Model Thinking
18ECSE411
Term Paper

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Abstract.

Education has been given prime importance by the union government in India and continues to expand rapidly. School connectivity has been improved by investment in school facilities and the training of teachers. In higher education too, the number of providers tends to grow exponentially. Education is a force multiplier that encourages self-reliance, promotes economic performance and enhance skills, and transforms people's lives by opening up possibilities for new livelihoods. However, alongside there are numerous gaps in this system. The current education system is not properly justified. There are problems in the area of transparency. There is no common educational content. Different states might have different content. No proper mechanism to validate the students. Indian education focuses more on theoretical knowledge rather than practical making the learning system boring and less effective. This model is proposed by studying different standard models like Social model, Behavioral models and many more. The model is also represented in the form of Transition Systems and Program Graphs. Different policies are represented by different parts of the Transition systems and Program graphs to ensure the correctness of the model. Thus, this paper tries to reduce the problems in the education system by building a model for education that concentrates on hybrid education system along with some new policies that need to be implemented and ultimately aims at universalization of education in India.

1. Introduction

Education is the most important thing for a country to grow and thrive. It moulds the behaviour and intellect of an individual. It allows a person to use knowledge and perception to make critical choices. Education systems thus play an important role in shaping one's life and the way one perceives the world. Unfortunately, amid several improvements, the current education system has not been very successful. Compared to the conventional system [1], no of schools has increased drastically, the chalkboards have switched to whiteboards, the content of books have also changed but the methodology of education almost remains the same. The methodology of the curriculum needs to change adequately to enhance the current education system [2].

The present Indian Education System has a variety of holes in its strategy [3]. Lack of capital is one of the major challenges in this system. Due to a lack of finance, most educational establishments need a framework, science equipment and libraries, and so on. Hence, the required results cannot be achieved. Mass illiteracy is yet another issue in this Indian education system. As per NSO, India's average literacy rate is 77.7% [4]. Current education framework is general. Enhancements in advance and specialized domains is required. The gross enrollment ratio for higher education [5] needs to improve so that more and more student get their place in a University. Most of the parents now a day look for a private school and prefer not to send their child to a government school. This is due to the lack of infrastructure and facility in government schools and colleges. Many rural areas do not have proper schools and students need to walk miles to go to school [6]. Out of all this, the main problem within the education system is the standard of education given to students. The education provided to students is usually academic and lacks practicality. It is difficult to implement all these issues into a single system but one can try to minimize these issues.

In the meantime, the mode of education has been changed from offline to online. Covid-19 in recent times, lead to a great disturbance in the field of education [7]. All of a sudden lockdown forced educational institutes to shift to online. With this new introduction to online education, there has been a significant change in the mode of education. Online education has its own added advantages and disadvantages [8]. Faculty are facing difficulties due to lack of online teaching experience. Lack of communication between the teacher and student is yet another concern. Evaluations in the form of exams are the worst part of this mode. It has become easy for students to cheat during the online examination. The most important disadvantage of this mode is the network connectivity and affordability for smart devices. It is very difficult for the people living in rural areas to access network since there has been a high demand for network all over the world. Moreover, it is difficult for a poor family to afford smart devices. Online education has some advantages too as students can learn from their home. They can access educational resources online anytime and so on. Thus, this change of mode for time being makes a way toward better advancements in the field of education with new challenges.

Education has to have a better model to minimize the gaps in the present education system by improvising the current model and by adding a flavour of online mode to it. Thus, this term paper presents a model that provides a new approach to the education system in India.

2. Literature Survey

The education system in India is one of the oldest in the world. We found significant growth in the system of education in our country since ancient times. Ancient Indian Education [9] was religious and personal. In the Vedic period, verbal education was treated as the most important form of education. In Vedic education [10], students (also known as 'Shishyas') went to Gurukuls or homes of 'Acharayas' to learn. They led the life of decency and purity, served the Acharyas and gained knowledge. Women education was also important. Women's learnt household chores and different religious activities. Students also learnt different arts like agriculture, stone carving, animal husbandry, sea trade and so on.

Post-Vedic period [11] showed significant development of education with an introduction to activities involving self-realization and austere-meditation. The Education system had greater improvements in the domain of Physical Science, Handicrafts, Geometry, Arithmetic, Astronomy, etc. With the evolution of Buddhism and Jainism in this period, the period had three main methods of teaching. The three methods of teaching adopted in this period were learning, meditation, and realization and experience. There were mainly two stages of education during this period: Primary and Higher education. Primary education includes reading, writing, arithmetic and Secondary education include religion, philosophy, Ayurveda, military training, etc.

During the medieval period [12], most of the parts of India had Islamic rulers. Hence, Islamic Education played a vital role in the growth of education during the medieval period. The teachers were highly committed to education and were considered seniors and highly respectable class of people. The education system was strict and students were disciplined and humble in activities. The education system was religious and was regarded as sacred. Before the Islamic age, the knowledge was mainly gained through Brahmins but later in Islamic age shape of education changed and education became available to everyone i.e. Hindu and Muslim, Rich and Poor, Men and Women, etc. Hindu students also learnt their education in Muslim schools itself along with other students during this age.

After the arrival of the East India Company, the system of Indian education completely changed [13]. They changed the medium from India's native language to English. They started textbook culture in India. Textbook contained a pre-defined syllabus [14]. Introduction of textbooks lead to unity and the same knowledge spread across all over the country but also degraded the respect for teachers in society. Teachers did not have the freedom to teach the knowledge they had and were made to teach the textbook syllabus. British also introduced examination systems in India. Examination ruined most of the purpose of learning. Student started to memorize things and not used to learn by interest. Some students even started quitting studies in fear of failure in examination. British completely changed the mode of the Indian education system to replace old and ancient strong Indian education and culture.

Present Indian Education [2] got contributions from both the public and private sector. The present education in India is controlled majorly by two entities central and state. The modern Indian education system is divided into different levels: Pre-primary, Primary, Secondary, Under-Graduation and Post-Graduation. There are mainly three board in the Indian education

system: the Central Board of Secondary Education (CBSE), the Council for the Indian School Certificate Examinations (CISCE) and the National Open School (NOS) for distance education. There are also state examination board that can be considered for higher education apart from these boards.

Recently, the Union Cabinet approved the National Education Policy (NEP) 2020 [15] that aimed at improving and universalization of education from pre-primary to secondary. The silent features of this new policy are sustainable development goals, Education as an Economy booster, Internationalization of higher education, Digitalization of education, Layered Accreditation system and many more. It depends upon the state and central government on how to implement these policies in the coming years.

3. Model for Indian Education System

This education model is proposed by considering different models and factors affecting the present Indian education system. The model highlights the modifications that need to be done in the current Indian education system to improve the learning system in India. The various factors affecting the mindset of students, its impact on current education and the ways to improve the system are further described in this section.

Universalization of Education is the first step in improving the Indian education system. Indian education consists of three boards State, CBSE, and ICSE. The question here arises is that is there a need for such type of divisions. Because once a student completes his/her 12^{th} then the background, the board does not matter. Therefore, there is a need to make a universal board for the country like CBSE and all other boards should be removed. There must be an option available to the student for language selection to maintain no dispute amongst the states. Similarly, there must a single entrance test for students in each field for their higher education. For example, there are different exams for engineering in different states say for Karnataka we have KCET for engineering and JEE for NIT and IIT's. Hence, there must be only one type of exam in similar fields or domains. This would ensure the universalization of education all over India and each student will get equal opportunity irrespective of the state.

As per NEP 2020, the system of education is replaced from 10+2 structure to 5+3+3+4 structure. It even includes pre-school education. Implementing this structure can be of utmost importance and has its challenges. No free lunch theorem states that the objectives of the optimized function might change based on the factors and the utility function. Therefore, the old 10+2 structure might be efficient in olden days but now in the world of digitization and increasing needs, the 10+2 structure might not be as efficient since the 10+2 structure does not concentrate on pre-schooling and focus mainly begins from the first standard. Hence, this new 5+3+3+4 structure concentrates more on pre-school education and divides it into four stages. However, with this, there come another challenge i.e. exams. Again, according to NFL theorem, it is not necessary that exams might be effective for all the age groups since there are various factors involved in different age groups. Hence, exams must be included in the curriculum from class 4^{th}. There must be no exams for the children belonging to age 3-8 years i.e. the first stage of the schooling system. This stage should focus on teaching in play-based or activity-based methods and on the development of language skills. Children at this stage

must be unaware of competition and utmost importance should be given to learning. The exams on other stages can be taken as usual.

The present system allows a student to select his/her preferred domain after completion of secondary education. So according to the proposed model, the choices of streams should be allowed from secondary stage i.e. from eighth class. This will allow the children to focus on the domains of interest at an early age allowing them to be specialized in a particular field. However, the challenge as stated by standing ovation model in this case is the bias involved in selecting the streams. Standing ovation model talks about how one is influenced by the other's behaviour. Therefore, before selecting streams counselling students and guiding them to the right path should also be the focus of the system.

Overcrowding in schools and colleges is yet another problem in the Indian education system. The overcrowding in classes can lead to a lack of individual attention. It might lead to noise and many disciplinary issues in the classrooms. The overcrowding may be a combination of a rise in population, a shortage of teachers and a decrease in funding that has caused class sizes to soar. From an engineering point of view, one can set a Tipping Point for the number of students in the class. The tipping point is the critical point in a situation, process, or system beyond which a significant and often unstoppable effect or change takes place. Therefore, in this case, a tipping point can be set in the form of a maximum number of students per classroom. The central government stating the maximum limit of students per classrooms can universally declare the tipping point. Many states have their limit introduced by the state government but is not accurately followed by the schools and colleges. Hence, a maximum limit per classroom is to be imposed to stop overcrowding in schools and colleges.

Social models play an important role in process of human decision-making. These models talk about how an individual is influenced by the people. These models talk about how society influences one's behaviour and how society models things all around the world. Various novels tell about society modelled in old ages. Therefore, with these models student can understand the history of society in past times. Thus, this model heads toward the Introduction of Indian classics in the curriculum to understand how society was. They talk about how families lived, how friends spent their time together, what our culture respected at one point, and they encourage the reader to examine how things have changed today, if at all. As a result, reading classics in a classroom offers students the ability not only to learn but also to debate these works. Listening to a range of views on the same collection of vocabulary broadens the horizons and allows for greater comprehension. Hence, Indian classics must be included in the curriculum.

There is always a random walk and luck involved in examinations especially in various competitive exams containing multiple choices. The random walk can be generated using the number of options for a given question and the total number of questions. The probability for getting a correct answer is 1/number of option but when considered, as a whole question paper containing a large number of questions there is some chance that the student might get some average score. This score is random, can be modelled using random walks in the form of a probability distribution, and can be called luck. Hence, to avoid this all the exams having multiple choices should have negative marking. Presently, some of the competitive exams have

negative marking but there is a need to implement this in every exam containing multiple choices.

At the time of higher education, students are made to select electives. While selecting electives students to come across various bias to select electives. One should properly select the electives and should not just choose for the sake of choosing it. Thus, replicator dynamics can be used in the selection of elective courses. Usually, students select courses based on the friend's choice and different bias. The selection of the elective courses for a student should follow replicator dynamics. A student should consider two cases while selecting courses one is how easy the course is (Number of students registering) (can be called as payoff) and how effective or useful that course can be in future for that student (effective payoff). Thus, both these factors are to be considered combinatorically. Effectiveness, of course, is must and along with that, it is important to study how difficult the course is because if the course is effective but due to its difficulty one fail to grasp important concepts then it is of no use.

Online education as discussed in earlier sections was the need of the hour in recent COVID times. However, using it in right and balanced proportions is of actual importance. There are various places where online educations have been implemented. It may be in the form of MOOC, flip classrooms, digital library and many such. This model uses some of the aspects of online education in formulating the education system that is further explained in this section.

Digital Library is becoming popular now a day. A digital library is a collection of electronically organized records and files accessible on the Internet. Users will be able to browse magazine posts, books, documents, photos, sound files and videos in the digital library. As mentioned according to NFL theorem, in olden days, education was delivered in Gurukuls and students did not have any textbook. However, slowly British people introduced the concept of Textbooks. Now in the present scenario, there are plenty of books and content available in the market. One cannot grab all the books available in the market due to the quality and quantity of books available. So, Digital Library is the means to read and access the contents online and from anywhere. The only challenge is to properly maintain and update the syllabus in the library. A special person/team should be assigned in schools and colleges to properly maintain and update the content present in this digital library.

Teachers should fairly formulate teaching tasks based on the actual qualifications, teaching material and teaching goals of students. The instructor then develops and publishes instructional materials based on teaching assignments. Teaching tools consist primarily of PPT videos and micro-course videos. These materials can be generated and registered by students, and other high-quality teaching resources can be borrowed efficiently. University education should attach considerable emphasis to the development of the creative innovation of students. Teachers can then easily illustrate the content of creativity and activity development to students by micro-courses, videos, and PPT.

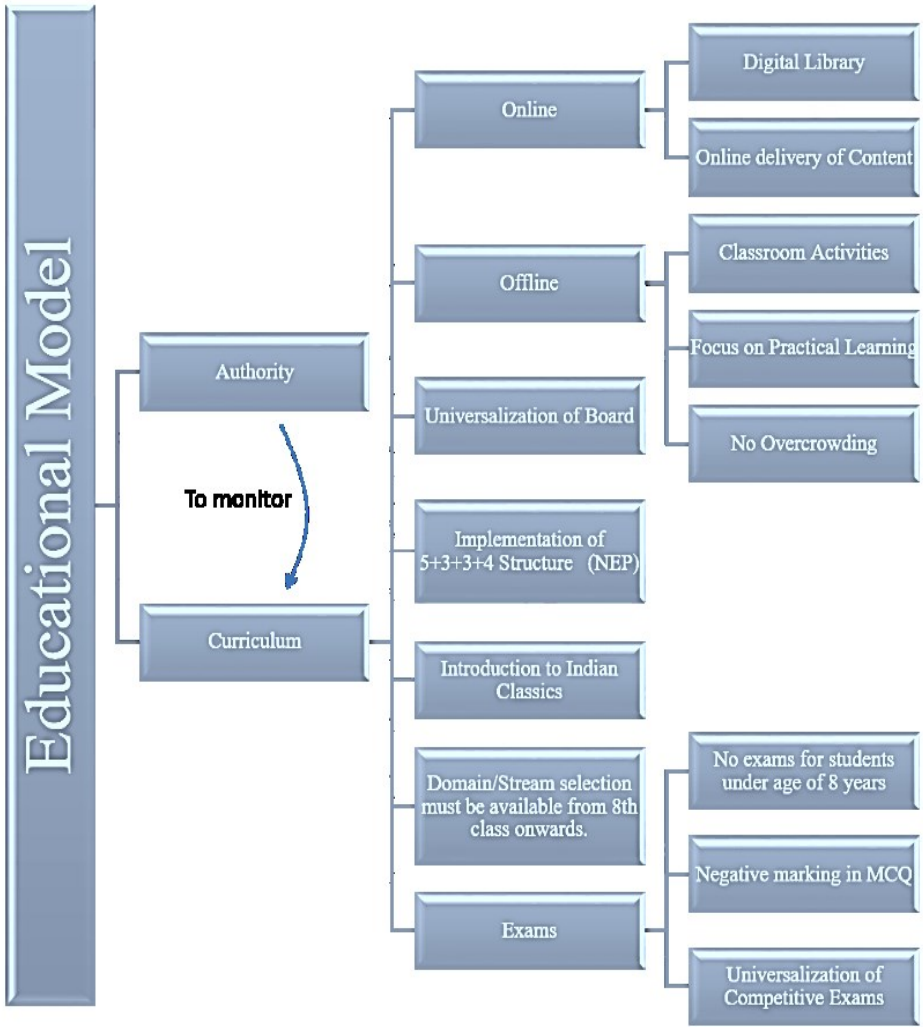

Figure 1 Model for Indian Education

District wise Authority is to be created to check the status of schools, colleges and university on the regular basis. This is necessary to maintain the proper system. Most of the schools and colleges fail to follow all the education rules. Hence, A proper authority should be maintained and strict actions need to be taken against the schools and colleges that violate the education policies.

Colonel Blotto is a game that assigns soldiers to the battlefield. The main motive is to win the maximum battlefields by dividing the players into the different battlefields without knowing the size of troops of the opponent. Therefore, in a similar way the curriculum has to be divided in between online and offline content in such a way that it might lead to an efficient education system. Thus, in this way, the model aims at establishing an education system consisting of both online and offline education modes with various other factors that are described in this section.

4. Formal Modeling

A program graph PG over set Var of typed variables is a Tuple (Loc, Act, Effect, ↪, Loc0, g0) where

Loc : is a set of locations,
Act : is a set of actions,
Effect : Act×Eval(Var)→Eval(Var),
↪ : ⊆Loc×Cond(Var)×Act×Loc,
Loc0 : ⊆Loc and is a set of initial locations,
g0 : ∈Cond (Var) and is the initial condition

Each program graph can be interpreted as a transition system, which results from unfolding. In other words, the semantics of a program graph is defined by a transition system.

Therefore, the notation for the Program Graph for the model proposed is as follows:

Tuple (Loc, Act, Effect, ↪, Loc0, g0) where:

Loc : {Education Institute, Validation, Valid, Invalid, Different Boards, Common curriculum, Class, Evaluation, Learning, Proper crowd, No exam, Exam, Activities, Practical Learning, Digital Library, Online Delivery of content},

Act :{ r==followed, r!=followed, b:Union(b1,b2,..bn), x<s, x>s, y>l, y<l, z==online, z==offline}, where r=rules of education policies, b= boards, x= strength of class, y= age of student, z= mode of learning, s=threshold, l=age limit

Effects : Effects are represented in the Program Graph diagram (They are denoted by loc → loc' on Eval(Var)),

↪ :{ $Validation \xrightarrow{Cond(r),r==followed} Valid, Validation \xrightarrow{Cond(r),r!=followed} Valid,$
$Different\ Boards \xrightarrow{Cond(b),b:Union(b1,b2,b3\ldots bn)} Common\ Curriculum,$
$Class \xrightarrow{Cond(x),x<s} Proper\ Crowd\ , Class \xrightarrow{Cond(x),x>s} Over\ Crowd,$
$Evaluation \xrightarrow{Cond(y),y<l} No\ exam, Evaluation \xrightarrow{Cond(y),y>l} Exam,$
$Learning \xrightarrow{Cond(z),z==offline} Activities, Practical\ Learning$
$Learning \xrightarrow{Cond(z),z==online} Digital\ Library,$ },

Loc0 : {Education Institute},
g0 : Initial condition depends on the educational institute

The Program Graph for this model is represented in figure 2.

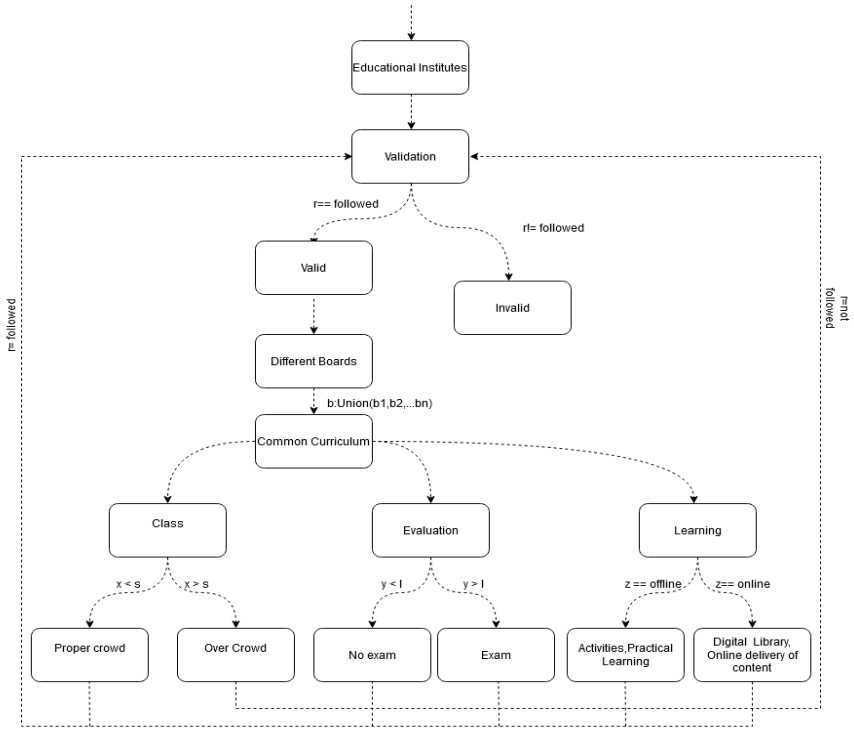

Figure 2 Program Graph

Transition System is used to define discrete systems' possible behaviour. It consists of states that can be labelled with labels selected from a set, and transitions between states. Also, on more than one transition, the same label can appear. Transitions specify how the system evolves from one state to another. A transition system TS is a tuple (S, Act, →, I, AP, L) where:

S : is a set of states,
Act : is a set of actions,
→ : ⊆ S×Act×S is a transition relation,
I : ⊆S is a set of initial states,
AP : is a set of atomic proposition,
L : S →2^{AP} is a labeling function.

Therefore, the notation for the transition system of the Program Graph for the model proposed is as follows:

Tuple (A, Act, →, I, AP, L) where:

S : {Education Institute, Valid, Different Boards, Common curriculum, Class, Evaluation, Learning, Proper crowd, No exam, Exam, Activities, Practical Learning, Digital Library, Online Delivery of content},

Act :{ Authority Validates, Universalization, No overcrowding, Dividing, Hybrid Mode},

→ :$\{Education\ Institute \xrightarrow{Authority\ Validates} Valid, r == followed$,
$Valid, r == followed \rightarrow Different\ Boards, b1 = state, b2 = CBSE, b3 = ICSE, Different\ Boards, b1 = state, b2 = CBSE, b3 = ICSE \xrightarrow{Universalization} Common\ Curriculum, b = union(b1, b2, b3)$,
$Common\ Curriculum, b = union(b1, b2, b3) \rightarrow Class$,
$Common\ Curriculum, b = union(b1, b2, b3) \rightarrow Evaluation$,
$Common\ Curriculum, b = union(b1, b2, b3) \rightarrow Learning$,
$Class \xrightarrow{No\ overcrowd} Proper\ Crowd, x < 40$, $Evaluation \xrightarrow{Divivding} No\ Exam, y < 8$, $Evaluation \xrightarrow{Dividing} Exam, y \geq 8$,$Learning \xrightarrow{Hybrid\ Modes} Activities, Practical\ Learning, z = offline$,
$Learning \xrightarrow{Hybrid\ Mode} Digital\ Library, Online\ Delivery\ of\ content, z = online\}$,

I : {Education Institute},

AP : {r, b, x, y, z}, where r=rules of education policies, b= boards, x= strength of class, y= age of student, z= mode of learning

L :{L(Valid) = {r}, L(Common curriculum)={b}, L(Proper crowd) = {x<40}, L(No exam) = {y<8}, L(Exam) = {y>8}, L(Activities) = {z=offline}, L(Practical Learning) = {z=offline}, L(Digital Library) = {z=online}, L(Online Delivery of content)= {z=online}}

The Transition System for the program graph is represented in figure 3.

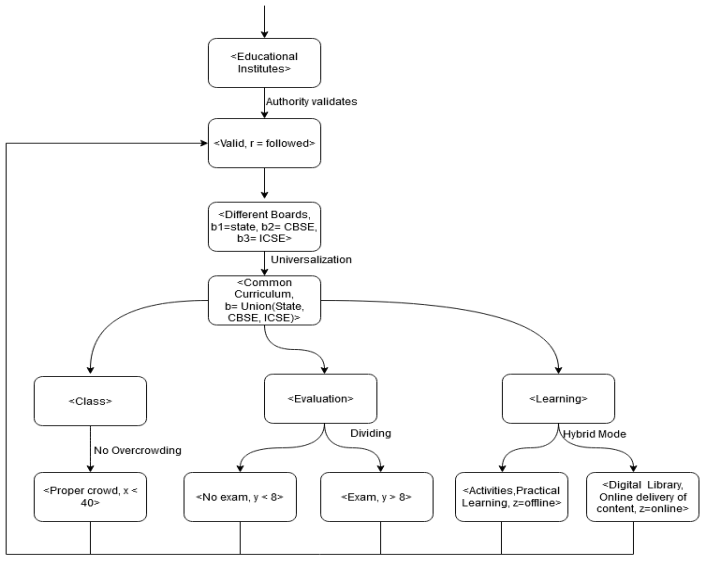

Figure 3 Transition System

Thus, in this way formal modelling is done to check the correctness of the system.

5. Fertility

The present model is build based on the type of people living in India and includes most of the aspects of Indian culture. The model is designed for the Indian education system and aims at universalization of Indian education. It encourages a common curriculum system. It considers various gaps present in Current Indian Education and provides solutions to most of the problems faced by the Indian Education System. Therefore, the model is specific for Indian education and hence, it is not applicable for any other domains and has only one application i.e. Indian Education System.

6. Conclusion and Future Scope

The model tries to fill the gaps in the current Indian education system. It suggests various new policies that can be implemented in the present education system. The proposed model aims at universalization of the current system to remove confusion and making the system transparent irrespective of the state education. It also makes use of online and offline hybrid teaching in school and college education. Hybrid teaching might not only be beneficial to improve the standard of curricula teaching but also has an essential functional significance for enhancing students' self-learning skills.

Implementing these changes in the current system is a big challenge. On paper, the model might look good but there is a tradeoff between quality education and budget allocated to educational institutes. Government need to build the curriculum in such a way that provides quality education to students. The mode would also establish a challenge to meet network requirements. Therefore, a huge amount must be invested to improve the education system. This model can be extended to further classify the content of learning for the different age group. Further, improvements in the aspect of the syllabus and the type of learning could be made to make the system more reliable.

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