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The Aakash tablet and technological imaginaries of mass education in contemporary India

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ABSTRACT

We explore here public and private initiatives in technological solutions for educating the poor and the disadvantaged in India since the second half of the twentieth century. Specifically, we document Ministry of Human Resource Development's project to develop an affordable tablet computer, named 'Aakash,' as a personal access device for digital courses and online learning materials. We approach this case study in relation to several educational technologies that preceded it, and with a wider interest in mapping a contemporary transition from satellite-based mass education to Internet-based mass education. We argue that this process cannot be easily seen as a transition from unilateral broadcasting to more democratic multi-casting model of communication and learning. Specifically, we study the manufacturing process of Aakash and the public debates around it, to comment on the nature of state power in India, as revealed in its attempts to imagine and develop a digital personal device to deliver mass education.

KEYWORDS

Aakash tablet; e-learning; education technology; India; mass education; state power

The optimism around technological solutions to the problem of human development, including those intertwined ones of access to education and alleviation of poverty, is abundant in nineteenth and twentieth century history. Some found reasons to be optimistic about vocational education and education in the industrial arts, while others found them in alleviating conditions of living such that time could be made for classroom instruction. From the call for 'occupational education' in the 1854 educational despatch¹ to the demands for 'smart schools' and 'compulsory vocational training' in the Ambani-Birla report of 2000,² the theme of technological solution for mass education for employment and poverty alleviation has had a long history across colonial and independent India. It is within this broad faith in education as providing a pathway out of poverty, the ability of technological solutions to solve problems of distributive social justice, and the increased engagement of the Indian software industry in questions of public welfare that the 'Aakash' tablet project took birth (Figure 1).

Aakash (Hindi – *sky*) is an android-based tablet computer the development of which was facilitated by the Ministry of Human Resource Development (henceforth, MHRD),

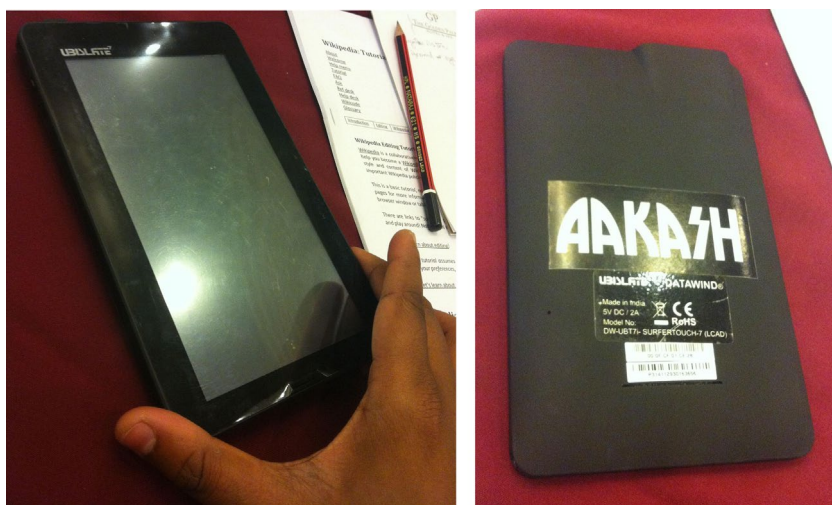


Figure 1. The first public version of the Aakash tablet, also known as DataWind Ubislate 7, launched in 2011. Credit: Subhashish Panigrahi. Shared on Wikimedia Commons under Creative Commons Attribution-Share Alike 3.0 Unported license. URLs: https://commons.wikimedia.org/wiki/File:Askaash_Ubislate_tablet.jpeg and https://commons.wikimedia.org/wiki/File:Askaash_Ubislate_tablet1.jpeg.

Government of India, and was championed as a key component of the national vision for bringing high-quality higher and secondary education modules to under-privileged students across India. The conceptualisation of the device referred to, even when not explicitly, the legacy of the ‘Simputer,’ (2002) an inexpensive personal computer developed at the Indian Institute of Science, Bangalore, and produced by Bharat Electronics Ltd., and also to the One Laptop Per Child (OLPC) project led by Nicholas Negroponte of the MIT Media Lab.

At Aakash’s birth in 2011, the MHRD announced a subsidised distribution policy aimed at college and university students all over India. Suggesting that this was less expensive than printing textbooks, Aakash was going to ensure better access to educational material and also, crucially, to online instruction. The fourth version of the tablet, proposed by the Ministry in 2013, was even more ambitious and aimed at making online course content available for high-school³ as well as university students. Furthermore, the MHRD claimed that they ‘wish to develop a technically and financially sustainable model to ensure that Aakash reaches every household in the country and every Indian is empowered and connected to the twenty-first century world through Information and Communication Technologies.’

The Aakash project has been seen as dying or dead by various observers⁴ but there is little by way of scholarly material to understand its development, changing goals, and more so, its testing and use. This paper explores Aakash in the historical spirit, and as a critical inquiry into the on-going developments of the project.⁵ We are especially concerned with the technological system of instruction and its delivery that is assumed, proposed, and responded to by the various actors involved in the *making of this technological device*. We are, therefore, interested in contemporary history, history of practice and in further exploring the debate on state power in India after independence. Contemporary history of (science and technology in) India remains largely the terrain of social science and, to some extent, of STS scholars but largely neglected by

historians. This becomes increasingly untenable in the digital age as the nature of the archive is changing far too rapidly with serious consequences for our ability to explain transformation – we must ask historical questions of the recent past if even an archive is to be generated.⁶ We will return to this shortly.

At this stage, we have not explored the perspectives of teachers, students or more generally, the consumers of these devices and the audiences of its content. We also, therefore, do not work with the differences in levels of education – primary, secondary, higher education or adult education, – each of which will have a distinct aspect to contribute to the larger story. In this essay, we do not engage with the content of (distance) education, but remain focused with making of a particular device. More broadly, we have delimited our concerns to the workings of state power in projects led by but also supported by the Government of India and the state governments. This delimitation is informed by our central concern: we argue that in the projects we study, the devices became the desire. In our study of the various projects, including Aakash, the contestations as well as the admiration for these projects often remained limited to the devices and technical capability. Content, quality and the *purpose* of instruction almost never came to the centre in the debates on technical solutions to educating the masses. Experience of these *educational* devices – from television sets and geo-stationary satellites, to desktop computers and to personal tablets – have instead contributed to the familiarity of these objects in popular imagination of national capabilities and, arguably, consumer culture.

We begin with a brief and not-so-linear history of projects in technologies of mass education to survey especially those initiatives that have informed the making of Aakash as an affordable educational device. We look at the Satellite Instructional Television Experiment (SITE) (1975), the Simputer – the first hand-held device developed in India (1998), the Hole in the Wall project developed and led by Sugata Mitra (1999), the Government of India led EDUSAT (2004), National Programme on Technology Enhanced Learning (2003), and finally, a national online education portal named Sakshat (2006). The SITE itself terminated rather quickly, but it led to several versions of television based instruction programmes, most notably, the University Grants Commission led Countrywide Classroom (1984–) aimed at higher secondary and university students. There were other programmes in the extension education format aimed, for example, at imparting horticultural and agricultural knowledge. Instruction in the broadcast-format – even countrywide classroom – continues to date, even after the arrival of the internet and its becoming the preferred medium also for the Indian state. While satellite based transmission has returned to the scene with EDUSAT, the television has not been replaced, but certainly shadowed by a variety of internet access and computing devices.

Each of the projects that we discuss briefly deserve attention on their own terms with a more robust historical sensibility than one could write about a project more recent, as Aakash was. We find it justified that we chose, instead, to focus on Aakash because of its relationship to the previous efforts – both technical and historical. More so, we decided to take advantage of the digital archive that was available, to some extent, in the public domain which is not the case for other projects. Though we use the term ‘digital archive,’ it is not a formal archive by any stretch of the imagination. We searched the internet continuously and via different strategies to find news reports, government reports and documents, and commentaries written by various technology bloggers and users of the Aakash device.

Documenting the project has been an interesting historical exercise. We have been attentive to documents disappearing from their online locations. One remarkable possibility for archival research opened up by the internet is the (limited, and often uncertain) ability to access materials that are not presently available on a website, but were part of it in the past. This possibility allowed us to access a few crucial government documents that are not directly available on the official websites any more. We have also been attentive to the reiterations and revisions that do not merely overtake or shadow earlier documents. They sometimes erase earlier documents altogether as digital revisions. We do not have access to personal correspondence or internal institutional correspondence relating to the project. We are, however, sceptical of that happening as no protocols for the archiving of digital correspondence is yet in place with the Government of India. Doing recent history of India is becoming an ever more difficult exercise that historians must urgently attend to, if we are to make the present ready to have its own past in the future.

We begin with a brief history of technological projects for mass education in India, surveying especially those initiatives that have informed the making of Aakash as an affordable educational device. In Section II, we look at the production history of Aakash through the various agencies and decision went into its making. We will follow this up with a discussion on the nature of the Aakash project and the questions it raises for contemporary history and the expectations of technology in Section III, before we tie up with a brief discussion on the nature of technical solutions for educating the masses.

I

The first of our cases, the SITE was a joint project between the American National Aeronautics and Space Agency (henceforth, NASA) and the Indian Space Research Organization (henceforth, ISRO) to launch a communication satellite and broadcast agriculture-focused educational content for young and adult learners in rural India. The institutional history of this project is traced to the talks beginning in the mid-1960s for collaboration between Atomic Energy Commission, and later Indian Space Research Organisation, and NASA on one hand,⁷ and the Education Commission (1964–1966) led by Daulat Singh Kothari that, among other things, emphasised linking up higher education and adult education with manpower needs of a recently-independent country on the other.⁸

By the late 1960s, the Government of India was interested in strengthening its space program as well as in mobilising satellite communication towards attending to claims of social justice and infrastructure development. The first agency they approached, in 1967, was the United Nations Educational, Scientific and Cultural Organisation (UNESCO) to initially conduct a feasibility study for direct broadcast of television programs to terrestrial receivers via satellite. Subsequently, they approached NASA to discuss collaboration on the project. The Indian Department of Atomic Energy and NASA signed a Memorandum of Understanding on 18 September 1969.⁹

A NASA ATS-6 satellite thus launched on .30 May 1974, broadcast content from 1 August 1975 to 31 July 1976 to 2400 villages in 20 districts across the states of Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Orissa, and Rajasthan.¹⁰ The project was supported by the UNESCO, the United Nations Development Programme, the United Nations Children's Fund, and the International Telecommunication Union.

The self-stated goal of this project was to make informational and educational television programming produced by All India Radio and Television widely available to adults in *rural* India. Programming content included information on family planning, hygiene, agricultural practices, social issues, and entertainment. Two separate audio channels addressed broadcasting in regional languages. The programme has been subsequently seen as a success that is strongly associated with the development of India's then budding space program.

Victoria Farmer succinctly describes the political context informing the technical aspirations of a newly independent nation-state:

... [t]he political sphere after the Nehru years was increasingly characterized by attempts at consolidation of political power at the highest levels of the Congress Party, and part of this broader goal included increasing hopes for the role new investments in television infrastructure could play in implementing the five-year economic plans, and more broadly in promoting a 'national' identity compliant with the political centralization of the early 1970s.¹¹

Asif Siddiqi extends this contextualisation of the SITE program by looking at the exchanges between NASA and the Indian National Committee for Space Research (1962) as framed by the strategic interests of the United States to strengthen India in the region especially to address the geopolitical imbalance created following the Chinese nuclear tests (1964). Siddiqi observes:

If the actual rationale for US assistance was obscured from public view, the outcome of the American offer to help with satellite television broadcasting perfectly aligned with the plans of those, such as (Homi Jehangir) Bhabha and (Vikram) Sarabhai, looking to establish an Indian space program.¹²

From a technical standpoint, the mission was a great success. Satellite transmissions were successful and paved the way for a rapid global increase of satellite-based television viewing. NASA's objectives for the project were to test the technical capability of its ATS-6 satellite and FM transmitter in space and they were exclusively involved in the monitoring of the program's impact. The Government of India was attendant to satellite based instruction, but was equally if not more motivated by the desire to gain experience in the development of satellites and satellite-based technology for the eventual launch of India's own space programme: the Indian National Satellite System (henceforth, INSAT). On the surface, the program appeared to offer a stunning technical solution to an enormous problem. It appeared that educational programmes on illiteracy, issues of basic hygiene, family planning, agricultural techniques, and teacher training could all be delivered relatively easily and quickly to every corner of India using satellite communication technology. At peak viewing in the earliest months, 200–600 people viewed programming per television set, though this declined to 60–80 people per television. In 52% of those polled agreed that they could apply what they had learned in their daily lives.¹³

In hindsight, it is clear that SITE had a significant impact on the development of Indian satellite capabilities.¹⁴ What is less clear is how much impact the small window of programming had on the average viewer.¹⁵ Providing electricity – and the development of infrastructure to deliver high technology to villages – was seen as a critical advancement; at the same time poor power supplies and faulty hardware made continuous viewing difficult. Gains in literacy, public information, and in education appear to have been vastly over-stated. It was known, in any case, that the variety of languages and regional dialects across the country posed a formidable challenge towards engaging the population to deliver a single kind of message. Programming was not often tested or sent through a pilot program, and was not

always well received or understood. The most successful programs were strictly informational, and occasionally generated further inquiries, but the entertainment program was as a notable flop.¹⁶

In hindsight, this experiment in satellite-based instruction offered no basis for comparing its value with other means of providing information, leave alone, and especially, classroom-based instruction. The technical success of SITE reinforced, at least within the policy circles, the belief that television could play an important role in providing educational programming and resources to the masses. Critical engagement with reception of the programs on the ground appears to have been ignored for the love of technology. SITE provided the impetus towards an expanded Indian satellite and space program, and continues to inform further projects of mass instruction with INSAT, and the EDUSAT initiative of late 1990s and early 2000s.

We see proof of this love for technology, as Siddiqi notes, in that the conceptualisation of the INSAT programme was shaped by the developmental and educational promises of the SITE initiative. He observes that

INSAT was to be all things to all people, a virtual technological panacea for the poor that would be a boon to both civil and civilian society in India, a new way to use space based on Gandhian principles that rejected the competitive model established by the superpowers.¹⁷

The ideological force of this conceptualisation was key to its continued impact on imagination of communication technologies in the next decades: through the UGC Countrywide Classroom initiative of mid-1980s, Computer Literacy and Studies in Schools and Computer Literacy and Awareness Programme also launched in mid-1980s, Education and Research Network that connected major Indian universities and research institutes in a pre-Internet era. In 1992, the revised Programme of Action of the National Policy on Education (1986)¹⁸ further emphasised the need to upgrade the technological infrastructure and solutions being used in primary, secondary, and higher standards, such as use of multimedia packages and audio/video conferencing.¹⁹

Efforts at mass education through television broadcasting continued (and continues) but the next device for mass education – the Simple, Inexpensive and Multi-Lingual People's Computer, or Simputer – came almost two decades after SITE! The decades in between saw several programmatic and infrastructural efforts, as mentioned above, to bring computers to schools as an instrument of learning, and to connect premier universities and research institutes. These efforts were soon integrated into the ICT@Schools scheme supported by the central government and initiated during the eighth Five Year Plan (1993–1998).²⁰ This scheme, and its later iterations, had a strong emphasis on digitisation of existing learning resources (available as audio and video cassettes) and development of e-content, building capacity of teachers, and establishing model 'smart schools.' Efforts towards technological innovation, hence, took a back seat with questions of content, building infrastructure, and human resource training taking the lead. It is not a surprise that the Simputer did not emerge from a state-led project but from an autonomous group of researchers working at the Indian Institute of Science (henceforth, IISc), Bangalore, a state-funded academic institution. Crucially, the device marked early tendencies of the shifts from satellite-based instruction to Internet-based learning, and from collective learning aided by television screens to individual (explorative) learning through personal digital devices. Designed to address the 'digital divide, social welfare, and contribute to human development in India,²¹ the idea for the device stemmed from 'The Bangalore Declaration on Information Technology for

Developing Countries in the Global Village.²² Important collaborators included, among others, software engineers and computer scientists of whom Swami Manohar, Vijay Chandru, and Amulya Reddy at the IISc were the key drivers.²³

The Simputer was designed to be easily shared amongst multiple users, each of whom could store their own data on removable memory cards. A touch-screen interface and a text-to-speech synthesiser were designed for use by semi-literate individuals, and for those with little or no contact with digital technology. The project goals were explicitly developmental – specifically microfinance – and educational purposes for use in rural schools. The device ran on a free and open source Linux operating system and was entirely designed and developed in Bangalore. Technologically the device was considered advanced for its time. It was among the first devices to switch from portrait to landscape screens depending on orientation and allowed the use of handwriting on every application.²⁴

The non-profit Simputer Trust launched initial prototypes of the device on 25 April 2001. The initial cost of INR 9000 was beyond the means of many of the original customers, but the device was still marketed to schools and the suggestion was that it be shared among multiple rural users. Initial reviews of the device, both internationally and from the Indian government were positive. The device was featured as one of the top global technological advancements by the New York Times (2001) and universally praised for its emphasis on ‘bridging the digital divide’ to under-served populations in India.

Since the initial launch of the device in April 2001, the production of the Simputer was licensed to two manufacturers, PicoPeta Simputers Private Limited and Encore Software. The device was subsequently shortlisted for several public-funded projects, but appears not to have received any of the contract bids at the time. Efforts to introduce the product into schools also met with problems, including electricity supply, lack of training and creation of user content, and the fear of theft – or desire of possession – of the device that kept it from wider distribution among multiple users. The device failed to sell many units and was rarely used for governmental or educational purposes, and has subsequently been seen as a failure following its initial positive launch.²⁵

Critics blamed the lack of state support for the Simputer device being shelved as a result of its inability to receive a wider following. The high cost of the device, relative to average income of its potential users in India, appears to have also played a key role in the failure of the Simputer. Both manufacturing licenses expired in 2006, and were not renewed by either company. Even though seen as ahead of its time technologically, the Simputer suffered from a lack general support and funding. Nonetheless, it has continued to influence the design imagination of cost-effective computing devices, as we see in the case of the Aakash project that rejects the laptop form for the one of tablet. It also failed to make the proposition of *private* access and learning devices attractive enough for various potential funding agencies, public or private. The television sets that were the chosen access device before Simputer, and the wall-mounted computers to be shared by groups of students that came after it, were both conceptualised around the idea of multiple learners sharing a common device. Thus, Simputer not simply pre-empted Aakash in the physical form of the tablet computer, but the idea of an individual device for each student, which it shared in common also with the OLPC initiative that came after the Simputer experiment.

The ‘Hole in the Wall’ project was initiated by Sugata Mitra, Professor of Educational Technology at Newcastle University, as an attempt primarily to engage children in poor localities through stand-alone computer kiosks.²⁶ On 28 January 1999, Mitra placed a

computer kiosk in a New Delhi slum in order to study, he claims, the impact of Minimally Invasive Education (MIE).²⁷ Any person, we are told, was free to use the kiosk and children, including many who were computer illiterate and with little knowledge of the English language, were encouraged to experiment freely with the technology. Within several months, Mitra claimed local children had developed their own words for describing basic computing features, displayed an enhanced sense of educational curiosity, and felt encouraged to take ownership of their own learning. The results prompted the Government of Delhi to set up 30 more of the learning stations in a resettlement colony. By 2001, Hole in the Wall Education Limited (HiWEL) a joint collaboration between the National Institute of Information Technology Limited, Delhi, and the International Finance Cooperation, was established. It later expanded its operations to more than 300 learning stations all over the country.

Mitra claims that this kind of educational intervention, 'Self-Organized Learning Environment,' is likely to encourage young students and adults to collaborate in a more democratic ways than a typical classroom environment would allow. This, in turn he argues, could begin to address the spectres of disadvantage in the digital arena – the digital divide – that includes access to basic computing equipment. The absence of an adult monitor, or a teacher, is claimed as an advantage to encourage spontaneity and an engagement with learning especially for those that have few resources to offer children and in any case have to contend with teacher absenteeism in government-run schools.²⁸

The Hole in the Wall Project and its creator Mitra received widespread acclaim for the perceived success of the program.²⁹ More than 30,000 children are covered by now extant 300 Hole in the Wall Stations. The Government of Delhi and the Government of India have both embraced the program, and the program operates in Cambodia, Botswana, Mozambique, Nigeria, Rwanda, Swaziland, Uganda, and Zambia.

While few deny the results of the experiment and the potential of the kiosks to offer unfettered access to digital technology, much about its impact remains unclear. We are aware that boys are more likely to dominate and benefit from the use of kiosks, or how sustainable the kiosks are over the long term, and if they ever can ever substitute instruction based learning or education. Without oversight and funding, kiosks in several areas have fallen into disrepair and disuse without clear lines of oversight. Additionally, the program is becoming more institutionalised and dependent on mediators, especially local teachers and administrators, for support, which may address issues of service delivery, but is also antithetical to the mission statement of the project.

In the last years of the twentieth century we have seen a global shift towards computers as the preferred device for the delivery of distance and interactive education. The educational technology initiatives of the Government of India, however, have remained primarily conceptualised around the television as the access device. Although pilot projects in bringing computers to Indian schools had an early start with the Computer Literacy and Studies in 1984 – a project led by MHRD, National Council of Educational Research and Training, and Department of Electronics, the actual classroom experience of the initiative was described by an evaluation report as akin to 'spectator sport'.³⁰ During 2001–2004, a remodelled version of the same project, renamed as CLASS 2000, attempted to introduce 'computer-based-learning' in 100 schools across the country, which were to be labelled as 'SMART Schools'.³¹ Nonetheless the macro-scale socio-technical imagination of remote delivery of instruction and learning remained a television-centric one, as apparent from the

continued support for the ISRO-led projects of satellite-based educational content broadcasting throughout 1980s and 1990s. The Simputer as well as the Hole in the Wall projects appear to be small bleeps in this arc of continued support for broadcast-education. However, these early experiments with computers, hand held or wall mounted, as personal and autonomous learning devices in contract to the state-driven initiatives to put the computer inside classrooms are important precedents for the techno-pedagogical imagination of Aakash.

It was in this mode on 20 September 2004, that EDUSAT, a satellite dedicated to education and especially to promoting tele-education in disadvantaged areas of the country, was launched.³² EDUSAT was a collaborative project between the Department of Space, ISRO, and the MHRD. The idea was first formally proposed by the ISRO in a 2002 report – ‘Educating the Nation – Need for a Dedicated Satellite.’ EDUSAT built upon previous technical efforts, specifically SITE and the INSAT System that followed. In theory, the entire country, including rural areas that have been critically under-served, was covered by and had access to the services provided by EDUSAT.³³ The project, again, was seen as a success from a technical standpoint – the satellite was designed and successfully launched into orbit and functioned until 2010. Its place and what the measure of its impact on student learning and the education system could be – is yet to be seriously explored. Critical examination of service delivery appeared to end with the launch of the satellite.³⁴

Programmes like EDUSAT hint at the strong stance taken by the Indian state on mobilising developments in Information and Communication Technologies to facilitate learning, but scholarly attention and public debate on such programs within the context of discussions on the quality of government-funded education services has historically been lacking. Without the technical knowledge and facilities to access and properly implement the technological solutions provided by EDUSAT, its potential impact, especially on the poorest communities with the fewest services, was limited. More crucially, the short life span of the program – a mere 7 years – combined with constraints, technical and social, on the ground limited EDUSAT’s contributions considerably. In 2013, Department of Space declared in an audit report that ‘EDUSAT failed to effectively achieve its objectives due to deficiencies in planning for the network connectivity, content generation and failure to have a robust management structure’³⁵ – impediments that resonate significantly with those cited for earlier educational technology projects.

The MHRD was also testing out the possibilities of Internet-based delivery of distance in education in parallel to the EDUSAT initiative. In 2003, the National Programme on Technology Enhanced Learning (henceforth, NPTEL) was introduced.³⁶ NPTEL was based upon a proposal submitted by the five Indian Institutes of Technology (Bombay, Delhi, Kanpur, Kharagpur, and Madras) and the Indian Institute of Science, Bangalore, to develop openly accessible syllabi and learning resources for more than one hundred undergraduate courses in five areas³⁷ alongside courses in basic science.³⁸ The IITs of Guwahati and Roorkee also joined the implementation process. Inspired by the Open Courseware initiative of the Massachusetts Institute of Technology, the goal was to make accessible better training than students were likely to get at their own institutions. It served, perhaps, reinforce the elite status of the IITs among engineering universities in India.

Soon these course documents were migrated to the Sakshat (Hindi – *face-to-face*, or *presence*) portal to aggregate online learning resources for students from kindergarten to postgraduate levels, including both standard educational and vocational contents. This ambitious project was featured as one of the pillars of the National Mission on Education

during the 11th Five Year Plan (2007–2012).³⁹ The portal marked the completion of the conceptual and technological shift from the satellite-based models of delivery of educational content, to an Internet-based one.⁴⁰

From the brief histories of the myriad institutions and devices outlined above, one thing is clear: the links between them are not obvious. The field is crowded with solutions that indicate at least one suggestion that most have been about capability building in engineering and technology, and none have been fully actualised to become an important solution to mass education, neither in the eyes of the state nor in the public domain. We think it is nonetheless important to discuss this cacophony of solutions together for two reasons: the projects claimed to address a similar goal even when they conceptualised learning, instruction and, most crucially, education, in quite different ways. Together they allow us to examine how the Indian state has thought about mass education, in particular, who the state identified as requiring education; what the assumptions were behind how learning was accomplished; and finally, to explore state power through the assumption that the state is ultimately responsible for the education for the masses. The panoply of solutions is testimony to competing state and non-state vision on mass education.

This is also a story of building, harnessing, and distributing technological capability. From INSAT to Internet-based courseware, these are all experiments that address the aspiration of capability at the frontiers of technology and engineering sciences. This contributes a partial explanation of why sustainable technological systems of delivering mass education did not come to fruition, as even government audit reports admit. For that to happen, educational content, its implication for the diversity of audiences, conditions on the ground for reception of both the technologies and instruction, all would have had to be built into the imagination of the project. However, the imagination of the state remained primarily a technological one, and not a pedagogic one.

The chronological organisation of the discussion above might suggest a linear narrative of changing technologies of distance education in independent India, but it cannot be called one of technological *learning* or even one of building technological systems. The goals and scales of the delivery kept shifting across these projects; they competed for recognition by national educational agencies; and the technologies often did not build upon ones that came earlier but, in most cases, attempted to recreate the apparatus of delivery and the actual learning experience itself.

It is not our goal to fully compare the devices but we might usefully juxtapose the projects and outcomes. SITE and EDUSAT (and Sakshat) were public initiatives, the Hole in the Wall project and Simputer were in their origin private initiatives. Both private initiatives grew out of academic contexts and operated on a smaller scale. State ownership and control of the delivery devices was clear in both SITE and EDUSAT, but that was less evident with the Internet-based devices that arose from private initiatives. The connection of both to the space programme and therefore to concerns of national security was directly reflected also in the budgets of SITE and EDUSAT – which were massive when compared with the Simputer or the Hole in the Wall project. Yet another distinguishing characteristic of the two was the emphasis on self-learning in ‘minimally invasive environments’ whereas the state-led SITE and EDUSAT were attempts to recreate the classroom situation socially and virtually.

It is within this government-industrial-academic complex that yet another device was launched to build upon and departed from the above projects in distinct ways. Aakash, the tablet that should take premier education to the masses was launched in 2010.

II

On 22 July 2010, Kapil Sibal, then Union Minister of Human Resource Development, announced the coming of a low cost access-cum-computing device to be used by students across India to directly access Internet-based educational materials.⁴¹ Aakash, as this device was later named, was introduced as a key component of an ongoing national initiative to produce and deliver digital educational content to students beyond the elite higher education institutes of the country. This initiative, the National Mission on Education through Information and Communication Technology (henceforth, NMEICT), explicitly focused not on provision of primary education to disadvantaged students through digital means, but on reducing unevenness in access to and infrastructures of higher education across the country. This, it would accomplish through online distance education modules (predominantly in science and technology fields) prepared by faculties of leading educational and research institutes (such as IISc and various Indian Institutes of Technology). This low cost access-cum-computing device thus entered the public imagination as a tool of *higher education* to help the students to overcome the academic, professional, bureaucratic, and infrastructural constraints affecting majority of non-elite and semi-urban universities in the country.

Aakash, however, did not come to substantially actualise this function. Manufacturing and testing of the device was continuously disrupted by process delays and conflicts between the various public and private partners. Media reports about Chinese origins about the device, or at least the majority of its components, did several rounds, as did reports suggesting intra-governmental frictions faced by its champion Kapil Sibal. Moreover, DataWind, the British-Canadian company entrusted with manufacturing of Aakash, repeatedly failed to meet production targets; devices submitted by DataWind for testing were often found to be of sub-optimum quality; devices acquired by the Ministry were not successfully distributed among students;⁴² and early devices made commercially available received harsh reviews. This section traces this troubled history of conceptualisation and manufacturing of the Aakash device. In doing so, it reflects on the evolving institutional arrangements created to undertake this celebrated technological innovation project for mass education.

The device announced on July 2010, however, was not the first such project declared by the MHRD. Again, there was a precursor to this: a \$10 laptop titled 'Sakshat' (Hindi – *face-to-face*, or *presence*), to be developed by a trusted group of technology institutes – including IISc, Vellore Institute of Technology, IIT Madras, and Semiconductor Laboratory (again) of the Department of Space – to create a prototype.⁴³ This laptop was aimed at enabling users to access the Internet, download content, and consume and share them offline. When the prototype was made public in February 2009, it was found to be a modem fused together with a small storage device, and not exactly a laptop.⁴⁴ The device was dropped and the name 'Sakshat' returned to signify only the above mentioned national education portal for hosting digital learning materials.

In response to an offer from a private company to bulk-sell laptops for school children at \$100, a debate ensued in the MHRD.⁴⁵ N. K. Sinha, then Mission Director of NMEICT, played a crucial role in convincing the MHRD to consider the possibility of developing a similar but inexpensive device in India.⁴⁶ A research team, including hardware and software experts, as well as persons with expertise in charting potential commercial possibilities of such a device, was set up under NMEICT. The location within the Mission determined the

purpose of the device from the very beginning: it was conceptualised as a tool for higher education, not school education.⁴⁷

The desired functions of this device were also defined by the NMEICT mandate. Hence it was expected to connect to wireless networks, write notes, read e-books, play streaming video, run free and open source educational software, and access content developed as part of the Mission. Any additional functions were ignored for the fear of inflating the price of the device. The response from IT companies in India to this (yet another) new project was less than lukewarm. The Ministry decided to approach the academic complex – IISc, IIT Kanpur, IIT Kharagpur, IIT Madras, and IIT Bombay. These institutions were funded to develop potential hardware designs for the desired tablet and to produce prototypes. In their own take on the history of Aakash, the Ministry argued that as the prototypes appeared, the prevailing air of scepticism began to clear. In addition, comparable commercial devices appeared on the international market adding to the enthusiasm for a bottom-of-the-pyramid market of less than \$100 tablets.⁴⁸

The press brief circulated at the inaugural of the device on 22 July 2010, noted that the fabrication of its motherboard took place at IIT Kanpur.⁴⁹ The price of the exhibited device was declared to be approximately \$35, and it was to be brought down in the future to \$20 and eventually to \$10. This reduction in price was expected to be achieved through falling hardware costs, and focused research & development investments to make the device more efficient, capable, and affordable. The brief claimed that the new IIT Rajasthan and a few other technical institutions were to set up research teams to upgrade the capabilities of the device.⁵⁰

Prem Kumar Kalra, then Director of IIT Rajasthan at Jodhpur, claimed that the agency to approach the MHRD in 2006 for bulk marketing educational laptops was the OLPC Foundation.⁵¹ He further claimed that the Ministry then called for an open contest among Indian engineering and technical institutions to develop an affordable computational device. The IIT Kanpur team, led by Kalra, (at the time Professor and Head of the Department of Electrical Engineering), won this bid.

When Kalra was appointed as Director of the newly instituted IIT Rajasthan in 2009, the project moved with him⁵² and transformed quite significantly in the process. After the first set of prototypes were created and exhibited on 22 July 2010, the ministry decided to discontinue R&D activities, and instead appointed the (newly formed) IIT Rajasthan to procure devices through an open tender process. The tender document specified the functionalities decided upon by the Ministry, and IIT Rajasthan was given the task to test select sample devices, before any decision to mass purchase by the Ministry.⁵³

HCL Infosystems won the contract. An amount of Rs 30 crore (approximately \$6.4 Million) was allocated by MHRD for the contract, and a deadline of January 2011 was set for introducing the device.⁵⁴ Interestingly, the government declared that a million of these devices would be distributed during 2011, exactly matching the target set by the OLPC Foundation earlier for distribution of XO Laptops in India.⁵⁵ In January 2011, the announced date for HCL Infosystems to introduce the first batch of the devices, the manufacturing contract was cancelled. The MHRD claimed that HCL demanded ‘additional, unacceptable conditions,’ and did not provide the necessary Rs 60 crore bank guarantee to undertake manufacturing in the first place.⁵⁶

A fresh tendering process began again to find a commercial vendor to produce the device. Not much was made public about the second tender until the device was finally

inaugurated in October 2011, although in an interview with the *New York Times* in August 2011, the minister Kapil Sibal announced that he possessed a commercially produced model of the device.⁵⁷ Two months later, on 5 October 2011, this device was officially launched.⁵⁸ Manufactured by the Canada based DataWind, the device was co-branded as Aakash – for devices bought by and redistributed at a subsidised rate by the MHRD – and Ubislate – for devices sold commercially by DataWind.⁵⁹

DataWind is a company specialising in affordable Internet-access devices founded by the brothers Suneet Singh Tuli and Raja Singh Tuli. Prior to production of Aakash, they primarily produced for the British market, while their R&D team was based in Canada.⁶⁰ Responding to public speculations and criticisms during 2010–2011 regarding the possibility of the low-cost-access-cum-computing device being manufactured and/or assembled in China, DataWind clarified that assembly of Aakash/Ubislate was in fact taking place in India, by the Secunderabad-based (then, Andhra Pradesh) Quad Electronics.⁶¹

Pre-sales booking of Ubislate tablets, priced at around Rs 2500, began in December 2011 through an online portal, and it saw overwhelming demand from Indian customers. Within 2 weeks, orders were placed for over 1.4 million units. DataWind's then existing production capacity was grossly insufficient to meet this demand. They declared that a plan to expand the number of production centres in India, and to also introduce an upgraded model at a slightly higher price (Rs 2999).⁶² During the launch event in October 2011, several students were handed the first model of the Aakash device for early usage and feedback. The response of these students, however, ranged from moderately lukewarm to heavily critical.⁶³

The procurement process for the first large set of Aakash devices (100,000 units) immediately led to a conflict between IIT Rajasthan, who found the supplied devices to be sub-standard, and DataWind, who found the testing standards imposed by IIT Rajasthan to be impractical (calling it 'military-grade specifications') given the maximum manufacturing cost agreed upon by the agencies.⁶⁴ Rumours that the MHRD would discontinue working with DataWind began to proliferate.⁶⁵ The MHRD simply moved the testing and procurement responsibility of the next generation of Aakash devices to IIT Mumbai and disengaged IIT Rajasthan from the process altogether.⁶⁶ None of this was anticipated by the makers of the device, neither the handover of manufacturing to a private firm not involved in the prototype, nor the resolution of the conflict related to manufacturing standards by removing IIT Rajasthan from the project and turning to the private sector.

If the move to privatise the manufacturing of the device originally prototyped by public institutions was the first critical moment of this story of the post-liberalisation Indian state's approach to technological innovation, then this curious resolution of the conflict between IIT Rajasthan and DataWind is the second. Here we see a mode of governance of technological innovation that cannot be called a 'total' or 'planned' approach. Instead the state seems to be 'unbundling'⁶⁷ the innovation and manufacturing process – prototyping, manufacturing, testing, and upgrading – so that each segment involves a renewed competition among changing sets of agencies, not necessarily public or private, under changing rules of competition, from development of domestic capability to urgent needs of delivery.⁶⁸

Deepak B. Phatak, a Professor at IIT Mumbai and head of the Aakash project claimed in an interview that the project transfer from IIT Rajasthan to IIT Bombay happened over a single meeting.⁶⁹ Phatak was apparently asked by Kapli Sibal, then Union Minister of Human Resource Development, whether he 'can do it.' As Phatak responded through an affirmative nod, the decision was finalised.⁷⁰

In March 2012, Phatak took over the reins of the project. Meanwhile, Quad and DataWind got involved in a legal battle that led to disassociation of the former from the project. Quad alleged that DataWind has not paid up, while the latter claimed that the former has violated intellectual property and contract agreements by attempting to sell devices directly to IIT Rajasthan.⁷¹ The next months saw speculation on the imminent closure of the Aakash project all of which came to an abrupt end as the second version of the device was launched by the President of India on 11 November, celebrated as the national education day.⁷² Media reports surfaced alleging that the devices were actually bought by DataWind from several manufacturing agencies located in Shenzhen and Hong Kong.⁷³ DataWind claimed that the capacitive touch screens, the main new feature of Aakash II tablets, were manufactured by the company in Montreal, Canada, while the final units were 'kitted' in various facilities in China for the sake of expediency, and yet, the final assembly was undertaken by VMC Systems (the Indian partner to DataWind after Quad) in Amritsar and Delhi.⁷⁴ The controversy did not come in the way of the launch of the device at the United Nations headquarters by the Secretary General Ban Ki-Moon, who emphasised the need for such devices to connect young learners to digital education opportunities.⁷⁵

With Kapil Sibal leaving the MHRD in the end of October 2012, the trajectory of the Aakash story took another major turn. Soon after taking charge of the office, M. M. Pallam Raju, who succeeded Sibal, started re-assessing the Aakash project and its objectives. In early March 2013, Raju declared, 'Let's not get obsessed with hardware ... [t]he overall (issue) is



Figure 2. Description: The Aakash 2 tablet being unveiled at the United Nations, by Ban Ki Moon, UN Secretary General, on 29 November 2012. Mr. Secretary General is joined by (clockwise) Mr. Hardeep Singh Puri, India's Ambassador to the UN, and Mr. Suneet Singh Tuli, CEO of Datawind. Credit: GoodReader. URL: <http://goodreader.s3.amazonaws.com/blog/uploads/images/UN-launching-of-Aakash2.jpg>.

how we enable students. Let the students decide which device is useful.’⁷⁶ Under-production and greatly delayed delivery of the devices had troubled the Aakash project from the start. In December 2011 during the first procurement phase, IIT Rajasthan received 6440 units of the device against the required supply of 100,000 units (Figure 2).⁷⁷

A report evaluating the NMEICT programme, published at about the same time as Raju took charge, highlighted the serious production troubles but also the value of the device if it were effectively delivered to the students.⁷⁸ Raju, perhaps in response to the report, appears to have re-considered his position and now wanted IIT Bombay to ensure that DataWind met the supply commitment of Aakash II devices⁷⁹ strictly by the end of the month, failing which he wanted to identify a new manufacturing agency.⁸⁰ The target of 100,000 Aakash II units to be supplied to MHRD was met by the end of April 2013, and DataWind declared that it would finally start delivering devices to those 4 million people who pre-booked the device a year ago.⁸¹ This, however, did not help much.

In the meanwhile, Rajat Moona, Director General of the Centre for Development of Advanced Computing (henceforth, CDAC), declared that the brand name of Aakash would be made available to public and private manufacturers of affordable access-cum-computing devices (against licensing fee paid to the Ministry), provided the devices met a minimum set of specifications.⁸² He claimed that this decision was triggered by the discontent of the Ministry as ‘several companies are driving mileage out of its publicity by selling anything in the name of Aakash’ (without providing any concrete examples of such fraudulent practices).⁸³ An inter-ministerial panel including members from the MHRD and the Ministry of Communication and Information Technology, academics from several IITs and researchers from public technology agencies such as CDAC and Centre for Development of Telematics (CDOT), Moona added, would develop the minimum specifications.

The first draft of the specification document for the now fourth version of the Aakash device was released by the Department of Electronics and Information Technology in June 2013 and public comments were invited.⁸⁴ The actual tendering process of the Aakash IV devices, however, got delayed yet again, and began in January 2014 only to get further postponed as the General Elections took place in April-May. As the Aakash project reached another moment of stillness with an uncertain future, it is worth noting how Kapil Sibal’s stepping down as the Union Minister of Human Resource Development coincided with the project’s transformation. The projects went from being a device procurement initiative of the MHRD to market creation and a standardisation initiative primarily led by the Department of Electronics and Information Technology, which is a part of the Ministry of Communication and Information Technology.⁸⁵ The deep ties between institutional trajectory of individuals and that of the project as a whole, thus, was not only limited to academics like Prem Kumar Kalra, but also to elected (political) representatives like Kapil Sibal.

III

Throughout the short history of the Aakash device, the verdict of ‘failed innovation’ figures prominently – from the early failure of ‘Sakshat’,⁸⁶ to allegations of Chinese origin of the Aakash device,⁸⁷ to manufacturing troubles and under-production of the device,⁸⁸ to criticisms of built quality and computing capacity,⁸⁹ to mistrust and failed collaborations between parties involved in its production,⁹⁰ and intra-governmental criticisms of the implementation process.⁹¹ Moreover, there remained a continuous tension within the government

itself regarding the necessity of the project, especially fuelled by (and fuelling) the image of the project as being driven by the *dreams* of a specific minister. At an event in late 2013, Kapil Sibal (then Union Minister of Communication and Information Technology, former Union Minister of Human Resource Development) admitted, '[the] Aakash tablet was my dream but it was not fulfilled, I tried hard ... some departments of my government did not support me ... despite that I continued to strive ...'⁹² This section explores the precise nature of this 'failure' of the device. Graeme Gooday in an earlier contribution to this journal outlined a historiography of 'failure': that 'success' or 'failure' may not be ascribed to the technological object itself in an uncomplicated manner, but must be understood in the context of '*human expectations* [and dreams] of hardware performance and distribution.'⁹³

Across early and later reviews of the device,⁹⁴ this failure is most intimately experienced at the material and functional levels of the device. The not-hand-y-to-use aspects have been endlessly noted – unyielding touch screen, lack of battery back-up, and a frequently freezing interface. The *thingness* of Aakash, so to speak, as foregrounded in its multiple modes of failure do not necessarily evoke responses that address its physical-material qualities. Public responses to the device have almost never discussed alternative hardware components and software platforms,⁹⁵ better manufacturing practices, or for that matter, and this most notably, almost nothing on the production of the learning materials to be accessed through the device.

Instead, the failure is interpreted in a framework of national aspirations, technical capabilities, and the capacity of the government to create and support innovation. In a survey of the media discourse around the Aakash device during 2012–2013, Preeti Mudliar and Joyojeet Pal found that the discussion was completely dominated by themes related to 'Made in India, competition with China, with national pride,' and the relationship between the 'Government of India and Aakash.'⁹⁶ This metonymical travel of the failure-of-the-device as a marker of the failure-of-the-government, especially of its ability to innovate, is at the heart of the popular discussion of Aakash. This discussion is produced through the grand statements by the government representatives,⁹⁷ as well as by both staunch critics⁹⁸ as well as champions of the device.⁹⁹ The question of failure, however, presupposes an original act, or promise, of innovation that has gone wrong. While the public gestures and statements of the representatives of the government and the public institutes engaged in the making of the device do suggest that such a failure took place, documents shared internally by the MHRD and IIT Rajasthan state otherwise.

A document released by the MHRD during the launch of the Aakash device declared that the device was designed by the 'design teams' of the Ministry, including the IITs that created different early prototypes.¹⁰⁰ Nowhere is it clear in the documents that the prototypes achieved the targeted ex-factory cost of \$35. The device had to be designed either at the level of the unit as a whole, that is in terms of specifying its each physical components and how they were to be assembled together, or at the level of its System on Chip (henceforth, SoC), that is the integrated circuit that contained all the computational components of the device within a unified microchip.

The report submitted by the Mission Directorate of NMEICT (under MHRD) to an Evaluation Committee headed by Professor Goverdhan Mehta specified that the 'entire process [of determining the functional requirements of the device] was discussed in various sessions at Mr. Sinha's [Director, NMEICT,] office at MHRD involving teams from different IITs and IISc as well as discussions with component vendors,' while the task of

preparation of the 'formal detailed spec[ification] document' was left to IIT Rajasthan.¹⁰¹ The same report also clarified:

It was left to the manufacturer of the device to decide specifically which make or model of the components were to be used and it would be the decision of the manufacturer whether to use some components to which they owned the patents.¹⁰²

In sum, neither the product design, nor the design (or prototype) of SoC, it would seem, was provided neither by the MHRD, nor the testing and procurement agency.

Prem Kumar Kalra, (then Director of IIT Rajasthan), in an interview following the launch of Aakash in October 2011 claimed that in giving manufacturing rights to an external agency, the research team behind the device failed to monetise their intellectual property.¹⁰³

The report submitted by the same Aakash project team at IIT Rajasthan to the NMEICT Evaluation Committee told another story. Here they stated that though IIT Rajasthan prepared 'detailed documentation of software and hardware *requirements*,' it did not specify the *actual design* of the device as that would involve 'favouring some specific chip-set manufacturer and that would have been *ethically and procedurally a wrong-doing*' (emphasis by the authors).¹⁰⁴ It is quite remarkable that in their submissions to the NMEICT Evaluation Committee, both NMEICT Directorate and IIT Rajasthan unequivocally stated that it was not possible to claim that Aakash was an 'Indian device.'¹⁰⁵ The NMEICT Directorate, although, shirked responsibility for funding the creation of this *non-Indian* device, and mentioned that '[h]ad IIT Rajasthan been able to fulfil the task given to them, hopefully, an Indian designed and Indian owned SoC and device would have emerged.'¹⁰⁶ It was important to make a device that could be called Indian.

Herein lies the paradox of the device. On one hand, the Ministry stated that Aakash was 'a unique device' since '[t]here is no other device that offers so much functionality at such a low cost,' and on the other hand, this claim for uniqueness and innovation was premised upon putting out a public tender that specified a list of minimum functionalities, and an assurance for large scale direct procurement by the Ministry at a given per unit cost.¹⁰⁷ It then appeared that the innovation had been attempted (if successfully or not) in the institutional arrangements for manufacturing the device, rather than in its design. The institutional arrangements themselves had been constantly under scrutiny and revision; and had been reconfigured several times disengaging from the corresponding stages of learning on the project. The device itself had simultaneously been the central objective of the constant shifting and re-calculation of this institutional arrangement, and, arguably, the least important component of the project that required being 'Indian,' but for its final assembly within Indian territory.

Ashish Rajadhyaksha has argued that the NMEICT initiative in particular, and e-learning projects of the Indian government in general, are driven by the state's desire to de-politicise and create autonomous channels of public communication and education so as 'to produce the exemplary citizen-subject.'¹⁰⁸ He has emphasised that e-governance machinery – such as the nodes of connectivity (National Knowledge Network and National Optical Fibre Network), content (National Programme on Technology Enhanced Learning), and access device (Aakash) – is mobilised by the state as a symbolically sufficient condition of *autonomy* of the delivery network from political, bureaucratic, and social 'contaminations.' Rajadhyaksha notes that the 'NMEICT constituted the technologization of autonomous governance' by bypassing an existing nation-wide architecture to deliver higher education, and selectively (through tenders, competitions, and institutional and personal linkages)

configuring the 'new' set of actors who would provide infrastructural support, create educational content, and provide the final physical interface between the educators, the content, and the learners.¹⁰⁹ He further argues that in the end the bypassing of existing architecture became a primary objective of the project, which in turn obstructed the realisation of the project itself. He quotes from a report on the status of several electronic governance initiatives prepared by Balaji Parthasarathy et al.¹¹⁰ to highlight the fact that actual implementation and functioning of these projects was often disrupted by the burden to translate 'such symbolic attributes into functioning systems.'¹¹¹

The failure of the Aakash device, can thus be read as the project's continuing inability to live up to symbolic expectations – that is, to live up to the technological desires of the state – and not only, or primarily, its technical requirements. In other words, the technical capabilities of the device were almost always evaluated in terms of their symbolic values: an Indian answer to Western models of affordable laptops or for that matter to mark India's ability – especially as opposed to China's – to design and manufacture computer hardware. The failure of the device – its technical limitations as well as its symbolic shortcomings – in a perverse way established the 'success' of the Indian state in re-defining the 'last mile problem' for the delivery of mass (initially higher, and eventually secondary and primary) education as one merely of having or not having an 'affordable access-cum-computing device.'

Shortly after the July 2010 public announcement of this device, Nicholas Negroponte, Founder and Chairman of the OLPC Foundation, wrote an open letter to the Indian government.¹¹² Congratulating the initiative to develop a tablet at or below \$35 targeted at educational usage, Negroponte warned that instead of projecting the tablet as '[India's] answer to MIT's \$100 computer,' it needs to be seen in a wider context of initiatives in computer-based learning.¹¹³ The letter offered six suggestions for the initiative, including the importance of the device to not to become a 'special purpose device' with a strict focus on educational content delivery and consumption. In this context, the early official description of the nameless tablet as a 'low cost access-cum-computing device' is noteworthy.¹¹⁴ It is difficult to imagine a contemporary computing device without connectivity.

In other words, a contemporary computing device could be said to be necessarily an access device to available communication networks. Where does the need for calling it an 'access-cum-computing' device come from? It comes, perhaps, from the hierarchy of priority – the device is primarily an *access* device, and secondarily can perform the function of a general-purpose *computer*. An archaeological reading of the assumptions of learning processes embodied in this device reveals an earlier layer of thinking – that of broadcasting educational programmes to television sets via satellite connection. Labelling it as 'access-cum-computing' frames the object as being shaped by the residue of the Indian state's education technological experiences of the past, including that of the SITE initiative.

This, however, is not to simplistically suggest that the Aakash tablet emerged as a new substitute for a television set when satellite-based delivery was replaced by the Internet. A shift had indeed appeared – and a significant one at that. This was the shift from collective consumption of learning materials to a personal (or individualised) one. Unlike the television sets of the SITE programme and others that followed suit, where the learners were expected to gather in a group and in presence of an instructor, the NMEICT imagined individual learners armed with personal access devices, with educational contents and aids, including virtual labs, being made available over Internet for self-learning.¹¹⁵ It is this

shift in the responsibility of education to the individual that is remarkable in this case, and a quality that was not particular to India.

To simply describe the Aakash project's failure as one due to the unbearable heaviness of functions ranging from the technical to the symbolic and political is to fall short of a full explanation. Alongside that narrative of *failure*, it is critical to foreground the quiet success of the project in establishing the tablet computer as a near-essential and familiarised everyday object for access to educational material. There is a remarkable accuracy in the MHRD's claim that the Aakash project established a sub \$100 tablet market in India – it did, even if it was not for the device they wanted to promote.¹¹⁶ The project played an important role in normalising the idea of a tablet computer as a necessary instrument for bridging the 'last mile gap' in welfare delivery (in this case, education), and more widely the idea of a tablet computer as a desirable media object. Further, in creating an architecture of education delivery that is autonomous from the bureaucracies, hierarchies, and entry barriers of the public university system, the state assembled an architecture of content creation and access that was intimately coded by the economies of telecommunication connectivity, competition for academic attention among creators of e-learning contents, and generation and mining of personal usage data.

After the launch of their commercial model in United Kingdom and other countries, DataWind recently, in 2014, launched a partnership with Bharat Sanchar Nigam Limited, a state-owned telecommunication service provider, to offer free Internet access (for 1 year) bundled with the device.¹¹⁷ DataWind also launched two critical cost-reducing measures: the introduction of an independent app store,¹¹⁸ that allowed DataWind to charge for software sold to users of Aakash, and the acceleration of accessing of web content through pre-processing by DataWind's own servers. The latter allowed DataWind to mine and monetise web browsing behaviours.¹¹⁹ It is remarkable, but not surprising, how divergent economies have converged to determine software running the device, which itself enables the tracking of use, including learning behaviour, that further enables creation and extraction of value which can be bought and sold.

The normalisation of personal digital devices as the preferred instrument to access the electronic world also opened up a space of leisure and consumption beyond the strict conceptualisations of developmental use of these devices. Even though the varied projects in devices for mass education surveyed in this paper categorically fail to even imagine the 'wild and everyday' media practices,¹²⁰ as we said earlier, they were nonetheless foundational to the economy of entertainment that has followed the introduction of these devices with a vengeance. We are thinking here of devices ranging from television sets, to computers, to mobile phones, and now tablets. These devices have more often than not taken unanticipated trajectories much beyond original purpose – they have sometimes disappeared completely as devices but have intimately shaped core layers of thinking on the problem. The vital impact of the Aakash project thus also needs to be read through the popularisation of personal digital devices that it unleashed. Responding to a description of the Aakash device as 'the iPad of the poor,' Suneet Singh Tuli explained that contrary to iPad, the Aakash was the 'the computer and Internet of the masses.'¹²¹ Did this failing technological solution which had been unable to solve educational inequalities in India leave in its wake new public imaginations and experiences of being digital in India? That is a matter for another study.

Epilogue

We have placed the Aakash project in a contemporary history of technological imaginations and solutions for mass education in late twentieth century India. We can observe that the Aakash project, as well as those preceding it, have been driven by a desire, primarily, to scale up the provision of education. The initiatives towards building delivery infrastructures for such mass-scale provision of education has almost always been accompanied by a larger desire for developing capabilities in space exploration, communication, and computing – the key technologies of twentieth century geopolitics. Our study of the manufacturing of the Aakash tablet, and its surrounding discourses, foreground the technological imagination of the state after liberalisation in India (1991), and its unique arrangements and efforts to create domestic capability of technological innovation in a context of globalised production and communication networks. We see our role as one of recovering the *work* of technology in the history of education as understood through the interactions between the state, academia, and industry (Figure 3).

Two key points about such interactions must be noted here. Firstly, the relevance of institutes, in the context of the making of the Aakash tablet, rose and fell as key individuals moved from one to another. This is illustrated by Prem Kumar Kalra's transfer from IIT Kanpur to IIT Rajasthan, and also by the implications of Kapil Sibal's movement from the MHRD to the Ministry of Communication and Information Technology. This is not to say that such personification, as opposed to institutionalisation, of crucial relations and decisions is a unique phenomenon of the post-liberalisation era, but to foreground the dependence of the technological imagination of the Indian state upon individual champions, as opposed to institutional and purely-pragmatic agendas.



Figure 3. Students at Pardada Pardadi Education Society in Anupshahr, Rajasthan, use the Aakash tablet in class as part of a pilot project introducing the low-cost computer into rural schools. Photograph taken on April 09, 2013. Credit: Sonali Campion. URL: <https://www.flickr.com/photos/sonalicampion/9449250639/>.

Secondly, unlike the celebrated politician-technocrat collaborations of yesteryears such as, Jawaharlal Nehru and Shanti Swarup Bhatnagar, Homi Jehangir Bhabha, Prasanta Chandra Mahalanobis; or later Rajiv Gandhi and Sam Pitroda, a purely tactical relationship between political leadership and technocrats (or private sector leaders) becomes prominent, often with an explicitly pragmatic focus on getting the job done. The relationship between Kapil Sibal and Prem Kumar Kalra is a case in point, as is the one between Kapil Sibal and DataWind. Again, this is not to say that the history of independent India has not seen a fall-out between technocrats and their political patrons, but our study foregrounds the increased fragility and continuously renegotiated nature of such relationships in contemporary times.

Both these points complicate the attempts at understanding the technological imagination of the contemporary Indian state as such. What we find instead is a number of key individuals who circulate through various nodes of the state structure, and shape, in the process, the negotiated manifestations of the technological imagination concerned.

Our choice of sources has been determined by our one goal: that of understanding the nature of state power in contemporary India at the intersection of education and technology. What we found in the myriad detail of implementing a technical solution was a messiness which indicates that state power, even when its efforts were less eminent (by its own admission), was never complete. When exercised on a shifting terrain where technology, the goals of education, and the nature of private investment were changing, relevant institutions of the state apparatus often found themselves unable to create, effectively control, and deliver durable socio-technical imaginaries – even as state power was maintained.¹²² Seeing like the state appears less compelling as a searing critique of the leviathan.¹²³ It is this insight that we consider historiographically crucial also to re-examine other state-led and state-supported projects in the past.

What is also remarkable in the making of the Aakash project is the marginality of discussions on the future of educational content and on curricula. What are the possible purposes and futures of industrialised education? In the 1970s, SITE appeared less ambiguous about its vision for education – the project wanted to take useful education to the rural hinterlands of India. Subsequent technological projects have been less clear on educational content. If the goal of the state-led projects is to produce a better workforce, then any meaningful debate or discussion of it in the public sphere is yet to be found. Similarly, any discussion of the consequences of standardised delivery of curricula and the potential to de-skill students and educators is rarely raised. The simultaneous creation of this desire for a digital personal device and the poverty of educational content indicate at the re-configuration of the mass education agenda in contemporary India towards creation of markets for new technologies of communication. The device has become the desire!

Notes

1. Tilak, 'Vocational Education in South Asia.'
2. Ambani and Birla, *Report on a Policy Framework*.
3. Thus far, it is proposed to develop material for the Central Board of Secondary Education (CBSE) curriculum.
4. Rabkin, 'How the Failed Aakash Tablet'; Singh, 'What Went Wrong'; Press Trust of India, 'Kapil Sibal: Aakash Tablet'; Anwer, 'It's Time We Chucked.'
5. Vishnoi, 'No Date of Expiry.'
6. Phalkey, 'Science, History and Modern India.'

7. Siddiqi, 'Making Space for the Nation.'
8. Agarwal, 'From Kothari Commission.'
9. Maharaj, 'An Overview of NASA-India Relations,' and 'Satellite Broadcasting in Rural India.'
10. Test villages were chosen using 1971 census data to ensure that sites chosen were suitably isolated and lacked most basic technology. 80% of the villages chosen did not have access to electricity before the start of the project.
11. Farmer, *Television, Governance, and Social Change*, 116.
12. Siddiqi, 'Making Space for the Nation,' 41.
13. Starosta and Merriam, 'The Impact of Media Technology.'
14. Chander and Karnik, *Planning for Satellite Broadcasting*.
15. Starosta and Merriam, 'The Impact of Media Technology.'
16. Planning Commission, *Evaluation Report*, 3–4.
17. Siddiqi, 'Making Space for the Nation,' 42.
18. The National Policy on Education 1986 proposed a 'technology mission' to urgently address the problem of widespread illiteracy in the country. See Chauhan, 'Education for All in India,' 232.
19. Bhatt, 'Growth of Computing Technology.'
20. Ministry of Human Resource Development, 'Revised ICT@Schools Scheme.'
21. Sterling, 'Simputer.'
22. Various. *The Bangalore Declaration*.
23. Chandru, 'The Simputer.'
24. The specifications of the Simputer featured 200 Mhz; 320 × 240 touch screen, 32 MB RAM, and 32 MB Flash.
25. The company PicoPeta launched another device – the Amida 4200 – based on the Simputer design in 2004. Two state governments proposed using the devices in government: the state of Karnataka used the device for land record procurements and the state of Chhattisgarh introduced projects in digital education. This is yet another story that can be followed up but beyond the scope of this paper.
26. Mitra, 'Self Organising Systems.'
27. Mitra, 'Minimally Invasive Education.'
28. Sociologists of education have looked at this aspect of poverty and education also in relation to the rise of private entrepreneurship in low-cost schools. See Nambissan, 'Poverty, Markets and Elementary Education.'
29. The project has received several awards, including the 'Digital Opportunity Award' in 2008 by the World Information Technology and Services Alliance. Mitra was awarded the \$1 million TED Prize in 2013 for the expansion of self-promoted learning. The author Vikas Swarup has claimed that 'Hole in the Wall' served as the inspiration for the book *Q&A*, which would later serve as the inspiration for the film 'Slumdog Millionaire.'
30. National Council of Educational Research and Training, *Position Paper of National Focus Group*, 6.
31. Ibid.
32. De, 'EDUSAT.'
33. The EDUSAT brochure described it as 'the first exclusive satellite for serving the educational sector[,] ... specially configured for audio-visual medium, employing digital interactive classroom and multimedia multicentric system.' The program was rolled out in three phases. Phase I focused on delivering content to and from three pilot schools, including Visveswaraya Technological University in Karnataka, Y. B. Chavan State Open University in Maharashtra, and Rajiv Gandhi Technical University in Madhya Pradesh, were connected using a Ku-band transponder on board a satellite – INSAT-3B – which was already in orbit. Following the launch of the EDUSAT satellite, the program moved in to Phase II. In Phase II, at least one uplink in each of the five spot beams was activated, allowing the connection of 100–200 schools. The national beam connects several key institutions, and includes Indira Gandhi National Open University, the National Council for Educational Research and Training, the Indian Institutes of Technology at Kharagpur and Chennai, the Institute of Electronics and

Telecommunication Engineers, the National Council of Science Museums, and the Centre for Environmental Education. Phase III included a wider rollout of services, including connecting additional primary and secondary schools, but users on the ground were expected to pay for ground services and technical assistance. The audit report of the project, however, noted that lack of identification and planning of financial resources for the users of EDUSAT services eventually led to its under-utilisation. See, Indian Space Research Organisation, *EDUSAT*, and Department of Space, *EDUSAT Utilisation Programme*.

34. While some states, notably Punjab, implemented feedback and complaint systems, it is unclear how the EDUSAT programs have been used, how many uplinks were stable, or how many schools effectively utilised the program when successfully connected. It is also not clear how school infrastructure might have changed to support EDUSAT-based learning, and therefore reorganised the classroom and in turn, reshaped the broader education system – especially curricula.
35. Department of Space, *EDUSAT Utilisation Programme*.
36. The National Programme on Technology Enhanced Learning (<http://nptel.ac.in/>) was an initiative in developing free online courses and educational materials to enable self- and distance learning in fields of engineering and science. It ran during 2003–2007, and was led by IISc, and seven Indian Institutes of Technology (Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras, and Roorkee).
37. These five areas were civil, computer science, electrical, electronics, and mechanical engineering. IIT Guwahati and IIT Roorkee also joined the project.
38. Krishnan, *National Programme on Technology Enhanced Learning*.
39. Sakshat was also integrated into the design of the National Mission on Education through Information and Communication Technology (henceforth, NMEICT), which started in 2009, as the website through which all e-learning content produced by the Mission was to be accessed.
40. The portal was to showcase nearly 1000 courses – some for the previously mentioned NPTEL program – but it is unclear if this target was reached. The programme was seen to be important enough that the President of India A. P. Abdul Kalam launched the portal in October 2006. The portal was designed at the Indira Gandhi National Open University and features five functional modules. These include Educational Resources, that is access to e-journals, digital archives, and digital library resources, and Scholarship module where students can share academic achievements and goals. Two of the modules, Testing and Superachiever, feature links to online tests, skill upgrading tools, and guided tests to encourage self-learning and assessment. The fifth portal is Interaction, and includes an email function, blogging tools, online chats, and a discussion forum to encourage interactions between peers and between students and teachers. An interactive classroom feature was also available.
41. Press Information Bureau, 'Low Cost Access-Cum-Computing Device.'
42. Information collected through Right to Information request by Nikhil Pahwa of MediaNama reveals that by mid 2012 (6 months after the launch of the device on October 2011), 6440 units of the device was supplied by DataWind to IIT Rajasthan, of which 650 were accepted by the latter after testing, and of that only 366 were distributed to students by the MHRD. Pahwa, 'Aakash Tablet RTI.'
43. Express News Service, 'Finally, a Glimpse of the \$10 Laptop.'
44. Without a screen or a keyboard, the device could not offer anything more than being used by a (separate) computer to access the Internet via its networking facilities, and to store only two gigabytes of data. Mukherjee, 'Bonsai Netbooks,'; Rangarajan, 'Ultra-low-cost access device.'
45. Ministry of Human Resource Development, 'The History of Aakash,' 3.
46. Mehta et al., *Report of the Evaluation Committee*, 167.
47. NMEICT was initiated in February 2009 by Arjun Singh, the then Union Minister of Human Resource Development, with an aim to enable knowledge and skill development in the higher education sector through opportunities of distributed learning via the Internet. The Mission had three components: (a) provision of Internet connectivity to all colleges and universities, (b) creation of 'high quality e-content' available free of cost to the learners, and (c) provision of

'low cost access-cum-computing devices' to the learners and educators. Approximately 60% of the total budget of the Mission (Rs 46 billion, or around \$1 billion in the prevailing exchange rate), was earmarked for provision of Internet connectivity to educational institutes through the National Knowledge Network. The rest of the amount was divided into supporting creation of educational content (including through NPTEL) and funding research, prototyping, and testing of the device. The National Knowledge Network (<http://www.nkn.in/>) is a high speed data communication infrastructure connecting various academic and research institutes in India through an optical fibre network. The project was approved in March 2010. See: Ministry of Human Resource Development, 'The History of Aakash.'

48. Ministry of Human Resource Development, 'The History of Aakash,' 3–4.
49. Press Information Bureau, 'Low Cost Access-Cum-Computing Device.'
50. Press Information Bureau, 'Low Cost Access-Cum-Computing Device.'
51. Bhattacharya, Devi, and Foster, 'Searching for the Aakash.'
52. Ibid.
53. Mehta et al., *Report of the Evaluation Committee*, 167–169.
54. Pahwa, 'HCL Wins Contract.'
55. The XO laptop (<http://laptop.org/en/laptop/>) was developed by the OLPC Foundation specifically to be used by children for ('constructionist') learning through exploring, experimenting, and expressing with the device. The laptops are built as durable, functional and energy-efficient machines so that children – especially in developing countries – can use them under harsh conditions.
56. Julka and Aulakh, 'Tender for \$35 Laptop Project.'
57. Curiously, he could not actually show it to the journalist(s) as the device was at his home and not in the office. See Raina, 'Is India's Elusive \$35 Laptop.'
58. Press Information Bureau, 'Shri Kapil Sibal Launches Aakash.'
59. The first version of the Aakash device had the following specifications: '366 MHz Conexant ARM 11 processor, 7" resistive touch screen, 256 MB RAM, two USB ports and wifi.' Moudgalya et al., 'Genesis of Aakash.'
60. Raina and Timmons, 'Meet Aakash'; Annanthakrishnan, 'Power in Your Palm.'
61. Sai Gopal, 'City Firm Develops.'
62. Julka, '14 Lakh Aakash Tablets Booked.'
63. Chopra, 'Kapil Sibal's Cheap Aakash'; Goel, 'Aakash Tablet Hands On.'
64. Press Trust of India, 'Aakash Tablet.'
65. One rumour suggested that two major public sector companies, Bharat Electronics Limited and Electronics Corporation of India Limited would now manufacture the device, with R&D supervision from a network of public agencies, including the Centre for Development of Advanced Computing and the Department of Information Technology, Government of India. See Agarwal and Nanda, 'Sibal Ejects DataWind.'
66. Raina and Timmons, 'The Aakash Project's Bitter Finish.'
67. Graham and Marvin, *Splintering Urbanism*, 139–142.
68. Sanjay Asthana maps a similar shift in broadcasting and media policies of the Indian state since independence: from the centralised efforts to create a 'televisual *nation-ness*' in the pre-liberalisation era, to the disaggregated efforts of the post-liberalisation that simultaneously partnered and competed with the emerging private media industry. See Asthana, 'Broadcasting, Space, and Sovereignty in India.'
69. Rabkin, 'How the Failed Aakash Tablet.'
70. Ibid.
71. Julka, 'Datawind Breaks Ties.'
72. Press Information Bureau, 'President Unveils Aakash Version.'
73. Raina and Li, 'India's Aakash.'
74. Chaudhary, 'Updated: Aakash 2.'
75. Press Trust of India, 'Aakash 2 Tablet.'
76. Nanda and Agarwal, 'Government Close to Giving Up.'
77. Mehta et al., *Report of the Evaluation Committee*, 109.

78. Ibid., 31–32.
79. The (upgraded) specifications of the Aakash II device was as follows: ‘512 MB RAM, 1 GHz ARM Cortex A8 processor, Android 4.0 operating system and a gravity sensor ... 2 GB NAND Flash, 2 GB SD Card, [and] 7” display.’ Moudgalya et al., ‘Genesis of Aakash 2,’ 23.
80. Press Trust of India, ‘HRD Ministry may Abandon.’
81. Rajan, ‘100,000 Aakash Tablets.’
82. Agarwal, ‘Govt Plans to License.’
83. Ibid.
84. Department of Electronics and Information Technology, ‘Finalization of Technical Specifications,’; Department of Electronics and Information Technology, ‘Proposed Aakash IV.’
85. As part of the national government headed by Dr. Manmohan Singh, Kapil Sibal served as the Minister of Communications and Information Technology from 19 January 2011, to 26 May 2014. He was also the Minister of Human Resource Development from 31 May 2009 to 28 October 2012. He was succeeded by Pallam Raju as the Minister of Human Resource Development under the same government. Even after stepping down from MHRD, that Kapil Sibal continued to head Department of Electronics and Information Technology.
86. Mukherjee, ‘Bonsai Netbooks.’
87. Raina and Li, ‘India’s Aakash.’
88. Nanda and Agarwal, ‘Government Close to Giving Up,’ and Mehtata et al., *Report of the Evaluation Committee*, 109.
89. Chopra, ‘Kapil Sibal’s Cheap Aakash.’
90. Julka, ‘Datawind Breaks Ties,’; Parthasarathi, ‘Cloudy Outlook for Aakash.’
91. Comptroller and Auditor General of India, *Report No. 19 of 2013*.
92. Press Trust of India, *Aakash Tablet is My Unfulfilled Dream*.
93. Gooday, ‘Critical Reflections on Histories,’ 286. Emphasis as in original.
94. Bhattacharya, Devi, and Foster, ‘Searching for the Aakash,’; Chopra, ‘Kapil Sibal’s Cheap Aakash,’; Nanda and Agarwal, ‘Government Close to Giving Up.’
95. The only exercise in considering alternative software platform for the device has been IIT Mumbai’s attempts at running Linux-based operating system on the device. Moudgalya et al., ‘Genesis of Aakash 2,’ 23.
96. Mudliar and Pal, ‘ICTD in the Popular Press.’
97. Kapil Sibal, the then Minister of Human Resource Development, mentioned in his address at the 36th Session of the General Conference of UNESCO that the Government of India ‘dedicate(s) this device to the children of the world [so as to] equip our children with the tools to face the challenges of the twenty-first century.’ Press Information Bureau, ‘Address of Shri Kapil Sibal.’
98. Title of an article by April Rabkin reads ‘How the Failed Aakash Tablet is an Object Lesson in India’s Long Road Ahead to Tech Innovation.’ Rabkin, ‘How the Failed Aakash Tablet.’
99. Vivek Wadhwa notes that ‘[t]he Indian government has inadvertently started a revolution’ and ‘[d]on’t be surprised to see villagers [soon] developing apps that solve their own unique problems,’ Wadhwa, ‘India’s Tablet Revolution.’
100. Ministry of Human Resource Development, ‘The History of Aakash,’ 1.
101. Mehta et al., *Report of the Evaluation Committee*, 169.
102. Ibid.
103. Anupam Gupta, one of the co-leaders of the Aakash project team under Kalra, further clarified that the ‘hardware innards’ of the device were assembled by the IIT team by carefully selecting components that were affordable yet provided basic performance specifications. The team then offered the ‘pre-manufacture proof-of-concept’ to the agency selected to undertake commercial manufacturing, to be used either as-is or in a modified form as the basis for the final design. See Subbaraman, ‘The Big Ideas.’
104. Mehta et al., *Report of the Evaluation Committee*, 174–175. Italics added.
105. Ibid., 176.
106. Ibid., 170.

107. Ministry of Human Resource Development, 'The History of Aakash,' 5, and Mehta et al., *Report of the Evaluation Committee*, 181–182.
108. Rajadhyaksha, *The Last Cultural Mile*, 153.
109. Ibid., 159.
110. Parthasarathy, *Information and Communications Technologies for Development*.
111. Rajadhyaksha, *The Last Cultural Mile*, 39.
112. Negroponte, '\$35 Tablet for Education.'
113. Ibid.
114. Press Information Bureau, 'Low Cost Access-Cum-Computing Device.'
115. Ministry of Human Resource Development, *National Mission on Education*, 15–18.
116. Ministry of Human Resource Development, *The History of Aakash*, 3–4.
117. Ghosh, 'DataWind Partners with BSNL.'
118. An 'app store' is a source for browsing, downloading and installing applications (or 'apps') into a mobile computing device. Developers of mobile operating systems (such as Apple, Google and Microsoft) often develop particular app stores through which applications can be installed to the operating system concerned, so as to control and monetise distribution of applications to users of devices running that operating system.
119. DataWind uses a patented technological system to route the web content being accessed by the user through servers owned by the company. These servers pre-process the content being send to the device so as to accelerate and smoothen the user experience. Kurup, 'We Want to Target.'
120. Rangaswamy and Arora, 'Mobile Internet in the Wild and Everyday.'
121. Kurup, 'We Want to Target.'
122. See, Jasanoff, *States of Knowledge*. Also see, Jasanoff, 'Governing Innovation.'
123. Scott, *Seeing Like a State*.

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