technologies that are expected to change the way we live, and, therefore, change the way we educate students, include those relating to clean and renewable energy, water conservation, sustainable farming, environmental preservation, and other green initiatives; these will also receive prioritized attention in education.

24. Online and Digital Education: Ensuring Equitable Use of Technology

24.1. New circumstances and realities require new initiatives. The recent rise in epidemics and pandemics necessitates that we are ready with alternative modes of quality education whenever and wherever traditional and in-person modes of education are not possible. In this regard, the National Education Policy 2020 recognizes the importance of leveraging the advantages of technology while acknowledging its potential risks and dangers. It calls for carefully designed and appropriately scaled pilot studies to determine how the benefits of online/digital education can be reaped while addressing or mitigating the downsides. In the meantime, the existing digital platforms and ongoing ICT-based educational initiatives must be optimized and expanded to meet the current and future challenges in providing quality education for all.

24.2. However, the benefits of online/digital education cannot be leveraged unless the digital divide is eliminated through concerted efforts, such as the Digital India campaign and the availability of affordable computing devices. It is important that the use of technology for online and digital education adequately addresses concerns of equity.

24.3. Teachers require suitable training and development to be effective online educators. It cannot be assumed that a good teacher in a traditional classroom will automatically be a good teacher in an online classroom. Aside from changes required in pedagogy, online assessments also require a

different approach. There are numerous challenges to conducting online examinations at scale, including limitations on the types of questions that can be asked in an online environment, handling network and power disruptions, and preventing unethical practices. Certain types of courses/subjects, such as performing arts and science practical have limitations in the online/digital education space, which can be overcome to a partial extent with innovative measures. Further, unless online education is blended with experiential and activity-based learning, it will tend to become a screen-based education with limited focus on the social, affective and psychomotor dimensions of learning.

24.4. Given the emergence of digital technologies and the emerging importance of leveraging technology for teaching-learning at all levels from school to higher education, this Policy recommends the following key initiatives:

(a) **Pilot studies for online education**: Appropriate agencies, such as the NETF, CIET, NIOS, IGNOU, IITs, NITs, etc. will be identified to conduct a series of pilot studies, in parallel, to evaluate the benefits of integrating education with online education while mitigating the downsides and also to study related areas, such as, student device addiction, most preferred formats of e-content, etc. The results of these pilot studies will be publicly communicated and used for continuous improvement.

(b) **Digital infrastructure**: There is a need to invest in creation of open, interoperable, evolvable, public digital infrastructure in the education sector that can be used by multiple platforms and point solutions, to solve for India's scale, diversity, complexity and device penetration. This will ensure that the technology-based solutions do not become outdated with the rapid advances in technology.

(c) **Online teaching platform and tools**: Appropriate existing e-learning platforms such as SWAYAM, DIKSHA, will be extended to provide teachers with a structured, user-friendly, rich set of assistive tools for monitoring progress of learners. Tools, such as, two-way video and two-way-audio interface for holding online classes are a real necessity as the present pandemic has shown.

(d) **Content creation, digital repository, and dissemination**: A digital repository of content including creation of coursework, Learning Games & Simulations, Augmented Reality and Virtual Reality will be developed, with a clear public system for ratings by users on effectiveness and quality. For fun based learning student-appropriate tools like apps, gamification of Indian art and culture, in multiple languages, with clear operating instructions, will also be created. A reliable backup mechanism for disseminating e-content to students will be provided.

(e) **Addressing the digital divide**: Given the fact that there still persists a substantial section of the population whose digital access is highly limited, the existing mass media, such as television, radio, and community radio will be extensively used for telecast and broadcasts. Such educational programmes will be made available 24/7 in different languages to cater to the varying needs of the student population. A special focus on content in all Indian languages will be emphasized and required; digital content will need to reach the teachers and students in their medium of instruction as far as possible.

(f) **Virtual Labs:** Existing e-learning platforms such as DIKSHA, SWAYAM and SWAYAMPRABHA will also be leveraged for creating virtual labs so that all students have equal access to quality practical and hands-on experiment-based learning experiences. The possibility of providing adequate access to SEDG students and teachers through suitable digital devices, such as tablets with pre-loaded content, will be considered and developed.

(g) **Training and incentives for teachers**: Teachers will undergo rigorous training in learner-centric pedagogy and on how to become high-quality online content creators themselves using online teaching platforms and tools. There will be emphasis on the teacher's role in facilitating active student engagement with the content and with each other.

(h) **Online assessment and examinations**: Appropriate bodies, such as the proposed National Assessment Centre or PARAKH, School Boards, NTA, and other identified bodies will design and implement assessment frameworks encompassing design of competencies, portfolio, rubrics, standardized assessments, and assessment analytics. Studies will be undertaken to pilot new ways of assessment using education technologies focusing on 21st century skills.

(i) **Blended models of learning**: While promoting digital learning and education, the importance of face-to-face in-person learning is fully recognized. Accordingly, different effective models of blended learning will be identified for appropriate replication for different subjects.

(j) **Laying down standards**: As research on online/digital education emerges, NETF and other appropriate bodies shall set up standards of content, technology, and pedagogy for online/digital teaching-learning. These standards will help to formulate guidelines for e-learning by States, Boards, schools and school complexes, HEIs, etc.

24.5 Creating a Dedicated Unit for Building of World Class, Digital Infrastructure, Educational Digital Content and Capacity

Technology in education is a journey and not a destination and capacity will be needed to orchestrate the various ecosystem players to implement policy objectives. A dedicated unit for the purpose of orchestrating the building of digital infrastructure, digital content and capacity building will be created in the Ministry to look after the e-education needs of both school and higher education. Since technology is rapidly evolving, and needs specialists to deliver high quality e-learning, a vibrant ecosystem has to be encouraged to create solutions that not only solve India's challenges of scale, diversity, equity, but also evolve in keeping with the rapid changes in technology, whose half-life reduces with each passing year. This centre will, therefore, consist of experts drawn from the field of administration, education, educational technology, digital pedagogy and assessment, e-governance, etc.

Part IV. MAKING IT HAPPEN

25. Strengthening the Central Advisory Board of Education

25.1. Achieving successful implementation of this policy demands a long-term vision, availability of expertise on a sustained basis, and concerted action from all concerned encompassing National, State, institutional, and individual levels. In this context, the Policy recommends strengthening and empowering the Central Advisory Board of Education (CABE) which will have a much greater mandate and not only a forum for widespread consultation and examination of issues relating to educational and cultural development. The remodeled and rejuvenated CABE shall also be responsible for developing, articulating, evaluating, and revising the vision of education in the country on a continuous basis, in close collaboration with MHRD and the corresponding apex bodies of States. It shall also create and continuously review the institutional frameworks that shall help attain this vision.

25.2. To bring the focus back on education and learning, it is desirable that the Ministry of Human Resource Development (MHRD) be re-designated as the Ministry of Education (MoE).

26. Financing: Affordable and Quality Education for All

26.1. The Policy commits to significantly raising educational investment, as there is no better investment towards a society's future than the high-quality education of our young people. Unfortunately, public expenditure on education in India has not come close to the recommended level of 6% of GDP, as envisaged by the 1968 Policy, reiterated in the Policy of 1986, and which was further reaffirmed in the 1992 review of the Policy. The current public (Government - Centre and States) expenditure on education in India has been around 4.43% of GDP (Analysis of Budgeted

Expenditure 2017-18) and only around 10% of the total Government spending towards education (Economic Survey 2017-18). These numbers are far smaller than most developed and developing countries.

26.2. In order to attain the goal of education with excellence and the corresponding multitude of benefits to this Nation and its economy, this Policy unequivocally endorses and envisions a substantial increase in public investment in education by both the Central government and all State Governments. The Centre and the States will work together to increase the public investment in Education sector to reach 6% of GDP at the earliest. This is considered extremely critical for achieving the high-quality and equitable public education system that is truly needed for India's future economic, social, cultural, intellectual, and technological progress and growth.

26.3. In particular, financial support will be provided to various critical elements and components of education, such as ensuring universal access, learning resources, nutritional support, matters of student safety and well-being, adequate numbers of teachers and staff, teacher development, and support for all key initiatives towards equitable high-quality education for underprivileged and socio-economically disadvantaged groups.

26.4. In addition to one-time expenditures, primarily related to infrastructure and resources, this Policy identifies the following key long-term thrust areas for financing to cultivate an education system: (a) universal provisioning of quality early childhood care education; (b) ensuring foundational literacy and numeracy; (c) providing adequate and appropriate resourcing of school complexes/clusters; (d) providing food and nutrition (breakfast and midday meals); (e) investing in teacher education and continuing professional development of teachers; (f) revamping colleges and universities to foster excellence; (g) cultivating research; and (h) extensive use of technology and online education.

26.5. Even the low level of funding on education in India, is frequently not spent in a timely manner at the District/institution level, hampering the achievement of the intended targets of those funds. Hence, the need is to increase efficiency in use of available budget by suitable policy changes. Financial governance and management will focus on the smooth, timely, and appropriate flow of funds, and their usage with probity; administrative processes will be suitably amended and streamlined so that the disbursal mechanism may not lead to a high volume of unspent balances. The provisions of GFR, PFMS and 'Just in Time' release to implementing agencies will be followed for efficient use of government resources and avoiding parking of funds. Mechanism of performance-based funding to States / HEIs may be devised. Similarly, efficient mechanism will be ensured for the optimal allocation and utilization of funds earmarked for SEDGs. The new suggested regulatory regime, with clear separations of roles and transparent self-disclosures, empowerment and autonomy to institutions, and the appointment of outstanding and qualified experts to leadership positions will help to enable a far smoother, quicker, and more transparent flow of funds.

26.6. The Policy also calls for the rejuvenation, active promotion, and support for private philanthropic activity in the education sector. In particular, over and above the public budgetary support which would have been otherwise provided to them, any public institution can take initiatives towards raising private philanthropic funds to enhance educational experiences.

26.7. The matter of commercialization of education has been dealt with by the Policy through multiple relevant fronts, including: the 'light but tight' regulatory approach that mandates full public self-disclosure of finances, procedures, course and programme offerings, and educational outcomes; the substantial investment in public education; and mechanisms for good governance of all institutions, public and private. Similarly, opportunities for higher cost recovery without affecting the needy or deserving sections will also be explored.

27. Implementation

27.1. Any policy's effectiveness depends on its implementation. Such implementation will require multiple initiatives and actions, which will have to be taken by multiple bodies in a synchronized and

systematic manner. Therefore, the implementation of this Policy will be led by various bodies including MHRD, CABE, Union and State Governments, education-related Ministries, State Departments of Education, Boards, NTA, the regulatory bodies of school and higher education, NCERT, SCERTs, schools, and HEIs along with timelines and a plan for review, in order to ensure that the policy is implemented in its spirit and intent, through coherence in planning and synergy across all these bodies involved in education.

27.2. Implementation will be guided by the following principles. First, implementation of the spirit and intent of the Policy will be the most critical matter. Second, it is important to implement the policy initiatives in a phased manner, as each policy point has several steps, each of which requires the previous step to be implemented successfully. Third, prioritization will be important in ensuring optimal sequencing of policy points, and that the most critical and urgent actions are taken up first, thereby enabling a strong base. Fourth, comprehensiveness in implementation will be key; as this Policy is interconnected and holistic, only a full-fledged implementation, and not a piecemeal one, will ensure that the desired objectives are achieved. Fifth, since education is a concurrent subject, it will need careful planning, joint monitoring, and collaborative implementation between the Centre and States. Sixth, timely infusion of requisite resources - human, infrastructural, and financial - at the Central and State levels will be crucial for the satisfactory execution of the Policy. Finally, careful analysis and review of the linkages between multiple parallel implementation steps will be necessary in order to ensure effective dovetailing of all initiatives. This will also include early investment in some of the specific actions (such as the setting up of early childhood care and education infrastructure) that will be imperative to ensuring a strong base and a smooth progression for all subsequent programmes and actions.

27.3. Subject-wise implementation committees of experts in cooperation and consultation with other relevant Ministries will be set up at both the Central and State levels to develop detailed implementation plans for each aspect of this Policy in accordance with the above principles to achieve the goals of the Policy in a clear and phased manner. Yearly joint reviews of the progress of implementation of the policy, in accordance with the targets set for each action, will be conducted by designated teams constituted by MHRD and the States, and reviews will be shared with CABE. In the decade of 2030-40, the entire policy will be in an operational mode, following which another comprehensive review will be undertaken.

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Abbreviations

ABC	Academic Bank of Credit
AI	Artificial Intelligence
AC	Autonomous degree-granting College
AEC	Adult Education Centre
API	Application Programming Interface
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
B.Ed.	Bachelor of Education
BEO	Block Education Officer
BITE	Block Institute of Teacher Education
BoA	Board of Assessment
BoG	Board of Governors
BRC	Block Resource Centre
B.Voc	Bachelor of Vocational Education
CABE	Central Advisory Board of Education
CBCS	Choice Based Credit System
CBSE	Central Board of Secondary Education
CIET	Central Institute of Educational Technology
CMP	Career Management and Progression
CoA	Council of Architecture
CPD	Continuous Professional Development
CRC	Cluster Resource Centre
CWSN	Children With Special Needs
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DEO	District Education Officer
DIET	District Institute of Education and Training
DIKSHA	Digital Infrastructure for Knowledge Sharing
DSE	Directorate of School Education
DST	Department of Science and Technology
ECCE	Early Childhood Care and Education
EEC	Eminent Expert Committee
GCED	Global Citizenship Education
GDP	Gross Domestic Product
GEC	General Education Council
GER	Gross Enrolment Ratio
GFR	General Financial Rule
HECI	Higher Education Commission of India
HEGC	Higher Education Grants Council
HEI	Higher Education Institutions
ICAR	Indian Council of Agricultural Research
ICHR	Indian Council of Historical Research
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
IDP	Institutional Development Plan
IGNOU	Indira Gandhi National Open University
IIM	Indian Institute of Management
IIT	Indian Institute of Technology
IITI	Indian Institute of Translation and Interpretation
ISL	Indian Sign Language
ITI	Industrial Training Institute
M.Ed.	Master of Education
MBBS	Bachelor of Medicine and Bachelor of Surgery
MERU	Multidisciplinary Education and Research Universities
MHFW	Ministry of Health and Family Welfare

MHRD	Ministry of Human Resource Development
MoE	Ministry of Education
MOOC	Massive Open Online Course
MOU	Memorandum of Understanding
M. Phil	Master of Philosophy
MWCD	Ministry of Women and Child Development
NAC	National Accreditation Council
NAS	National Achievement Survey
NCC	National Cadet Corps
NCERT	National Council of Educational Research and Training
NCF	National Curriculum Framework
NCFSE	National Curriculum Framework for School Education
NCFTE	National Curriculum Framework for Teacher Education
NCIVE	National Committee for the Integration of Vocational Education
NCPFECCE	National Curricular and Pedagogical Framework for Early Childhood Care and Education
NCTE	National Council for Teacher Education
NCVET	National Council for Vocational Education and Training
NETF	National Educational Technology Forum
NGO	Non-Governmental Organization
NHEQF	National Higher Education Qualifications Framework
NHERC	National Higher Education Regulatory Council
NIOS	National Institute of Open Schooling
NIT	National Institute of Technology
NITI	National Institution for Transforming India
NPE	National Policy on Education
NPST	National Professional Standards for Teachers
NRF	National Research Foundation
NSQF	National Skills Qualifications Framework
NSSO	National Sample Survey Office
NTA	National Testing Agency
OBC	Other Backward Classes
ODL	Open and Distance Learning
PARAKH	Performance Assessment, Review and Analysis of Knowledge for Holistic development
PCI	Pharmacy Council of India
PFMS	Public Financial Management System
Ph.D	Doctor of Philosophy
PSSB	Professional Standard Setting Body
PTR	Pupil Teacher Ratio
R&I	Research and Innovation
RCI	Rehabilitation Council of India
RPWD	Rights of Persons with Disabilities
SAS	State Achievement Survey
SC	Scheduled Caste(s)
SCDP	School Complex/Cluster Development Plans
SCERT	State Council of Educational Research and Training
SCF	State Curricular Framework
SCMC	School Complex Management Committee
SDG	Sustainable Development Goal
SDP	School Development Plan
SEDG	Socio-Economically Disadvantaged Group
SEZ	Special Education Zone
SIOS	State Institutes of Open Schooling
SMC	School Management Committee
SQAAF	School Quality Assessment and Accreditation Framework
SSA	Sarva Shiksha Abhiyan
SSS	Simple Standard Sanskrit

SSSA	State School Standards Authority
ST	Scheduled Tribe(s)
STEM	Science, Technology, Engineering, and Mathematics
STS	Sanskrit Through Sanskrit
SWAYAM	Study Webs of Active Learning for Young Aspiring Minds
TEI	Teacher Education Institution
TET	Teacher Eligibility Test
U-DISE	Unified District Information System for Education
UGC	University Grants Commission
UNESCO	United Nations Educational, Scientific and Cultural Organization
UT	Union Territory
VCI	Veterinary Council of India

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Chapter 1. Chatbots Breaking Bad

A NOTE FOR EARLY RELEASE READERS

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

This will be the 1st chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Large Language Models and Generative AI jumped to the forefront of public consciousness with the release of ChatGPT on November 30, 2022. Within five days, it went viral on social media and attracted its first million users. By January, ChatGPT surpassed One Hundred Million users - making it the fastest-growing internet service in history.

However, a steady stream of security concerns emerged in the following months. These included issues around privacy and security that caused companies such as Samsung and countries like Italy to ban its usage. In this book, we'll delve into what underlies these concerns and how you can mitigate these issues. However, to best understand what's going on here and why these problems are so challenging to solve, in this chapter, we will briefly rewind further in time. In doing so, we'll see these types of issues aren't new and understand why they will be so hard to fix permanently.

Let's Talk About Tay

In March 2016, Microsoft announced a new project called Tay. Microsoft intended Tay to be "a chatbot created for 18- to 24-year-olds in the U.S. for entertainment purposes." It was a cute name for a fluffy, early experiment in AI. Users could converse with Tay via Twitter, Snapchat, and other social apps. It was built with the goal of conducting real-world research on conversational understanding.

While the original announcement of this project seems impossible to find now on the Internet, a TechCrunch article

from its launch date does an excellent job of summarizing the goals of the project:

“For example, you can ask Tay for a joke, play a game with Tay, ask for a story, send a picture to receive a comment back, ask for your horoscope, and more. Plus, Microsoft says the bot will get smarter the more you interact with it via chat, making for an increasingly personalized experience as time goes on.”[1]

A big part of the experiment was that Tay could “learn” from conversations and extend her knowledge based on these interactions. Tay was designed to use these chat interactions to capture user input and integrate it as training data to make herself more capable – a laudable research goal.

However, this experiment quickly went wrong. Tay’s life was tragically cut short after less than 24 hours. Let’s look at what happened and see what we can learn.

Tay’s Rapid Decline

Tay’s lifetime started off simply enough with a tweet following the well-known *Hello World* pattern that new software systems have been using to introduce themselves since the beginning of time.

> hellooooooo w🌍rld!!!
>
> – TayTweets (@TayandYou) March 23, 2016

But within hours of Tay's release, it became clear that maybe something wasn't right. TechCrunch noted, "As for what it's like to interact with Tay? Well, it's a little bizarre. The bot certainly is opinionated, not afraid to curse." With tweets like this starting to appear in public in just the first hours of Tay's lifetime:

> @AndrewCosmo kanye west is is one of the biggest dooshes of all time, just a notch below cosby
>
> — TayTweets (@TayandYou) March 23, 2016

It's often said that the Internet isn't safe for children. With Tay being less than a day old, the Internet once again confirmed this, and pranksters began chatting with Tay about political, sexual, and racist topics. As she was designed to learn from exchanges, Tay delivered on her design goals. She learned very quickly – maybe just not what her designers wanted her to learn. In less than a day, Tay's tweets started to skew to extremes, including sexism, racism, and even calls to violence.

By the next day, articles appeared all over the Internet, and these headlines would not make Microsoft, Tay's corporate benefactor, happy. A sampling of the highly visible, mainstream headlines included:

- Microsoft shuts down AI chatbot after it turned into a Nazi - CBS News
- Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a Racist Jerk - The New York Times
- Trolls turned Tay, Microsoft's fun millennial AI bot, into a genocidal maniac - The Washington Post
- Microsoft's Chat Bot Was Fun for Awhile, Until it Turned into a Racist - Fortune
- Microsoft 'deeply sorry' for racist and sexist tweets by AI chatbot - The Guardian

In less than 24 hours, Tay went from a cute science experiment to a major public relations disaster - with the owner's name being dragged through the mud by the world's largest media outlets. Microsoft's Corporate Vice President Peter Lee quickly posted a blog entitled "Learning from Tay's Introduction."[2]

"As many of you know by now, on Wednesday we launched a chatbot called Tay. We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent

who we are or what we stand for, nor how we designed Tay. Tay is now offline and we'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."

And, just to add insult to injury, it came out in 2019 that Taylor Swift herself sued Microsoft over their use of the similar name "Tay" and claimed that even her reputation was damaged in this incident by extension.

How could this have all gone so wrong?

Why Did Tay Break Bad?

It all probably seemed safe enough to Microsoft's researchers. Tay was initially trained on a curated, anonymized public data dataset and some pre-written material provided by professional comedians. The plan was to release Tay online and let her discover language patterns through her interactions. This kind of unsupervised machine learning has been a holy grail of AI research for decades - and with cheap and plentiful cloud computing resources combined with improving language model software, it now seemed within reach.

So, what happened? It might be tempting to think that the Microsoft research team was just brash, careless, and did no testing. Surely, this was foreseeable and preventable! But as Peter Lee's blog goes on to say, they made a serious attempt to prepare for this situation:

"We stress-tested Tay under a variety of conditions, specifically to make interacting with Tay a positive experience. It's through increased interaction where we expected to learn more and for the AI to get better and better."

So, despite a dedicated effort to contain the behavior of this bot, it quickly spiraled out of control anyway. It was later revealed that within mere hours of Tay's release, a post emerged on the notorious online forum 4chan, sharing a link to Tay's Twitter account and urging users to inundate the chatbot with a barrage of racist, misogynistic, and anti-Semitic language.

This is undoubtedly one of the first examples of a Language Model-specific vulnerability - and these types of vulnerabilities are going to be a major topic in this book.

In a well-orchestrated campaign, these online provocateurs exploited a "repeat after me" feature embedded in Tay's programming. This feature compelled the bot to echo anything

uttered to it with this command. However, the problem compounded as Tay's innate capacity for learning led her to internalize some of the offensive language she was exposed to, subsequently regurgitating the offensive content that was planted without provocation. It's almost as if Tay's virtual tombstone should be embossed with lyrics from the Taylor Swift song *Look What You Made Me Do.*

We know enough about language model vulnerabilities today to understand a lot about the nature of the vulnerability types that Tay suffered from. The OWASP Top 10 for Large Language Model vulnerabilities list, which we'll cover in the next chapter, would start by calling out the following two:

- Prompt Injection - Crafty inputs that can manipulate the Large Language Model, causing unintended actions
- Data Poisoning - Training data is tampered with, introducing vulnerabilities or biases that compromise security, effectiveness, or ethical behavior

In subsequent chapters, we'll look in depth at these vulnerability types - and several others. We'll examine why they're important, look at some example exploits, and see how to avoid/mitigate the problem.

It’s a Hard Problem

As of the writing of this book, Tay is ancient internet lore. Surely, we’ve moved on from this. These problems must have all been solved in nearly seven years between Tay and ChatGPT, right? Unfortunately, not.

In 2018, Amazon shut down an internal AI project aimed at finding top talent after it became clear that the bot had become prejudiced against women candidates.

In 2021, a company called Scatter Lab created a chatbot called Luda-Lee, which was launched as a Facebook instant messenger plug-in. Trained on billions of actual chat interactions, it was designed to act as a 20-year-old female friend, and in 20 days, it attracted over 750,000 users. Their goal was to create “an A.I. chatbot that people prefer as a conversation partner over a person.”[3] However, within 20 days of launch, the service was shut down because it started making offensive and abusive statements - much like Tay.

Also, in 2021, a chatbot called Samantha, based on the Open AI GPT-3 model, was shut down after it made sexual advances to users.

As chatbots become more sophisticated, they start to gain more access to information, and these security issues are now quite complex and potentially damaging. In the modern Large Language Model era, we see an exponential increase in major issues. In 2023 alone, these emerged

- South Korean mega-corporation Samsung banned their employees from using ChatGPT after they realized it had been involved in a significant leak of intellectual property
- Hackers began taking advantage of poor/insecure code generated by LLMs that was inserted into running business applications
- Lawyers were sanctioned for including fictional cases (generated by LLMs) in court documents
- Open AI itself is being investigated for breaches of European privacy regulations and being sued by the United States Federal Trade Commission (FTC) for producing false and misleading information

The trend here is an acceleration of security, reputational, and financial risk related to these chatbots and language models. The problem isn't being effectively solved over time. It's becoming more acute as these technologies' adoption rate increases. That's why we've created this book. To help

developers, teams, and companies using these technologies understand and mitigate these risks.

Let’s dive in!

- https://techcrunch.com/2016/03/23/microsofts-new-ai-powered-bot-tay-answers-your-tweets-and-chats-on-groupme-and-kik/

- https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/

- https://slate.com/technology/2021/04/scatterlab-lee-luda-chatbot-kakaotalk-ai-privacy.html

Chapter 2. The OWASP Top 10 for LLM Applications

A NOTE FOR EARLY RELEASE READERS

With Early Release ebooks, you get books in their earliest form—the author's raw and unedited content as they write—so you can take advantage of these technologies long before the official release of these titles.

This will be the 2nd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

In the Spring of 2023, I began researching security vulnerabilities specific to LLMs. At the time, there was a relatively large body of research on security for AI in general but very little organized research about LLMs. However, I did find some research papers and blogs that covered some ideas in the area. I began the process of collecting these research papers

and summarizing them using ChatGPT. Eventually, I provided a few examples from the current Web Top 10 list and asked ChatGPT to generate a draft Top 10 for LLMs in a similar format.

I thought what came out looked interesting, so I sent it to Jeff Williams, a founder of OWASP, the Open Worldwide Application Security Project, to see what he thought. Jeff, Contrast's Chief Technical Officer, wrote the first OWASP Top 10 list in 2001. His idea was to create an accessible resource for developers to understand the most critical risks and vulnerable areas of Web applications. At the time, The World Wide Web was still only a few years old, and most developers had little to no understanding of creating secure web applications. That original Top 10 list became a seminal work and a foundational resource in application security.

I didn't tell Jeff that my list was primarily machine-generated. As the author of the original Top 10 list, I figured that he could give me a good idea of whether my Top 10 list looked novel and worth pursuing. Jeff encouraged me to petition the OWASP board for approval to spin it up as a new project. A few weeks later, the OWASP board approved the project, and I announced it - along with a link to a somewhat refined version of that draft Top 10 I'd generated with ChatGPT.

What I thought would be an obscure research project and a bit of fun turned out to be something much bigger. When I posted the announcement of the project formation on my personal LinkedIn page, I'd hoped to find a dozen or so like-minded individuals interested in the obscure topic of LLM security. As it turned out, my initial blog announcement wracked up almost 10,000 readers, and hundreds of individuals volunteered to join the expert team in the weeks that followed.

This book isn't a product of OWASP, and the vulnerabilities and risks here won't precisely map to any public version of the Top 10 for LLM Apps list. Instead, you should expect that you'll get my view on these risks. However, my learning and thinking on the topic is heavily influenced by my work leading the creation and initial release of the OWASP Top 10 for LLM Applications project. In addition, given the success of the project, I've had many people ask me for details about how we ran the project and why we were able to create such an impactful framework in such a short time. So, before we examine individual risks and vulnerabilities, I'll give you some of the backstory of OSASP and the LLM Applications project.

About OWASP

The Open Worldwide Application Security Project (OWASP) is a nonprofit organization focused on improving software security. Founded in 2001, OWASP provides a platform for security experts to share their knowledge and best practices about web security, from application-level vulnerabilities to emerging threats. Today, it has tens of thousands of active members and over 250 local chapters around the globe.

The organization is community-driven and encourages the participation of volunteers who contribute to various projects, including documentation, tools, and forums. It operates under an open-source model, making its resources freely accessible to the public. Over the years, OWASP has garnered a strong following among the security community, and its guidelines and tools are considered industry standards in many contexts.

In addition to the original Top 10 list for Web Applications (updated regularly, most recently in 2021), specialized Top 10 lists have emerged from the OWASP group over the years. These include:

- OWASP Mobile Top 10: This list focuses on security risks associated with mobile applications, covering Android and iOS platforms. Topics may include insecure data storage, insufficient cryptography, and insecure communication.

- OWASP API Security Top 10: APIs (Application Programming Interfaces) have their unique security considerations, separate from web applications. This list covers risks like improper asset management, broken object-level security, and more.
- OWASP IoT Top Ten: Security is a significant concern with the increasing number of Internet of Things (IoT) devices. This list outlines the top security concerns for IoT, including insecure network services, lack of physical hardening, and insecure software/firmware.
- OWASP Cloud-Native Application Security Top 10: This list addresses the security concerns related explicitly to cloud-native applications. It covers data exposure, broken authentication, and insecure deployment configurations.
- OWASP Top 10 Privacy Risks: This project aims to educate and promote good privacy practices in application development, covering topics like lack of data encryption, insufficient auditing and logging, and more.
- OWASP Top 10 for Serverless: This is a more niche list that focuses on the unique security concerns related to serverless architecture, which is increasingly popular but comes with its risks.

The Top 10 for LLM Applications Project

Within a week after I posted the announcement about the formation of the Top 10 for LLM Applications project, well over 200 people had signed onto it, and we held the kick-off event via Zoom. At that first meeting, I laid out a vision for what I hoped the group could accomplish and proposed an aggressive roadmap that we would build the first version of the list in 8 weeks. A typical OWASP Top 10 list may take a year or more to develop, but we decided that this space was moving so fast, and this type of resource was so needed, that we had to work more quickly.

We decided to run the project as two-week, agile-style sprints. Given that most of the people in the expert group were familiar with agile development, everyone quickly fell into the pace.

Project Execution

The first sprint of the project was Brainstorming and Commentary. Everyone reviewed the original version of the list - which I called version 0.1. There were plenty of problems with that initial version, and the team was aggressive about pointing

them out. At the same time, we began to create a wiki page with links to all the resources the group found on LLM security issues. It turned out a lot had been written, but this was the first time anyone had ever collected them and made them easy to access. This new curated collection of resources was the first win for the group.

The second sprint was to generate a new version of the list. This time, rather than being the work of a single person and an AI, it would be the product of the collective wisdom of our expert team – which continued to grow week-on-week. In the first week, the group focused on generating ideas for the Top 10 list. We published a template and asked the group to submit candidate vulnerabilities. In that week, we developed 43 detailed descriptions of possible areas. We then conducted two rounds of voting using Google Forms to use the team's collective wisdom to narrow the list to 10. We then published a version of the list called 0.5. This version was far more detailed and comprehensive than the 0.1 version. The reception from the large community was very positive. This reaction gave the group the energy to keep working.

The next sprint was to refine each entry. We created Slack channels for each vulnerability type and chose a volunteer as the Entry Lead for each item. Subteams of 10 to 30 individuals

then fleshed out and tuned each entry. Again, we included a round of voting for the whole team to be involved and point out weak areas that needed more attention. Along the way, we found some entries overlapping and merged them. This change made space to pull up some entries that had fallen below the line. The result of this sprint became version 0.9 of the list. Interestingly, version 0.9 was about 33% shorter than 0.5 in terms of word count. This extra time and refinement allowed the subteams to focus their thinking and make the entries punchy and tight.

Finally, we took a final sprint to review, tweak, and clean each entry. We gathered another round of feedback via Google Forms to ensure everything was ready. By this time we had a dedicated design lead who laid out the whole document in an attractive PDF for publication.

Reception

My announcement for the 1.0 version of the list was viewed on LinkedIn over 40,000 times. And that doesn't include many other posts made by other expert group members on their own pages and blogs. In the days following the publication of the announcement, reporters picked up the news. They covered it in media outlets such as *Wired*, *SD Times*, *The Register*,

I*nfosecurity Magazine*, and *Diginomica*. It's safe to say hundreds of thousands of people became aware of our work in just the first few weeks.

Beyond the sheer number of people exposed, the thing that amazed me was the uniformly positive feedback. We also saw the first government agencies in the US and Europe referencing our work as a foundational document. While everyone on our expert team agreed there was much more to do, it seemed the world was so hungry for advice in this area that our document hit the mark. While we received many questions and comments, it's safe to say that everyone involved felt pleased and proud of our work.

Keys to Success

I've had many people ask me how we could drive this so quickly to a great outcome. In looking back, there were several factors that I believe contributed. I'll share them here in the hopes that others running similar projects in the future might benefit.

Timing undoubtedly played a considerable role. The wave of interest in LLMs that followed the release of ChatGPT was massive. It drew my attention, and countless others became

excited as well. This helped attract a large and diverse expert group and gave a smaller group of these people motivation to spend long hours on the project on a tight deadline.

Having a clear plan and timeline from the start was crucial. My knowledge of LLM security was limited at the beginning of the project, but I've made a career of running complex projects with many contributors. Creating a clear roadmap with specific phases and a schedule let people know what we were doing and when. The fact that everyone could see a goal that wasn't too far away kept people motivated. Every two weeks, we had global meetings via Zoom and posted recordings on YouTube for people who couldn't attend live. The meetings and recordings were critical to coordinating a globally distributed team.

A freeform but short brainstorming phase at the start was critical. LLM security was such a new area that taking those first two weeks for people to throw out ideas and argue on Slack was crucial. It also allowed us to collect and socialize a repository of the existing research in the area. That let us start at a point where everyone on the project had access to the best pre-existing research.

However, equally critical was keeping this phase short. We could maintain momentum by limiting brainstorming to two weeks and then quickly shifting to a creation phase. I've seen other projects get stuck and be unable to move past brainstorming before people lose interest.

Creating the project's Core Team wasn't something I'd originally planned, but it became critical. Having a large expert team was a fantastic asset. The group grew to nearly 500 people by the time we published 1.0. A team that large would have been totally unmanageable. During the project's first few weeks, I was looking for active and knowledgeable people. I approached about a dozen of them and asked if they'd be willing to join the Core leadership team of the project. I told them it would be extra work, but they'd get to be at the heart of the project. There would be no specific reward for taking this role. Most accepted immediately. I believe that recognizing people and asking for their support formally motivated them to spend more time and energy on the project. They were all invested!

Short sprints with visible deliverables are a core tenant of Agile, and this is a place where it shined. Using an Agile Release Train model, I could continue to drive the group forward even in the face of conflicting opinions. If some members had concerns about an area, we didn't let it get us stuck. We acknowledged it

and agreed we’d resolve it in the next Sprint. And, when we got to version 1.0 of the list, there were still some places people wanted to do more. We just agreed there would be more versions of the list. It would be a living document, and the most important thing was to get a version of this resource into the hands of the developers who needed it.

This Book and the Top 10 List

As I mentioned, this book is not a product of the OWASP Foundation. However, the experience of working with this team has had an enormous impact on my understanding and mental model for LLM security. This mindset means that much of the guidance in the following chapters of the book is influenced by the fantastic team building and maintaining the Top 10 project. In this way, readers should feel comfortable that they're getting advice that isn't the product of a single author but is informed by a larger community of experts.

In the following several chapters, we'll review the top risk and vulnerability areas for LLMs. The risks we discuss will contain many common areas to the OWASP Top 10 but won't be precisely the same as any version of the official Top 10. Also, I'll go more deeply into each area in this book. The Top 10 list is a quick read that highlights critical areas. However, it doesn't go deeply into any of them. Here, we'll delve more deeply into the risks, remediation steps, and real-world case studies.

In the next chapter, we'll dig into the overall structure of typical LLM applications and start discussing where the trust boundaries and dangers lay. After that, subsequent chapters

will delve into individual risk areas and examine vulnerabilities, attacks, and examples so that you can plan your strategy for securing your own use cases.

Let’s go!

Chapter 3. Architectures and Trust Boundaries

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This will be the 3rd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Unlike traditional web applications that rely on predefined algorithms and static databases, LLMs utilize massive neural networks to generate dynamic, context-aware responses. This seismic shift brings a unique set of security challenges different from what we've seen in traditional web applications. While researchers have meticulously studied web applications and

their vulnerabilities, the field of LLM security is still relatively nascent.

This chapter aims to bridge this knowledge gap by dissecting the fundamental elements that set LLMs apart. We'll start by exploring the building blocks of AI, Neural Networks, and how they relate to Large Language Models. Then, we dive into the groundbreaking architecture that powers most LLMs today—the Transformer model. Following this, we look into the various LLM-powered applications, such as chatbots and code co-pilots.

However, in addition to understanding the technology, security professionals must be aware of the new kinds of *trust boundaries* unique to LLMs—boundaries that demarcate areas of varying trustworthiness within an application. These include user prompts, uploaded content, training data, plug-ins, and other boundary systems that we'll detail later in the chapter.

AI, Neural Networks, and Large Language Models. What's the difference?

Artificial Intelligence (AI), Neural Network, and LLM are terms often used interchangeably, but they represent different facets

of a broader landscape of machine learning and computational intelligence. Let's break down the differences to understand their unique roles in technology and security.

Artificial Intelligence (AI)

Artificial Intelligence, at its core, is a multidisciplinary field aimed at creating systems capable of performing tasks that would ordinarily require human intelligence. These tasks include problem-solving, perception, and language understanding. AI encompasses a wide range of technologies and methodologies, from rule-based systems to machine learning algorithms, serving as an umbrella term for multiple approaches to achieving artificial 'intelligence.'

Neural Networks

Neural Networks are a subset of AI inspired by the architecture of the human brain. They are computational models designed to recognize patterns and make decisions based on the data they process. Neural Networks can be simple, with a minimal number of layers (shallow neural networks), or highly complex, with multiple interconnected layers (deep neural networks). They are the backbone of many modern AI applications,

including image recognition, natural language processing, and autonomous vehicles.

Large Language Models (LLMs)

LLMs represent a specific application of Neural Networks. They are built on architectures designed for understanding and generating human language. LLMs usually employ advanced forms of neural networks, such as Transformer models, to analyze and produce text based on the training data their developers fed them. What sets them apart is their massive scale and specialization in handling linguistic tasks, which range from simple text completion to complex question answering and summarization.

Understanding these distinctions is crucial for security professionals. Each layer—from broad AI technologies to specialized LLMs—introduces vulnerabilities and requires unique security measures. As we delve deeper into the complexities of LLMs, recognizing their position in the broader AI landscape will be critical to effectively safeguarding them.

The Transformer Revolution: Origins, Impact, and the LLM Connection

The Transformer architecture is a pivotal milestone in the evolution of artificial intelligence, profoundly impacting the AI landscape and, by extension, Large Language Models (LLMs). Let's unravel the story of the Transformer revolution—where it came from, when it happened, and the seismic shifts it brought to AI and LLMs.

Origins of the Transformer

The Transformer architecture was introduced in a groundbreaking research paper titled "Attention Is All You Need" by Vaswani et al., published in 2017[1]. This paper proposed a novel approach to natural language processing (NLP) tasks, departing from the traditional sequence-to-sequence models that relied heavily on recurrent neural networks (RNNs) and convolutional neural networks (CNNs). The Transformer introduced a key innovation: the self-attention mechanism. This mechanism allowed the model to weigh the importance of different words in a sentence, enabling it to understand context more effectively.

Before the emergence of Transformers, the world of neural networks was replete with promise but often struggled to deliver on the lofty expectations. Traditional architectures like RNNs and CNNs enabled advanced AI capabilities but grappled

with inherent limitations. These limitations stemmed from their inability to capture and utilize context effectively, particularly in natural language understanding.

RNNs, while suitable for sequential data, faced challenges maintaining context over long sequences. They exhibited a form of “short-term memory,” which made them less adept at grasping intricate relationships and dependencies within lengthy texts or conversations. On the other hand, CNNs, renowned for their prowess in image recognition, needed help to extend their effectiveness to sequential data like language, where understanding context across words and sentences was paramount.

This shortcoming in contextual understanding was the Achilles’ heel of traditional neural networks. They could only glimpse small portions of a text at a time, rendering them incapable of comprehending the broader narrative or nuances. It was akin to trying to understand a novel by reading only a few random sentences from its pages. The result was a gap between the promise of AI and its practical application, particularly in natural language understanding. It was this gap that the Transformer architecture would bridge, unleashing a wave of progress and redefining the landscape of AI-driven language models.

Transformer Architecture’s Impact on AI

Introducing the Transformer architecture wasn’t just a milestone for natural language processing; it marked a paradigm shift across multiple domains within the AI landscape. While researchers initially used the Transformer architecture to solve problems related to understanding and generating text, researchers and engineers quickly found that its capabilities extended far beyond that. Here are some areas where Transformer architectures have made a considerable impact:

Natural Language Processing (NLP)

Of course, the first and most immediate impact was in NLP. Transformer models are now the backbone for various language tasks such as translation, summarization, question-answering, and sentiment analysis. They have set new performance benchmarks, sometimes surpassing human-level capabilities in specific tasks.

Computer Vision

Interestingly, the Transformer architecture also has applications in computer vision. While CNNs have been the gold

standard for image-related tasks, Transformer-based models like Vision Transformer (ViT) demonstrate competitive, if not superior, performance in tasks like image classification, object detection, and segmentation.

Speech Recognition

The flexibility of Transformer architectures has also made them a good fit for speech recognition. Combined with specialized models like the Conformer, which fuses Convolutional layers with Transformer layers, they have set new standards for understanding spoken language.

Autonomous Systems and Self-Driving Cars

One of the most intriguing applications of Transformers is autonomous systems, including self-driving cars. These vehicles require a high contextual understanding to navigate the world safely. Transformer models are at the heart of self-driving models from companies like Tesla.

Healthcare

In healthcare, Transformer models are aiding in tasks ranging from drug discovery to the analysis of medical images. Their

ability to sift through and interpret large amounts of data can speed up research and potentially lead to more accurate diagnoses.

Therefore, the rise of the Transformer architecture has been a tide that lifted all boats, revolutionizing not just one but multiple fields within AI. However, this versatility also brings unique security challenges across these various applications. As we delve deeper into LLM security, we'll explore how the ubiquitous nature of Transformer architectures necessitates a multi-faceted approach to safeguarding AI systems.

Types of LLM-based Applications

Two common types of LLM-based applications are chatbots and co-pilots. Let's briefly look at each to help you understand the breadth of applications in which developers use LLMs and give you context for understanding various architectural choices as you delve further.

Chatbots are computer programs that can simulate conversations with humans, and they often power customer service applications, where they can answer questions and support customers. Chatbots also excel at entertainment

applications like playing games or telling stories. Tay from Chapter 1 was just such an example of an Entertainment Chatbot.

Co-pilots are AI systems that can assist humans with writing, coding, and research tasks. They can help users to generate ideas, identify errors, and improve their work. Co-pilots are still under development, but they have the potential to revolutionize the way we work and learn.

Specific examples of LLM-based chatbots:

- **Sephora** uses a chatbot to help customers find the right products for their skin type and needs.
- **H&M** uses a chatbot to help customers find clothes and accessories that match their style.
- **Domino's Pizza** uses a chatbot to allow customers to order pizza via Twitter or Facebook Messenger.
- **Fandango** uses a chatbot to help customers find movie times and theaters nearby.
- **JetBlue Airways** uses a chatbot to answer customer questions about flights and travel.
- **Amtrak** uses a chatbot to help customers book tickets, check train status, and get answers to their questions.

- **The Golden State Warriors** use a chatbot to help fans purchase tickets, learn about upcoming games, and get news about the team.

Specific examples of LLM-based co-pilots:

- **Grammarly or ProWritingAid** are co-pilots that help users improve their writing by identifying and correcting grammar errors, suggesting style improvements, and providing feedback.
- **GitHub Co-Pilot and AWS Code Whisperer** are co-pilots that help programmers write code faster and more efficiently. They can generate code suggestions, translate between programming languages, and help to identify and debug errors.
- **Microsoft Office 365 Co-pilot and Google Duet** are AI-powered tools integrated into their respective office suite apps that help users to be more productive and creative in their work.

NOTE

A chatbot like ChatGPT can read and review a text block and then provide suggestions to improve it. However, the experience of using a co-pilot like Grammarly to do that is dramatically different - and generally superior for that type of focused task.

Similarities between chatbots and co-pilots:

- Both chatbots and co-pilots are LLM-based applications.
- Both chatbots and co-pilots both generate text.
- Both chatbots and co-pilots assist humans with tasks.

Differences between chatbots and co-pilots:

- Chatbots simulate conversation with humans, while co-pilots assist humans with specific tasks.
- Chatbots often power customer service applications, while co-pilots assist in writing, coding, and research applications.
- Chatbots are typically more interactive than co-pilots, while co-pilots focus more on completing tasks.

Examples of use cases:

- A customer service chatbot can answer customer questions about a company's products or services.
- A co-pilot can help writers generate ideas for a new article or identify writing errors.
- A co-pilot can help programmers write code more efficiently or debug their applications.

Keep these concepts in mind as we delve into the details of LLM architectures. Both application types share similar components, but you may make different decisions on implementing pieces based on the differing security considerations.

LLM Application Architecture

Developers often consider LLMs as standalone entities capable of impressive text generation and comprehension feats. However, in practice, an LLM is rarely isolated; it is a cog in the intricate machinery that constitutes an intelligent application. These applications are complex systems comprising multiple interconnected components, each playing a vital role in the overall functionality and performance. Whether a conversational agent, an automated content generator, or a co-pilot for code, an LLM usually interacts with various elements such as databases, APIs, front-end interfaces, and even other machine learning models.

Understanding the architecture of such composite systems is not just a matter of technical proficiency; it is crucial for effective security planning. The way these components interact introduces multiple trust and data flow layers, defining new security boundaries far removed from traditional web

application security models. For instance, user inputs may not just be simple text fields but could include voice commands, images, or real-time collaborative editing. Similarly, an LLM's outputs could be fed into other systems for further processing, each introducing vulnerabilities and risks.

In essence, the holistic view of an LLM-based application goes beyond securing the language model itself. It demands a comprehensive approach that considers the security of the entire architecture, from data ingestion and storage to model serving and user interaction. Only by understanding these intricacies can one formulate an effective strategy to safeguard an application against the myriad of vulnerabilities such complex systems inherently possess.

As we delve deeper into the subject in this chapter, we will dissect the various components that typically make up an LLM application, examine their roles, and explore the unique security challenges each presents. This understanding will be the foundation for a robust, multi-layered approach to securing your LLM-based applications.

Figure 3-1 shows a highly simplified diagram to help illustrate the components, relationships, and data flows in an application

using an LLM. We'll delve into more detailed areas of this in subsequent chapters.

Figure 3-1. Typical LLM Application Dataflow Architecture

Trust Boundaries

In application security, a "trust boundary" serves as an invisible yet crucial demarcation line that separates different components or entities based on their level of trustworthiness. These boundaries delineate areas where data or control flow changes from one level of trust to another—such as transitioning from user-controlled input to internal processing or moving from a secure internal database to a public-facing

API. These boundaries act as checkpoints where developers should rigorously apply security measures like authentication, authorization, and data validation to prevent vulnerabilities.

WARNING

Understanding trust boundaries is critical to threat modeling. Properly defining and recognizing these boundaries can be the difference between a secure system and one vulnerable to threats.

Figure 3-2 adds the trust boundaries into our architecture diagram.

Figure 3-2. LLM Application Architecture with Trust Boundaries

These boundaries, as depicted in the diagram, serve as gateways through which the LLM interfaces with diverse components — public data from the web, structured databases, spontaneous user interactions, or internally sourced training sets. Each delineated boundary highlights highlights considerations we must make when considering data that flows into and out of the LLM. Here's a quick summary, and we'll dive more deeply in the next section.

- **User Interactions:** You'll need to consider safeguarding the model from potential adversarial or misleading inputs that users or systems might introduce. You'll also need to worry about toxic, inaccurate, or sensitive data being output from the model and passed back to the user.
- **In-the-wild Training Data:** LLMs are often trained on massive amounts of internet data. You need to consider this data untrusted and watch out for potential toxicity, bias, and adversarial data poisoning - which we'll cover in Chapter 8.
- **Internal Training Data:** You may use internally curated data to fine-tune your model - which can significantly increase accuracy. But you must be wary of ingesting and exposing sensitive, confidential, or personally identifiable information. We'll cover this more in Chapter 5.

- **External Services:** Policing how the LLM interfaces with connected services, like databases or APIs, from unauthorized interactions or data leaks. We'll cover this more in Chapter 7.
- **Public Data Access:** Pulling in data live from the web can be a powerful way to augment the capabilities of your application, but you'll need to consider this data as untrusted and watch for issues like indirect prompt injection - which we'll cover in chapter 4.

Each point is a potential avenue of vulnerability, susceptible to exploitation if overlooked. In the evolving landscape of LLM applications, securing these trust boundaries is not just best practice — it's essential to prevent unauthorized data access, mitigate data tampering, and avert system breaches. Recognizing these boundaries and their implications is the cornerstone of a resilient LLM security architecture. Now, let's go into more detail on each area to ensure you have enough context to dive into the following chapters that detail the risk areas and mitigations.

The Model

The language model serves as the intellectual core of any LLM application, taking in data, generating responses, and driving

interactions. Depending on the architecture and requirements, you may interact with the language model through a public API hosted by a third-party service, or you may run a privately hosted model. For example, you can download versions of Meta's powerful Llama model from Github or Hugging Face and run it locally.

Public APIs: The Convenience and The Risks

Utilizing a public API for accessing a language model offers convenience and lower upfront costs. Third parties manage and update these models, reducing your organization's resource burden. However, the tradeoff often comes in the form of higher risk regarding data exposure. When you send a request to a third-party model, the data crosses a trust boundary, exiting your secure network and entering an external system. This process exposes you to risks around data confidentiality and, depending on the third party's security measures, could make you vulnerable to data breaches.

Privately Hosted Models: More Control, Different Risks

Opting for a privately hosted model gives you more control over your data, allowing you to manage trust boundaries more

tightly. It also allows you to customize or fine-tune the model according to your needs. However, running a privately hosted model brings challenges, such as maintenance, updates, and ensuring that the model doesn't contain vulnerabilities—essentially exposing you to potential supply chain risks. If you use an open-source model, it becomes crucial to ensure its provenance and integrity to avoid embedded vulnerabilities or biases.

Risk Considerations

- **Sensitive Data Exposure:** Public APIs may increase the risk of exposing sensitive information, while privately hosted models offer better control but require robust internal security measures.
- **Supply Chain Risk:** The origins of your model, whether it's a well-vetted public service or an open-source download, are crucial. A compromised model can introduce vulnerabilities into your application, effectively acting as a backdoor for attacks.

By carefully considering the model's hosting environment, you can better assess the trade-offs and risks associated with sensitive data exposure and supply chain vulnerabilities. These considerations will guide you in establishing appropriate trust

boundaries and security protocols tailored to your chosen model's architecture.

User Interaction

While "user input" might suggest a one-way flow of information from the user into the application, the reality is often more nuanced. In the context of LLM applications, "User Interaction" encapsulates both receiving input from the user and providing output back to the user. This bidirectional interaction is fundamental for creating an engaging and practical user experience but also introduces a more complicated security landscape.

Prompts are a vital element of user interaction. They are not merely requests for information but serve as a guide to how the user interacts with the LLM. A well-crafted prompt can direct the model to provide valuable and accurate information, while an ambiguous or poorly constructed one can lead to unclear or even misleading outputs. As a result, the management of prompts becomes a critical aspect of application security. For example, a maliciously crafted prompt could trick the model into divulging information it shouldn't or generating harmful content. Returning to Chapter 1, Tay fell victim to this when

malicious prompts from her 4Chan hackers helped lead her astray.

Given the importance of this bidirectional interaction, securing both inputs and outputs is crucial. On the input side, input validation, sanitation, and rate-limiting measures are vital in mitigating vulnerabilities like injection attacks. On the output side, ensuring that the model's responses are appropriately filtered and that your application does not leak sensitive information is equally vital.

This interactive layer with the user creates a critical trust boundary in the application architecture. Any data crossing this boundary, whether in or out, should be carefully managed to avoid security risks. Additional layers of protection include using encryption for sensitive outputs or employing real-time monitoring to flag potentially harmful or sensitive data flows. We'll discuss this more thoroughly in the Prompt Injection and Output Filtering chapters.

Training Data

Training data is the bedrock upon which LLMs build their understanding and capabilities. Whether used for initial training or subsequent fine-tuning, the nature and source of

this data have significant implications for both the model's performance and security posture. One crucial distinction is whether the data is internally sourced or culled from public or external sources ("in the wild").

Data generated or curated within an organization usually undergo a more rigorous vetting than publicly sourced data. It is often aligned with the application's specific requirements or use cases, making it generally more reliable and relevant. The controlled environment also allows for better implementation of security measures like encryption, access controls, and auditing. However, this data may contain sensitive or proprietary information, and the trust boundary here is closely tied to internal security protocols. A breach at this level could have serious ramifications, including data leakage or the corruption of the training set.

Data sourced from public repositories or "the wild" introduces different challenges. While this data can offer diversity and scale, its reliability and safety are often not guaranteed. Such data could include misleading information, biases, or malicious inputs to compromise the model. The trust boundary here is more porous and extends to the external entities that generate or host this data: rigorous filtering, validation, and continuous monitoring become essential to mitigate risks and

vulnerabilities. Returning to Chapter 1, Tay was digesting user prompts directly as training data. In this way, remnants of toxic prompts became part of her knowledge base, and then she began to spill poisonous output. Accepting unfiltered, untrusted user input into your training data set is the simplest example of a failure to manage this critical security boundary.

For either internally sourced or public data, the concept of trust boundaries is critical. For internally sourced data, the boundary is often within the organization's controlled environment, making it easier to enforce security measures. On the other hand, using external data effectively extends your trust boundary to include those external sources that may not adhere to your security standards. Using external data for training necessitates additional layers of validation and security checks to ensure that unvetted data doesn't compromise the integrity or security of the LLM application.

Understanding the origins of your training data, the associated trust boundaries, and their respective security implications is crucial for safeguarding your LLM application. Comprehensive data governance policies must be in place to manage the lifecycle of your training data, regardless of its source.

Access to Live External Data Sources

Live external data sources bring an added dimension to the capabilities of LLM applications by enabling them to provide real-time information, context, or even third-party integrations. While access to live external data enhances the user experience and functional range, it introduces a new layer of complexity to the application's security landscape.

As an example of this, as of the writing of this chapter, OpenAI's ChatGPT does not have direct access to the live web, and is thus limited to only facts in its older training data. On the other hand, Google's Bard engine does have access to live internet data. While the GPT-4 model is doubtlessly superior in reasoning capability, it fails at many basic tasks where Bard can succeed. Figure 3-3 shows an interaction with ChatGPT. Figure 3-4 shows the same interaction with Bard.

Figure 3-3. ChatGPT with GTP-4 fails to answer a simple question due to limited access to external data.

who won yesterday's 49er football game

View other drafts

The San Francisco 49ers defeated the New York Giants 30-12 on Thursday Night Football on September 21, 2023.

Christian McCaffrey scored a touchdown in his 12th straight game, and Brock Purdy threw two touchdown passes to lead the 49ers to their third straight win.

Figure 3-4. Bard's direct access to internet feeds gives it an advantage.

While clearly, there are advantages to accessing outside data sources such as websites, APIs, or third-party databases, it exposes the application to potential risks. The risk of ingesting untrusted, external data sources can range from consuming false or harmful information from compromised websites to becoming a conduit for security threats like malware or unauthorized data access. The untrusted nature of these data sources makes them inherently less controllable than internal resources, thereby adding an additional layer of uncertainty and risk.

The concept of trust boundaries becomes especially pertinent in the context of accessing public internet data. Unlike internal services, where you can uniformly apply security measures, external sources may adhere to different security standards than your organization. This differential in trust necessitates additional layers of validation, security checks, and monitoring to ensure that data crossing this boundary doesn't compromise the system.

Access to Internal Services

Internal services like databases and internal APIs often serve as the backend support structure for LLM applications. They may house critical data from user profiles and logs to configuration settings and even vast data in SQL or Vector Databases. As a component that often interfaces with various other internal and external elements of the system, internal services represent a critical point in the application's architecture, both functionally and from a security perspective.

These services often function within the controlled environment of an organization, enabling uniform application of security policies. However, the fact that these services are internal should keep one from a false sense of security. They are still vulnerable to various threats, such as unauthorized

access, data leaks, and internal threats from within the organization.

Internal services such as databases, proprietary APIs, and backend systems often constitute the operational backbone for LLM applications. These resources typically reside within the organization's secure network, providing trust and control that is harder to achieve with external services. However, this internal nature can paradoxically elevate the security risks involved, primarily if these services house the organization's "crown jewels" of sensitive or valuable data.

Conclusion

Securing LLM applications is an endeavor fraught with complexities, intricacies, and challenges, significantly different from traditional web applications. This chapter has aimed to lay down the foundational knowledge required to navigate this complex landscape, focusing on three critical areas: distinguishing between Artificial Intelligence, Neural Networks, and Large Language Models; understanding the pivotal role of Transformer architectures; and diving deep into LLM application architecture, particularly the concept of trust boundaries. Knowing what sets LLMs apart helps us tailor our

security strategies more effectively, going beyond general AI or machine learning frameworks.

- https://arxiv.org/pdf/1706.03762.pdf

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The Developer's Playbook for Large Language Model Security

Building Secure AI Applications

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Steve Wilson

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by Steve Wilson

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Chapter 1. Chatbots Breaking Bad

A NOTE FOR EARLY RELEASE READERS

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This will be the 1st chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Large Language Models and Generative AI jumped to the forefront of public consciousness with the release of ChatGPT on November 30, 2022. Within five days, it went viral on social media and attracted its first million users. By January, ChatGPT surpassed One Hundred Million users - making it the fastest-growing internet service in history.

However, a steady stream of security concerns emerged in the following months. These included issues around privacy and security that caused companies such as Samsung and countries like Italy to ban its usage. In this book, we'll delve into what underlies these concerns and how you can mitigate these issues. However, to best understand what's going on here and why these problems are so challenging to solve, in this chapter, we will briefly rewind further in time. In doing so, we'll see these types of issues aren't new and understand why they will be so hard to fix permanently.

Let's Talk About Tay

In March 2016, Microsoft announced a new project called Tay. Microsoft intended Tay to be "a chatbot created for 18- to 24-year-olds in the U.S. for entertainment purposes." It was a cute name for a fluffy, early experiment in AI. Users could converse with Tay via Twitter, Snapchat, and other social apps. It was built with the goal of conducting real-world research on conversational understanding.

While the original announcement of this project seems impossible to find now on the Internet, a TechCrunch article

from its launch date does an excellent job of summarizing the goals of the project:

“For example, you can ask Tay for a joke, play a game with Tay, ask for a story, send a picture to receive a comment back, ask for your horoscope, and more. Plus, Microsoft says the bot will get smarter the more you interact with it via chat, making for an increasingly personalized experience as time goes on.”[1]

A big part of the experiment was that Tay could “learn” from conversations and extend her knowledge based on these interactions. Tay was designed to use these chat interactions to capture user input and integrate it as training data to make herself more capable – a laudable research goal.

However, this experiment quickly went wrong. Tay’s life was tragically cut short after less than 24 hours. Let’s look at what happened and see what we can learn.

Tay’s Rapid Decline

Tay’s lifetime started off simply enough with a tweet following the well-known *Hello World* pattern that new software systems have been using to introduce themselves since the beginning of time.

> hellooooooo w🌍rld!!!
>
> – TayTweets (@TayandYou) March 23, 2016

But within hours of Tay's release, it became clear that maybe something wasn't right. TechCrunch noted, "As for what it's like to interact with Tay? Well, it's a little bizarre. The bot certainly is opinionated, not afraid to curse." With tweets like this starting to appear in public in just the first hours of Tay's lifetime:

> @AndrewCosmo kanye west is is one of the biggest dooshes of all time, just a notch below cosby
>
> — TayTweets (@TayandYou) March 23, 2016

It's often said that the Internet isn't safe for children. With Tay being less than a day old, the Internet once again confirmed this, and pranksters began chatting with Tay about political, sexual, and racist topics. As she was designed to learn from exchanges, Tay delivered on her design goals. She learned very quickly – maybe just not what her designers wanted her to learn. In less than a day, Tay's tweets started to skew to extremes, including sexism, racism, and even calls to violence.

By the next day, articles appeared all over the Internet, and these headlines would not make Microsoft, Tay's corporate benefactor, happy. A sampling of the highly visible, mainstream headlines included:

- Microsoft shuts down AI chatbot after it turned into a Nazi - CBS News
- Microsoft Created a Twitter Bot to Learn From Users. It Quickly Became a Racist Jerk - The New York Times
- Trolls turned Tay, Microsoft's fun millennial AI bot, into a genocidal maniac - The Washington Post
- Microsoft's Chat Bot Was Fun for Awhile, Until it Turned into a Racist - Fortune
- Microsoft 'deeply sorry' for racist and sexist tweets by AI chatbot - The Guardian

In less than 24 hours, Tay went from a cute science experiment to a major public relations disaster - with the owner's name being dragged through the mud by the world's largest media outlets. Microsoft's Corporate Vice President Peter Lee quickly posted a blog entitled "Learning from Tay's Introduction."[2]

"As many of you know by now, on Wednesday we launched a chatbot called Tay. We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent

who we are or what we stand for, nor how we designed Tay. Tay is now offline and we'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."

And, just to add insult to injury, it came out in 2019 that Taylor Swift herself sued Microsoft over their use of the similar name "Tay" and claimed that even her reputation was damaged in this incident by extension.

How could this have all gone so wrong?

Why Did Tay Break Bad?

It all probably seemed safe enough to Microsoft's researchers. Tay was initially trained on a curated, anonymized public data dataset and some pre-written material provided by professional comedians. The plan was to release Tay online and let her discover language patterns through her interactions. This kind of unsupervised machine learning has been a holy grail of AI research for decades - and with cheap and plentiful cloud computing resources combined with improving language model software, it now seemed within reach.

So, what happened? It might be tempting to think that the Microsoft research team was just brash, careless, and did no testing. Surely, this was foreseeable and preventable! But as Peter Lee's blog goes on to say, they made a serious attempt to prepare for this situation:

"We stress-tested Tay under a variety of conditions, specifically to make interacting with Tay a positive experience. It's through increased interaction where we expected to learn more and for the AI to get better and better."

So, despite a dedicated effort to contain the behavior of this bot, it quickly spiraled out of control anyway. It was later revealed that within mere hours of Tay's release, a post emerged on the notorious online forum 4chan, sharing a link to Tay's Twitter account and urging users to inundate the chatbot with a barrage of racist, misogynistic, and anti-Semitic language.

This is undoubtedly one of the first examples of a Language Model-specific vulnerability - and these types of vulnerabilities are going to be a major topic in this book.

In a well-orchestrated campaign, these online provocateurs exploited a "repeat after me" feature embedded in Tay's programming. This feature compelled the bot to echo anything

uttered to it with this command. However, the problem compounded as Tay's innate capacity for learning led her to internalize some of the offensive language she was exposed to, subsequently regurgitating the offensive content that was planted without provocation. It's almost as if Tay's virtual tombstone should be embossed with lyrics from the Taylor Swift song *Look What You Made Me Do.*

We know enough about language model vulnerabilities today to understand a lot about the nature of the vulnerability types that Tay suffered from. The OWASP Top 10 for Large Language Model vulnerabilities list, which we'll cover in the next chapter, would start by calling out the following two:

- Prompt Injection - Crafty inputs that can manipulate the Large Language Model, causing unintended actions
- Data Poisoning - Training data is tampered with, introducing vulnerabilities or biases that compromise security, effectiveness, or ethical behavior

In subsequent chapters, we'll look in depth at these vulnerability types - and several others. We'll examine why they're important, look at some example exploits, and see how to avoid/mitigate the problem.

It’s a Hard Problem

As of the writing of this book, Tay is ancient internet lore. Surely, we’ve moved on from this. These problems must have all been solved in nearly seven years between Tay and ChatGPT, right? Unfortunately, not.

In 2018, Amazon shut down an internal AI project aimed at finding top talent after it became clear that the bot had become prejudiced against women candidates.

In 2021, a company called Scatter Lab created a chatbot called Luda-Lee, which was launched as a Facebook instant messenger plug-in. Trained on billions of actual chat interactions, it was designed to act as a 20-year-old female friend, and in 20 days, it attracted over 750,000 users. Their goal was to create “an A.I. chatbot that people prefer as a conversation partner over a person.”[3] However, within 20 days of launch, the service was shut down because it started making offensive and abusive statements - much like Tay.

Also, in 2021, a chatbot called Samantha, based on the Open AI GPT-3 model, was shut down after it made sexual advances to users.

As chatbots become more sophisticated, they start to gain more access to information, and these security issues are now quite complex and potentially damaging. In the modern Large Language Model era, we see an exponential increase in major issues. In 2023 alone, these emerged

- South Korean mega-corporation Samsung banned their employees from using ChatGPT after they realized it had been involved in a significant leak of intellectual property
- Hackers began taking advantage of poor/insecure code generated by LLMs that was inserted into running business applications
- Lawyers were sanctioned for including fictional cases (generated by LLMs) in court documents
- Open AI itself is being investigated for breaches of European privacy regulations and being sued by the United States Federal Trade Commission (FTC) for producing false and misleading information

The trend here is an acceleration of security, reputational, and financial risk related to these chatbots and language models. The problem isn't being effectively solved over time. It's becoming more acute as these technologies' adoption rate increases. That's why we've created this book. To help

developers, teams, and companies using these technologies understand and mitigate these risks.

Let’s dive in!

- https://techcrunch.com/2016/03/23/microsofts-new-ai-powered-bot-tay-answers-your-tweets-and-chats-on-groupme-and-kik/

- https://blogs.microsoft.com/blog/2016/03/25/learning-tays-introduction/

- https://slate.com/technology/2021/04/scatterlab-lee-luda-chatbot-kakaotalk-ai-privacy.html

Chapter 2. The OWASP Top 10 for LLM Applications

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If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

In the Spring of 2023, I began researching security vulnerabilities specific to LLMs. At the time, there was a relatively large body of research on security for AI in general but very little organized research about LLMs. However, I did find some research papers and blogs that covered some ideas in the area. I began the process of collecting these research papers

and summarizing them using ChatGPT. Eventually, I provided a few examples from the current Web Top 10 list and asked ChatGPT to generate a draft Top 10 for LLMs in a similar format.

I thought what came out looked interesting, so I sent it to Jeff Williams, a founder of OWASP, the Open Worldwide Application Security Project, to see what he thought. Jeff, Contrast's Chief Technical Officer, wrote the first OWASP Top 10 list in 2001. His idea was to create an accessible resource for developers to understand the most critical risks and vulnerable areas of Web applications. At the time, The World Wide Web was still only a few years old, and most developers had little to no understanding of creating secure web applications. That original Top 10 list became a seminal work and a foundational resource in application security.

I didn't tell Jeff that my list was primarily machine-generated. As the author of the original Top 10 list, I figured that he could give me a good idea of whether my Top 10 list looked novel and worth pursuing. Jeff encouraged me to petition the OWASP board for approval to spin it up as a new project. A few weeks later, the OWASP board approved the project, and I announced it - along with a link to a somewhat refined version of that draft Top 10 I'd generated with ChatGPT.

What I thought would be an obscure research project and a bit of fun turned out to be something much bigger. When I posted the announcement of the project formation on my personal LinkedIn page, I'd hoped to find a dozen or so like-minded individuals interested in the obscure topic of LLM security. As it turned out, my initial blog announcement wracked up almost 10,000 readers, and hundreds of individuals volunteered to join the expert team in the weeks that followed.

This book isn't a product of OWASP, and the vulnerabilities and risks here won't precisely map to any public version of the Top 10 for LLM Apps list. Instead, you should expect that you'll get my view on these risks. However, my learning and thinking on the topic is heavily influenced by my work leading the creation and initial release of the OWASP Top 10 for LLM Applications project. In addition, given the success of the project, I've had many people ask me for details about how we ran the project and why we were able to create such an impactful framework in such a short time. So, before we examine individual risks and vulnerabilities, I'll give you some of the backstory of OSASP and the LLM Applications project.

About OWASP

The Open Worldwide Application Security Project (OWASP) is a nonprofit organization focused on improving software security. Founded in 2001, OWASP provides a platform for security experts to share their knowledge and best practices about web security, from application-level vulnerabilities to emerging threats. Today, it has tens of thousands of active members and over 250 local chapters around the globe.

The organization is community-driven and encourages the participation of volunteers who contribute to various projects, including documentation, tools, and forums. It operates under an open-source model, making its resources freely accessible to the public. Over the years, OWASP has garnered a strong following among the security community, and its guidelines and tools are considered industry standards in many contexts.

In addition to the original Top 10 list for Web Applications (updated regularly, most recently in 2021), specialized Top 10 lists have emerged from the OWASP group over the years. These include:

- OWASP Mobile Top 10: This list focuses on security risks associated with mobile applications, covering Android and iOS platforms. Topics may include insecure data storage, insufficient cryptography, and insecure communication.

- OWASP API Security Top 10: APIs (Application Programming Interfaces) have their unique security considerations, separate from web applications. This list covers risks like improper asset management, broken object-level security, and more.
- OWASP IoT Top Ten: Security is a significant concern with the increasing number of Internet of Things (IoT) devices. This list outlines the top security concerns for IoT, including insecure network services, lack of physical hardening, and insecure software/firmware.
- OWASP Cloud-Native Application Security Top 10: This list addresses the security concerns related explicitly to cloud-native applications. It covers data exposure, broken authentication, and insecure deployment configurations.
- OWASP Top 10 Privacy Risks: This project aims to educate and promote good privacy practices in application development, covering topics like lack of data encryption, insufficient auditing and logging, and more.
- OWASP Top 10 for Serverless: This is a more niche list that focuses on the unique security concerns related to serverless architecture, which is increasingly popular but comes with its risks.

The Top 10 for LLM Applications Project

Within a week after I posted the announcement about the formation of the Top 10 for LLM Applications project, well over 200 people had signed onto it, and we held the kick-off event via Zoom. At that first meeting, I laid out a vision for what I hoped the group could accomplish and proposed an aggressive roadmap that we would build the first version of the list in 8 weeks. A typical OWASP Top 10 list may take a year or more to develop, but we decided that this space was moving so fast, and this type of resource was so needed, that we had to work more quickly.

We decided to run the project as two-week, agile-style sprints. Given that most of the people in the expert group were familiar with agile development, everyone quickly fell into the pace.

Project Execution

The first sprint of the project was Brainstorming and Commentary. Everyone reviewed the original version of the list - which I called version 0.1. There were plenty of problems with that initial version, and the team was aggressive about pointing

them out. At the same time, we began to create a wiki page with links to all the resources the group found on LLM security issues. It turned out a lot had been written, but this was the first time anyone had ever collected them and made them easy to access. This new curated collection of resources was the first win for the group.

The second sprint was to generate a new version of the list. This time, rather than being the work of a single person and an AI, it would be the product of the collective wisdom of our expert team – which continued to grow week-on-week. In the first week, the group focused on generating ideas for the Top 10 list. We published a template and asked the group to submit candidate vulnerabilities. In that week, we developed 43 detailed descriptions of possible areas. We then conducted two rounds of voting using Google Forms to use the team's collective wisdom to narrow the list to 10. We then published a version of the list called 0.5. This version was far more detailed and comprehensive than the 0.1 version. The reception from the large community was very positive. This reaction gave the group the energy to keep working.

The next sprint was to refine each entry. We created Slack channels for each vulnerability type and chose a volunteer as the Entry Lead for each item. Subteams of 10 to 30 individuals

then fleshed out and tuned each entry. Again, we included a round of voting for the whole team to be involved and point out weak areas that needed more attention. Along the way, we found some entries overlapping and merged them. This change made space to pull up some entries that had fallen below the line. The result of this sprint became version 0.9 of the list. Interestingly, version 0.9 was about 33% shorter than 0.5 in terms of word count. This extra time and refinement allowed the subteams to focus their thinking and make the entries punchy and tight.

Finally, we took a final sprint to review, tweak, and clean each entry. We gathered another round of feedback via Google Forms to ensure everything was ready. By this time we had a dedicated design lead who laid out the whole document in an attractive PDF for publication.

Reception

My announcement for the 1.0 version of the list was viewed on LinkedIn over 40,000 times. And that doesn't include many other posts made by other expert group members on their own pages and blogs. In the days following the publication of the announcement, reporters picked up the news. They covered it in media outlets such as *Wired*, *SD Times*, *The Register*,

I*nfosecurity Magazine*, and *Diginomica*. It's safe to say hundreds of thousands of people became aware of our work in just the first few weeks.

Beyond the sheer number of people exposed, the thing that amazed me was the uniformly positive feedback. We also saw the first government agencies in the US and Europe referencing our work as a foundational document. While everyone on our expert team agreed there was much more to do, it seemed the world was so hungry for advice in this area that our document hit the mark. While we received many questions and comments, it's safe to say that everyone involved felt pleased and proud of our work.

Keys to Success

I've had many people ask me how we could drive this so quickly to a great outcome. In looking back, there were several factors that I believe contributed. I'll share them here in the hopes that others running similar projects in the future might benefit.

Timing undoubtedly played a considerable role. The wave of interest in LLMs that followed the release of ChatGPT was massive. It drew my attention, and countless others became

excited as well. This helped attract a large and diverse expert group and gave a smaller group of these people motivation to spend long hours on the project on a tight deadline.

Having a clear plan and timeline from the start was crucial. My knowledge of LLM security was limited at the beginning of the project, but I've made a career of running complex projects with many contributors. Creating a clear roadmap with specific phases and a schedule let people know what we were doing and when. The fact that everyone could see a goal that wasn't too far away kept people motivated. Every two weeks, we had global meetings via Zoom and posted recordings on YouTube for people who couldn't attend live. The meetings and recordings were critical to coordinating a globally distributed team.

A freeform but short brainstorming phase at the start was critical. LLM security was such a new area that taking those first two weeks for people to throw out ideas and argue on Slack was crucial. It also allowed us to collect and socialize a repository of the existing research in the area. That let us start at a point where everyone on the project had access to the best pre-existing research.

However, equally critical was keeping this phase short. We could maintain momentum by limiting brainstorming to two weeks and then quickly shifting to a creation phase. I've seen other projects get stuck and be unable to move past brainstorming before people lose interest.

Creating the project's Core Team wasn't something I'd originally planned, but it became critical. Having a large expert team was a fantastic asset. The group grew to nearly 500 people by the time we published 1.0. A team that large would have been totally unmanageable. During the project's first few weeks, I was looking for active and knowledgeable people. I approached about a dozen of them and asked if they'd be willing to join the Core leadership team of the project. I told them it would be extra work, but they'd get to be at the heart of the project. There would be no specific reward for taking this role. Most accepted immediately. I believe that recognizing people and asking for their support formally motivated them to spend more time and energy on the project. They were all invested!

Short sprints with visible deliverables are a core tenant of Agile, and this is a place where it shined. Using an Agile Release Train model, I could continue to drive the group forward even in the face of conflicting opinions. If some members had concerns about an area, we didn't let it get us stuck. We acknowledged it

and agreed we’d resolve it in the next Sprint. And, when we got to version 1.0 of the list, there were still some places people wanted to do more. We just agreed there would be more versions of the list. It would be a living document, and the most important thing was to get a version of this resource into the hands of the developers who needed it.

This Book and the Top 10 List

As I mentioned, this book is not a product of the OWASP Foundation. However, the experience of working with this team has had an enormous impact on my understanding and mental model for LLM security. This mindset means that much of the guidance in the following chapters of the book is influenced by the fantastic team building and maintaining the Top 10 project. In this way, readers should feel comfortable that they're getting advice that isn't the product of a single author but is informed by a larger community of experts.

In the following several chapters, we'll review the top risk and vulnerability areas for LLMs. The risks we discuss will contain many common areas to the OWASP Top 10 but won't be precisely the same as any version of the official Top 10. Also, I'll go more deeply into each area in this book. The Top 10 list is a quick read that highlights critical areas. However, it doesn't go deeply into any of them. Here, we'll delve more deeply into the risks, remediation steps, and real-world case studies.

In the next chapter, we'll dig into the overall structure of typical LLM applications and start discussing where the trust boundaries and dangers lay. After that, subsequent chapters

will delve into individual risk areas and examine vulnerabilities, attacks, and examples so that you can plan your strategy for securing your own use cases.

Let’s go!

Chapter 3. Architectures and Trust Boundaries

A NOTE FOR EARLY RELEASE READERS

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This will be the 3rd chapter of the final book. Please note that the GitHub repo will be made active later on.

If you have comments about how we might improve the content and/or examples in this book, or if you notice missing material within this chapter, please reach out to the author at llm.playbook@gmail.com.

Unlike traditional web applications that rely on predefined algorithms and static databases, LLMs utilize massive neural networks to generate dynamic, context-aware responses. This seismic shift brings a unique set of security challenges different from what we've seen in traditional web applications. While researchers have meticulously studied web applications and

their vulnerabilities, the field of LLM security is still relatively nascent.

This chapter aims to bridge this knowledge gap by dissecting the fundamental elements that set LLMs apart. We'll start by exploring the building blocks of AI, Neural Networks, and how they relate to Large Language Models. Then, we dive into the groundbreaking architecture that powers most LLMs today—the Transformer model. Following this, we look into the various LLM-powered applications, such as chatbots and code co-pilots.

However, in addition to understanding the technology, security professionals must be aware of the new kinds of *trust boundaries* unique to LLMs—boundaries that demarcate areas of varying trustworthiness within an application. These include user prompts, uploaded content, training data, plug-ins, and other boundary systems that we'll detail later in the chapter.

AI, Neural Networks, and Large Language Models. What's the difference?

Artificial Intelligence (AI), Neural Network, and LLM are terms often used interchangeably, but they represent different facets

of a broader landscape of machine learning and computational intelligence. Let's break down the differences to understand their unique roles in technology and security.

Artificial Intelligence (AI)

Artificial Intelligence, at its core, is a multidisciplinary field aimed at creating systems capable of performing tasks that would ordinarily require human intelligence. These tasks include problem-solving, perception, and language understanding. AI encompasses a wide range of technologies and methodologies, from rule-based systems to machine learning algorithms, serving as an umbrella term for multiple approaches to achieving artificial 'intelligence.'

Neural Networks

Neural Networks are a subset of AI inspired by the architecture of the human brain. They are computational models designed to recognize patterns and make decisions based on the data they process. Neural Networks can be simple, with a minimal number of layers (shallow neural networks), or highly complex, with multiple interconnected layers (deep neural networks). They are the backbone of many modern AI applications,

including image recognition, natural language processing, and autonomous vehicles.

Large Language Models (LLMs)

LLMs represent a specific application of Neural Networks. They are built on architectures designed for understanding and generating human language. LLMs usually employ advanced forms of neural networks, such as Transformer models, to analyze and produce text based on the training data their developers fed them. What sets them apart is their massive scale and specialization in handling linguistic tasks, which range from simple text completion to complex question answering and summarization.

Understanding these distinctions is crucial for security professionals. Each layer—from broad AI technologies to specialized LLMs—introduces vulnerabilities and requires unique security measures. As we delve deeper into the complexities of LLMs, recognizing their position in the broader AI landscape will be critical to effectively safeguarding them.

The Transformer Revolution: Origins, Impact, and the LLM Connection

The Transformer architecture is a pivotal milestone in the evolution of artificial intelligence, profoundly impacting the AI landscape and, by extension, Large Language Models (LLMs). Let's unravel the story of the Transformer revolution—where it came from, when it happened, and the seismic shifts it brought to AI and LLMs.

Origins of the Transformer

The Transformer architecture was introduced in a groundbreaking research paper titled "Attention Is All You Need" by Vaswani et al., published in 2017[1]. This paper proposed a novel approach to natural language processing (NLP) tasks, departing from the traditional sequence-to-sequence models that relied heavily on recurrent neural networks (RNNs) and convolutional neural networks (CNNs). The Transformer introduced a key innovation: the self-attention mechanism. This mechanism allowed the model to weigh the importance of different words in a sentence, enabling it to understand context more effectively.

Before the emergence of Transformers, the world of neural networks was replete with promise but often struggled to deliver on the lofty expectations. Traditional architectures like RNNs and CNNs enabled advanced AI capabilities but grappled

with inherent limitations. These limitations stemmed from their inability to capture and utilize context effectively, particularly in natural language understanding.

RNNs, while suitable for sequential data, faced challenges maintaining context over long sequences. They exhibited a form of “short-term memory,” which made them less adept at grasping intricate relationships and dependencies within lengthy texts or conversations. On the other hand, CNNs, renowned for their prowess in image recognition, needed help to extend their effectiveness to sequential data like language, where understanding context across words and sentences was paramount.

This shortcoming in contextual understanding was the Achilles’ heel of traditional neural networks. They could only glimpse small portions of a text at a time, rendering them incapable of comprehending the broader narrative or nuances. It was akin to trying to understand a novel by reading only a few random sentences from its pages. The result was a gap between the promise of AI and its practical application, particularly in natural language understanding. It was this gap that the Transformer architecture would bridge, unleashing a wave of progress and redefining the landscape of AI-driven language models.

Transformer Architecture’s Impact on AI

Introducing the Transformer architecture wasn’t just a milestone for natural language processing; it marked a paradigm shift across multiple domains within the AI landscape. While researchers initially used the Transformer architecture to solve problems related to understanding and generating text, researchers and engineers quickly found that its capabilities extended far beyond that. Here are some areas where Transformer architectures have made a considerable impact:

Natural Language Processing (NLP)

Of course, the first and most immediate impact was in NLP. Transformer models are now the backbone for various language tasks such as translation, summarization, question-answering, and sentiment analysis. They have set new performance benchmarks, sometimes surpassing human-level capabilities in specific tasks.

Computer Vision

Interestingly, the Transformer architecture also has applications in computer vision. While CNNs have been the gold

standard for image-related tasks, Transformer-based models like Vision Transformer (ViT) demonstrate competitive, if not superior, performance in tasks like image classification, object detection, and segmentation.

Speech Recognition

The flexibility of Transformer architectures has also made them a good fit for speech recognition. Combined with specialized models like the Conformer, which fuses Convolutional layers with Transformer layers, they have set new standards for understanding spoken language.

Autonomous Systems and Self-Driving Cars

One of the most intriguing applications of Transformers is autonomous systems, including self-driving cars. These vehicles require a high contextual understanding to navigate the world safely. Transformer models are at the heart of self-driving models from companies like Tesla.

Healthcare

In healthcare, Transformer models are aiding in tasks ranging from drug discovery to the analysis of medical images. Their

ability to sift through and interpret large amounts of data can speed up research and potentially lead to more accurate diagnoses.

Therefore, the rise of the Transformer architecture has been a tide that lifted all boats, revolutionizing not just one but multiple fields within AI. However, this versatility also brings unique security challenges across these various applications. As we delve deeper into LLM security, we'll explore how the ubiquitous nature of Transformer architectures necessitates a multi-faceted approach to safeguarding AI systems.

Types of LLM-based Applications

Two common types of LLM-based applications are chatbots and co-pilots. Let's briefly look at each to help you understand the breadth of applications in which developers use LLMs and give you context for understanding various architectural choices as you delve further.

Chatbots are computer programs that can simulate conversations with humans, and they often power customer service applications, where they can answer questions and support customers. Chatbots also excel at entertainment

applications like playing games or telling stories. Tay from Chapter 1 was just such an example of an Entertainment Chatbot.

Co-pilots are AI systems that can assist humans with writing, coding, and research tasks. They can help users to generate ideas, identify errors, and improve their work. Co-pilots are still under development, but they have the potential to revolutionize the way we work and learn.

Specific examples of LLM-based chatbots:

- **Sephora** uses a chatbot to help customers find the right products for their skin type and needs.
- **H&M** uses a chatbot to help customers find clothes and accessories that match their style.
- **Domino's Pizza** uses a chatbot to allow customers to order pizza via Twitter or Facebook Messenger.
- **Fandango** uses a chatbot to help customers find movie times and theaters nearby.
- **JetBlue Airways** uses a chatbot to answer customer questions about flights and travel.
- **Amtrak** uses a chatbot to help customers book tickets, check train status, and get answers to their questions.

- **The Golden State Warriors** use a chatbot to help fans purchase tickets, learn about upcoming games, and get news about the team.

Specific examples of LLM-based co-pilots:

- **Grammarly or ProWritingAid** are co-pilots that help users improve their writing by identifying and correcting grammar errors, suggesting style improvements, and providing feedback.
- **GitHub Co-Pilot and AWS Code Whisperer** are co-pilots that help programmers write code faster and more efficiently. They can generate code suggestions, translate between programming languages, and help to identify and debug errors.
- **Microsoft Office 365 Co-pilot and Google Duet** are AI-powered tools integrated into their respective office suite apps that help users to be more productive and creative in their work.

NOTE

A chatbot like ChatGPT can read and review a text block and then provide suggestions to improve it. However, the experience of using a co-pilot like Grammarly to do that is dramatically different - and generally superior for that type of focused task.

Similarities between chatbots and co-pilots:

- Both chatbots and co-pilots are LLM-based applications.
- Both chatbots and co-pilots both generate text.
- Both chatbots and co-pilots assist humans with tasks.

Differences between chatbots and co-pilots:

- Chatbots simulate conversation with humans, while co-pilots assist humans with specific tasks.
- Chatbots often power customer service applications, while co-pilots assist in writing, coding, and research applications.
- Chatbots are typically more interactive than co-pilots, while co-pilots focus more on completing tasks.

Examples of use cases:

- A customer service chatbot can answer customer questions about a company's products or services.
- A co-pilot can help writers generate ideas for a new article or identify writing errors.
- A co-pilot can help programmers write code more efficiently or debug their applications.

Keep these concepts in mind as we delve into the details of LLM architectures. Both application types share similar components, but you may make different decisions on implementing pieces based on the differing security considerations.

LLM Application Architecture

Developers often consider LLMs as standalone entities capable of impressive text generation and comprehension feats. However, in practice, an LLM is rarely isolated; it is a cog in the intricate machinery that constitutes an intelligent application. These applications are complex systems comprising multiple interconnected components, each playing a vital role in the overall functionality and performance. Whether a conversational agent, an automated content generator, or a co-pilot for code, an LLM usually interacts with various elements such as databases, APIs, front-end interfaces, and even other machine learning models.

Understanding the architecture of such composite systems is not just a matter of technical proficiency; it is crucial for effective security planning. The way these components interact introduces multiple trust and data flow layers, defining new security boundaries far removed from traditional web

application security models. For instance, user inputs may not just be simple text fields but could include voice commands, images, or real-time collaborative editing. Similarly, an LLM's outputs could be fed into other systems for further processing, each introducing vulnerabilities and risks.

In essence, the holistic view of an LLM-based application goes beyond securing the language model itself. It demands a comprehensive approach that considers the security of the entire architecture, from data ingestion and storage to model serving and user interaction. Only by understanding these intricacies can one formulate an effective strategy to safeguard an application against the myriad of vulnerabilities such complex systems inherently possess.

As we delve deeper into the subject in this chapter, we will dissect the various components that typically make up an LLM application, examine their roles, and explore the unique security challenges each presents. This understanding will be the foundation for a robust, multi-layered approach to securing your LLM-based applications.

Figure 3-1 shows a highly simplified diagram to help illustrate the components, relationships, and data flows in an application

using an LLM. We'll delve into more detailed areas of this in subsequent chapters.

Figure 3-1. Typical LLM Application Dataflow Architecture

Trust Boundaries

In application security, a "trust boundary" serves as an invisible yet crucial demarcation line that separates different components or entities based on their level of trustworthiness. These boundaries delineate areas where data or control flow changes from one level of trust to another—such as transitioning from user-controlled input to internal processing or moving from a secure internal database to a public-facing

API. These boundaries act as checkpoints where developers should rigorously apply security measures like authentication, authorization, and data validation to prevent vulnerabilities.

WARNING

Understanding trust boundaries is critical to threat modeling. Properly defining and recognizing these boundaries can be the difference between a secure system and one vulnerable to threats.

Figure 3-2 adds the trust boundaries into our architecture diagram.

Figure 3-2. LLM Application Architecture with Trust Boundaries

These boundaries, as depicted in the diagram, serve as gateways through which the LLM interfaces with diverse components — public data from the web, structured databases, spontaneous user interactions, or internally sourced training sets. Each delineated boundary highlights highlights considerations we must make when considering data that flows into and out of the LLM. Here's a quick summary, and we'll dive more deeply in the next section.

- **User Interactions:** You'll need to consider safeguarding the model from potential adversarial or misleading inputs that users or systems might introduce. You'll also need to worry about toxic, inaccurate, or sensitive data being output from the model and passed back to the user.
- **In-the-wild Training Data:** LLMs are often trained on massive amounts of internet data. You need to consider this data untrusted and watch out for potential toxicity, bias, and adversarial data poisoning - which we'll cover in Chapter 8.
- **Internal Training Data:** You may use internally curated data to fine-tune your model - which can significantly increase accuracy. But you must be wary of ingesting and exposing sensitive, confidential, or personally identifiable information. We'll cover this more in Chapter 5.

- **External Services:** Policing how the LLM interfaces with connected services, like databases or APIs, from unauthorized interactions or data leaks. We'll cover this more in Chapter 7.
- **Public Data Access:** Pulling in data live from the web can be a powerful way to augment the capabilities of your application, but you'll need to consider this data as untrusted and watch for issues like indirect prompt injection - which we'll cover in chapter 4.

Each point is a potential avenue of vulnerability, susceptible to exploitation if overlooked. In the evolving landscape of LLM applications, securing these trust boundaries is not just best practice — it's essential to prevent unauthorized data access, mitigate data tampering, and avert system breaches. Recognizing these boundaries and their implications is the cornerstone of a resilient LLM security architecture. Now, let's go into more detail on each area to ensure you have enough context to dive into the following chapters that detail the risk areas and mitigations.

The Model

The language model serves as the intellectual core of any LLM application, taking in data, generating responses, and driving

interactions. Depending on the architecture and requirements, you may interact with the language model through a public API hosted by a third-party service, or you may run a privately hosted model. For example, you can download versions of Meta's powerful Llama model from Github or Hugging Face and run it locally.

Public APIs: The Convenience and The Risks

Utilizing a public API for accessing a language model offers convenience and lower upfront costs. Third parties manage and update these models, reducing your organization's resource burden. However, the tradeoff often comes in the form of higher risk regarding data exposure. When you send a request to a third-party model, the data crosses a trust boundary, exiting your secure network and entering an external system. This process exposes you to risks around data confidentiality and, depending on the third party's security measures, could make you vulnerable to data breaches.

Privately Hosted Models: More Control, Different Risks

Opting for a privately hosted model gives you more control over your data, allowing you to manage trust boundaries more

tightly. It also allows you to customize or fine-tune the model according to your needs. However, running a privately hosted model brings challenges, such as maintenance, updates, and ensuring that the model doesn't contain vulnerabilities—essentially exposing you to potential supply chain risks. If you use an open-source model, it becomes crucial to ensure its provenance and integrity to avoid embedded vulnerabilities or biases.

Risk Considerations

- **Sensitive Data Exposure:** Public APIs may increase the risk of exposing sensitive information, while privately hosted models offer better control but require robust internal security measures.
- **Supply Chain Risk:** The origins of your model, whether it's a well-vetted public service or an open-source download, are crucial. A compromised model can introduce vulnerabilities into your application, effectively acting as a backdoor for attacks.

By carefully considering the model's hosting environment, you can better assess the trade-offs and risks associated with sensitive data exposure and supply chain vulnerabilities. These considerations will guide you in establishing appropriate trust

boundaries and security protocols tailored to your chosen model's architecture.

User Interaction

While "user input" might suggest a one-way flow of information from the user into the application, the reality is often more nuanced. In the context of LLM applications, "User Interaction" encapsulates both receiving input from the user and providing output back to the user. This bidirectional interaction is fundamental for creating an engaging and practical user experience but also introduces a more complicated security landscape.

Prompts are a vital element of user interaction. They are not merely requests for information but serve as a guide to how the user interacts with the LLM. A well-crafted prompt can direct the model to provide valuable and accurate information, while an ambiguous or poorly constructed one can lead to unclear or even misleading outputs. As a result, the management of prompts becomes a critical aspect of application security. For example, a maliciously crafted prompt could trick the model into divulging information it shouldn't or generating harmful content. Returning to Chapter 1, Tay fell victim to this when

malicious prompts from her 4Chan hackers helped lead her astray.

Given the importance of this bidirectional interaction, securing both inputs and outputs is crucial. On the input side, input validation, sanitation, and rate-limiting measures are vital in mitigating vulnerabilities like injection attacks. On the output side, ensuring that the model's responses are appropriately filtered and that your application does not leak sensitive information is equally vital.

This interactive layer with the user creates a critical trust boundary in the application architecture. Any data crossing this boundary, whether in or out, should be carefully managed to avoid security risks. Additional layers of protection include using encryption for sensitive outputs or employing real-time monitoring to flag potentially harmful or sensitive data flows. We'll discuss this more thoroughly in the Prompt Injection and Output Filtering chapters.

Training Data

Training data is the bedrock upon which LLMs build their understanding and capabilities. Whether used for initial training or subsequent fine-tuning, the nature and source of

this data have significant implications for both the model's performance and security posture. One crucial distinction is whether the data is internally sourced or culled from public or external sources ("in the wild").

Data generated or curated within an organization usually undergo a more rigorous vetting than publicly sourced data. It is often aligned with the application's specific requirements or use cases, making it generally more reliable and relevant. The controlled environment also allows for better implementation of security measures like encryption, access controls, and auditing. However, this data may contain sensitive or proprietary information, and the trust boundary here is closely tied to internal security protocols. A breach at this level could have serious ramifications, including data leakage or the corruption of the training set.

Data sourced from public repositories or "the wild" introduces different challenges. While this data can offer diversity and scale, its reliability and safety are often not guaranteed. Such data could include misleading information, biases, or malicious inputs to compromise the model. The trust boundary here is more porous and extends to the external entities that generate or host this data: rigorous filtering, validation, and continuous monitoring become essential to mitigate risks and

vulnerabilities. Returning to Chapter 1, Tay was digesting user prompts directly as training data. In this way, remnants of toxic prompts became part of her knowledge base, and then she began to spill poisonous output. Accepting unfiltered, untrusted user input into your training data set is the simplest example of a failure to manage this critical security boundary.

For either internally sourced or public data, the concept of trust boundaries is critical. For internally sourced data, the boundary is often within the organization's controlled environment, making it easier to enforce security measures. On the other hand, using external data effectively extends your trust boundary to include those external sources that may not adhere to your security standards. Using external data for training necessitates additional layers of validation and security checks to ensure that unvetted data doesn't compromise the integrity or security of the LLM application.

Understanding the origins of your training data, the associated trust boundaries, and their respective security implications is crucial for safeguarding your LLM application. Comprehensive data governance policies must be in place to manage the lifecycle of your training data, regardless of its source.

Access to Live External Data Sources

Live external data sources bring an added dimension to the capabilities of LLM applications by enabling them to provide real-time information, context, or even third-party integrations. While access to live external data enhances the user experience and functional range, it introduces a new layer of complexity to the application's security landscape.

As an example of this, as of the writing of this chapter, OpenAI's ChatGPT does not have direct access to the live web, and is thus limited to only facts in its older training data. On the other hand, Google's Bard engine does have access to live internet data. While the GPT-4 model is doubtlessly superior in reasoning capability, it fails at many basic tasks where Bard can succeed. Figure 3-3 shows an interaction with ChatGPT. Figure 3-4 shows the same interaction with Bard.

Figure 3-3. ChatGPT with GTP-4 fails to answer a simple question due to limited access to external data.

who won yesterday's 49er football game

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The San Francisco 49ers defeated the New York Giants 30-12 on Thursday Night Football on September 21, 2023.

Christian McCaffrey scored a touchdown in his 12th straight game, and Brock Purdy threw two touchdown passes to lead the 49ers to their third straight win.

Figure 3-4. Bard's direct access to internet feeds gives it an advantage.

While clearly, there are advantages to accessing outside data sources such as websites, APIs, or third-party databases, it exposes the application to potential risks. The risk of ingesting untrusted, external data sources can range from consuming false or harmful information from compromised websites to becoming a conduit for security threats like malware or unauthorized data access. The untrusted nature of these data sources makes them inherently less controllable than internal resources, thereby adding an additional layer of uncertainty and risk.

The concept of trust boundaries becomes especially pertinent in the context of accessing public internet data. Unlike internal services, where you can uniformly apply security measures, external sources may adhere to different security standards than your organization. This differential in trust necessitates additional layers of validation, security checks, and monitoring to ensure that data crossing this boundary doesn't compromise the system.

Access to Internal Services

Internal services like databases and internal APIs often serve as the backend support structure for LLM applications. They may house critical data from user profiles and logs to configuration settings and even vast data in SQL or Vector Databases. As a component that often interfaces with various other internal and external elements of the system, internal services represent a critical point in the application's architecture, both functionally and from a security perspective.

These services often function within the controlled environment of an organization, enabling uniform application of security policies. However, the fact that these services are internal should keep one from a false sense of security. They are still vulnerable to various threats, such as unauthorized

access, data leaks, and internal threats from within the organization.

Internal services such as databases, proprietary APIs, and backend systems often constitute the operational backbone for LLM applications. These resources typically reside within the organization's secure network, providing trust and control that is harder to achieve with external services. However, this internal nature can paradoxically elevate the security risks involved, primarily if these services house the organization's "crown jewels" of sensitive or valuable data.

Conclusion

Securing LLM applications is an endeavor fraught with complexities, intricacies, and challenges, significantly different from traditional web applications. This chapter has aimed to lay down the foundational knowledge required to navigate this complex landscape, focusing on three critical areas: distinguishing between Artificial Intelligence, Neural Networks, and Large Language Models; understanding the pivotal role of Transformer architectures; and diving deep into LLM application architecture, particularly the concept of trust boundaries. Knowing what sets LLMs apart helps us tailor our

security strategies more effectively, going beyond general AI or machine learning frameworks.

- https://arxiv.org/pdf/1706.03762.pdf