Digital Innovation, School Readiness and Intervention Approaches: a case of Connected Learning Initiative (CLIx) in Indian high schools

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Abstract

The expansion and sophistication in the field of design and development of technological affordances in school education offers numerous possibilities for improving education delivery and quality. In recent years, governmental policy and programs in India have acknowledged the need to integrate technology at secondary education level given its potential to transform classrooms. Yet, the key challenges have been about organically integrating technology within the school curriculum while simultaneously empowering the teachers to use these affordances as effective pedagogical tools. Adoption and diffusion of innovative educational practices at scale has suffered due to lack of adequate infrastructure on the one hand as well as lack of educational resources that can foster deep, authentic and connected learning in regional Indian languages on the other. This paper presents the relevance of digital innovation at the high school level, keeping in mind the status and challenges of secondary education in India, particularly in government schools serving the disadvantaged groups in rural and semi-urban areas. The idea of 'readiness' of schools is then examined at two levels: first, the 'technological readiness' comprising of infrastructure provisions and second, the 'stakeholder readiness' comprising of aspirations and openness of stakeholders to receive a digital innovation in school.

Based on primary data collected through school level surveys and interviews with education officials, principals, teachers and students in three Indian states, the paper analyses the school 'readiness' in terms of challenges and opportunities for rolling out a large scale digital innovation program in Indian high schools. Using the case of Connected Learning Initiative (CLIx) which is a unique, collaborative program of Tata Institute of Social Sciences, Massachusetts Institute of Technology and Tata Trusts, the paper discusses the key intervention approaches that can address the school readiness. The approaches include working at scale, mobilising existing resources working with government for sustainability and building local ecosystems that can enable creation of digital pathways of learning in schools.

1. Introduction

The rapidly evolving landscape of digital learning has the potential to change how education is transacted and how learners engage and participate in the pedagogical processes. In several developing countries, technology is used as one of the tools to address challenges of education provision, access, equity, efficiency and quality. The 2030 Agenda for Sustainable Development adopted by the United Nations in September 2015 acknowledged that there is great scope in accelerating the human progress by eliminating digital gaps, which is only possible by educating the society on the spread of information and communications technology. In the Indian context, the existing inequities in educational opportunities are further exacerbated by a digital divide and there is a need to facilitate connectedness at all levels between the learners, teachers and the larger ecosystem. Technology enabled "connected learning" has the potential to address geographical and social disparities by working at scale and thereby addressing the goals of equity and social inclusion.

Empirical evidence on the impact of such programs has been mixed (OECD, 2015). Literature on the impact of technology on improving education, specifically in the Indian context, is sparse. Banerjee et al. (2005) found that computer assisted instruction improved student performance in mathematics score among fourth-grade students in Vadodara, India. Linden (2008) showed that out-of-school programs are more effective in improving schooling outcomes than in-school programs. Some of the evaluation studies conducted in developing countries show positive effects on student test scores (Banerjee et al., 2007; He, Linden and MacLeod, 2008; Linden, 2008; Barrera-Osorio and Linden, 2009). Hattie and Yates (2013) did a meta-analyses of 81 research studies on computer assisted learning and found that learning gains are neither bigger nor smaller than any well intentioned teaching activity. On the other hand, Leuven et al., 2007; Carrillo, Onofa and Ponce, 2010), Goolsbee and Guryan (2006), Angrist and Lavy (2002), Rouse and Krueger (2004). Cristia, Czerwonko and Garofalo (2010) found limited or no evidence of positive impact of technology on improvement of student performance. Research shows that for programs to be sustainable they should be integrated within the school curriculum (Underwood et al 2000).

In recent years, governmental policy and programs in India have acknowledged the need to integrate technology at secondary education level given its potential to transform classrooms. Yet, the key challenges have been about organically integrating technology within the school curriculum while simultaneously empowering the teachers to use these affordances as effective pedagogical tools. Adoption and diffusion of innovative educational practices at scale has suffered due to lack of adequate infrastructure on the one hand as well as lack of educational resources that can foster deep, authentic and connected learning in regional Indian languages on the other.

2. Secondary education status in India and need for digital innovations

There has been an unprecedented increase in demand for secondary education in India during the past decade. The challenge of improving access, equity and quality of secondary education has been addressed through the *Rashtriya Madhyamik Shiksha Abhiyan* of the Ministry of Human Resources Development, Government of India. As per the latest figures available (U-DISE 2014-15), 38 million adolescents receive secondary education (grades IX and X) from 233517 secondary schools while 23 million are doing their senior/higher secondary education (grades XI and XII) from 109318 senior secondary schools in India. There are inequalities in enrollment at secondary and senior secondary level in terms of gender and socio-economic backgrounds. Transition rate from upper primary to secondary education is 92.67 percent and it decreases significantly to 58.34 percent from secondary stage to senior secondary level (Registrar General, Census of India, 2011).

A major area of concern is the quality of learning and poor performance in standardised assessments. The first ever National Assessment Survey (NAS) to understand whether students have attained expected "specified and valued learning standards after ten years of schooling, irrespective of their diverse social, cultural and economic backgrounds" was conducted in 2015, by the National Council for Education Research and Training (NCERT) on a sample basis. The analysis shows that rural children, children studying in government schools and government - aided private schools and those from socially marginal groups like Scheduled Tribes (ST) and Scheduled Castes (SC) did well below national average. Around 85% of the students got less than half of the answers correct in English and Math while only 22% students got more than 50% of answers right in Science subject. Overall, the quality of learning in language, Mathematics, Science and Social Studies leaves a lot for improvement (NCERT, 2015).

Recognizing the possibilities of education technology in improving the quality of education as early as in mid-1980s, the National Policy of Education (1986, modified in 1992) stressed the need to employ education technology in education. The Centrally Sponsored Schemes (CSS) initiated as a result of this policy – Education Technology and Computer Literacy and Studies in Schools (CLASS) on pilot basis finally led to the more comprehensive Information and Communication Technology@schools (ICT@schools) program in 2004, which was revised in 2010 and integrated within RMSA in 2015. The ICT@school mainly targets secondary students, to provide them with opportunities to build their ICT skills and capacities and enable them to learn through computer aided learning. The scheme was envisaged to be a major catalyst to bridge the digital divide amongst students of various socio-economic and other geographical barriers (Government of India: National Policy on ICT in school education, 2012). This scheme initially implemented through the Public, Private Partnership (PPP) approach of BOOT (Build, Own, Operate and Transfer) model. An early evaluation of two large scale ICT@school program by IT for Change (Kasinathan and Vishwanath, 2010), shows that "the integrated model" followed in Kerala state's ICT@Schools program, which emphasised developing systemic in-house capabilities anchored around the role of school teachers, showed considerable success. On the other hand, the evaluation commented that the alternative model of 'outsourcing' or 'BOOT' in the state of Karnataka did not demonstrate any improvement. The program funds were mainly used to pay the private vendors to run the program instead of building in-house capacities. The study cautioned that outsourcing of such programs should fully take into account the distinction between non-core processes such as procurement, installation and maintenance of hardware, and core activities with direct pedagogical implications like content and software, teacher training and learning processes. Another evaluation carried out by the Central Institute of Education Technology in collaboration with a group of state specific evaluators in 2015 shows that the core activities related to content, software, pedagogy, teacher training and learning processes were not given much attention under ICT@ school program in most places. The use of ICT infrastructure was limited to basic office level administrative tasks. In addition, the education resources provided lacking in imagination and depth. In sum, although the program of ICT@Schools scheme has been an important starting point in terms of getting the technological readiness in schools, it has remained at that level without leveraging the infrastructure provision to build systemic capacities through enhanced student learning practices and teacher professional development.

3. School readiness

Studies on impact of large scale interventions on ICT in schools at the international level point to the presence of a number of factors that contribute to the success of interventions. These include school related factors such as school technology and support (Grimes & Warschauer, 2008; Penuel, 2006; Dexter, Anderson, and Ronnkvist (2002), professional development of teachers, teacher motivation and readiness (Inan and Lowther, 2010), school leadership, correspondence of technology with pedagogical aims of education (Eickelmann, 2011). Studies have also shown the importance of stakeholder support and administrative encouragement for successful technology integration in schools (Inan & Lowther, 2010; ISTE, 2007; Murphy et al., 2007; Nachmias, Mioduser, Cohen, Tubin, & Forkosh-Baruch, 2004; Rutledge et al., 2007).

The idea of 'school readiness' in literature is framed from the point of view of the learner's readiness for the schooling or the learning process. While this is an important dimension of any intervention, we argue that it is also important to focus on the readiness of the school system to receive the intervention. The impact of the intervention and its sustainability, we suggest, will depend on how prepared is the school system to adopt digital innovation in classrooms. The idea of schools' readiness is relevant to prepare the ground for intervention itself and also to ensure pathways for its sustainability. In this paper, we propose a conceptualisation of school readiness which comprises of two components [a] *technological readiness* in terms of availability and access to infrastructure [b] *stakeholder readiness* which includes the receptivity, openness and motivation of the stakeholders to engage with the innovation. These two components provide us a useful conceptual tool to identify the key ingredients or requirements of a field oriented innovation. We argue that both technological readiness as well as stakeholder readiness are required to make a digital innovation successful and sustainable. While many innovative programs aim to build readiness of both components (technology and stakeholders), these are not available ready-made as a starting point. The achievement of such readiness becomes a process goal in itself and informs the intervention approaches adopted as part of the innovation.

In this paper, we discuss the two components that make up school readiness for adopting a digital innovation by using a case study of the Connected Learning Initiative (CLIx), a unique, collaborative program of Tata Institute of Social Sciences, Massachusetts Institute of Technology and Tata Trusts. CLIx is an effort to improve the professional and academic prospects of high schools students from under-served communities in India. It incorporates thoughtful pedagogical design and leverages contemporary technology, including online capabilities, to provide quality educational content and experiences at scale. Data gathered from field surveys and key informant interviews over a period of one year is used to describe the technological readiness in two states (Rajasthan and Mizoram) and stakeholder readiness in four states (Rajasthan, Mizoram, Chhattisgarh and Telangana) that are taken up for intervention in India. Since innovation is an incremental process, there is value in presenting our findings and approach based on field work in progress.

3.1 Technology readiness of schools selected for CLIx

The technological readiness of schools for CLIx intervention is ensured through the selection process wherein the sub-sample of the schools have the maximum likelihood of being technology-ready due to their coverage under the ICT@School scheme. During the pilot phase, four states of India representing different regions have been selected (Rajasthan in the North-West, Mizoram in North-East, Telangana in South and Chhattisgarh in Central India). The technological readiness parameters used for selecting the schools included: (a) electricity and internet connectivity and (b) ICT@school related provisions. Data collected through field mapping surveys show that the status of technological readiness poses at least two challenges. First, is the lack of adequate infrastructure itself, in terms of availability and functionality and second, is the challenge posed by the patchy and uneven readiness of technological infrastructure to the design and development of appropriate curricular offerings that will work in a range of infrastructure settings.

Data also shows that Jaipur (where state capital is located) is better in terms of many parameters compared to Sirohi. Mizoram does not have access to some technological aids such as web camera, a dish or a LAN setting. In Rajasthan, 96% of the CLIx schools in Jaipur and 94% of the CLIx schools in Sirohi have internet connection. However, in Mizoram, only 43% or 13 schools out of 30 CLIx schools have access to internet. In Rajasthan, CLIx schools, 22% use wired broadband for internet services while 67% schools use 2G/3G dongles for connection. On the other hand, in Mizoram, almost all schools use wired broadband for internet connectivity.

Internet speed is also important to facilitate better functioning of CLIx curricular offerings. In more than half of the schools in Rajasthan (around 57%) have internet connection with a speed of less than 256 kilobyte per second (kbps). On the other hand, all schools with internet facility in Aizawl have a speed of 512 kbps. More than half of the schools in Rajasthan reported irregular connectivity with internet.

3.2 Stakeholder readiness: Preparation for “CLIx Habitat”

Literature indicates the critical role played by the stakeholders themselves, in terms of their positions, expectations, openness, concerns and motivations towards the intervention. Within CLIx, the stakeholders are intended to serve as active learners and contributors to the innovation itself. To create the “CLIx habitat”, some of the readiness activities undertaken at school level are (a) school computer labs must be open before/after school hours for maximizing use of resources, (b) timetable of the school hours will be adjusted in such a way that every student would get a fair amount of time to engage in CLIx curricular offerings, (c) a special introductory curricular offering called Invitation to CLIx (i2c) which is meant to orient teachers and students to work on computers, (d) to activate science lab with the help of students and teachers to utilize the lab space more often and regular. Continuous feedback and guidance from experts and CLIx curriculum resource persons would help to make Science lab more meaningful than before, (e) interaction of high school students with local engineering/Science/B.Ed Colleges to mobilize resources and to create a bi-directional learning experiences for all (f) CLIx-curriculum teams are continuously interacting with students on various module piloting, so that students authentic experiences will be the part of CLIx curricular offerings. A bottom up approach is being used to prepare modules, where learners will play a major role in it, (g) build up local resource support and including teacher education institutions such as IASEs in the intervention for continuity and sustainability of program, (h) integration with other program on ICT and building on synergies in input and output.

There is also a significant space created for establishing new epistemic communities for academic discussion and associated discourses. The CLIx preparation of teachers is at two levels. One level is to make state resource group for mathematics, science and communicative English which will work closely with the CLIx-Teacher Professional Development team. The teacher professional development, is a core component under CLIx to prepare school teachers to roll out various curricular modules developed by CLIx. Another level of teacher preparation is at school level, where teachers will be an active participant of module offerings and module testing. The school principal is another important stakeholder of the intervention. CLIx orients them on scope of this initiative at district level, understands their everyday experiences about school management and their feedback helps CLIx to make readiness plan more robust.

CLIx is working closely with government schools although the CLIx approach itself is quite new to the government school system. Thus, the biggest requirement is to help them understand the whole idea about CLIx as a digital innovative intervention, quite unlike the earlier programs of the government. Formal agreements have been entered into with the state governments which allows for leveraging existing resources. For instance, in Rajasthan state, the education department has signed MOU with internet providers to setup broadband connections in all schools. This level of motivation and engagement from state official across four different states gives rise to new kinds of challenges: (a) officers are more ambitious in terms of output and visibility of the intervention, (b) they are comparing and assessing level of input in terms of quantity of outputs, (c) due to their own budgetary constraints, they are unable to commit to provide/upgrade technological infrastructure as per the requirements of the CLIx curricular offerings. Work on stakeholder readiness has been a critical pillar of the early preparation because it creates the foundation on which a robust intervention would rest. This process also allows for the concerns and tensions amongst the stakeholders to surface, which need to be resolved through the intervention process.

4. Intervention approaches

CLIx has partnered with organisations in four states, that are invested locally, to optimally utilize the experience and resources that the local implementation partners have. These partnerships are unique in each of these states. In addition to the common framework and approach to the implementation, the state partnership and local implementation partnership leverage on their specific strengths to build state level interventions. For instance, in Telangana state, it is the government, State Council of Educational Research and Training (SCERT), which has taken the ownership of implementing the program. Its openness to technology, educational reforms, leadership and organisation structures makes intervention approach different in Telangana. In Mizoram, with department of school education, it is the Mizoram University that is the local implementation partner offering the possibility of recognizing the communities of practice and network of support systems. In the Chhattisgarh state, with the department of school education, there is a multi-agency partnership with an NGO, UNICEF and Tata Institute of Social Sciences, while in Rajasthan, the partnership is between the department of school education and an NGO, Centre for Education Research and Practice (CERP) which has closely worked with state education department on teacher professional development. The various kinds of collaborating institutions allow for building on state specific requirements and resources.

4.1 Course offering

CLIx builds digital and new media skills among student and teachers and provides authentic learning experience for English, Mathematics and Science with hands-on learning, enabled through technology. It leverages technology for continuous professional development of teachers. The CLIx proof of concept includes a significant implementation component to establish the relevance and viability of the project and to demonstrate the intervention's ability to contribute to teaching-learning process, both inside/outside the education system, and at scale. A field action research approach is followed to develop the working model by which the curricular components would be accessed by the learners and teachers, and incorporated into the teaching learning process. Development, research and implementation goes hand in hand. The offerings are open access as well as focused on specific geographies (Rajasthan, Chhattisgarh, Mizoram, Telangana) where there are identified learner groups (teachers and students) who will use these resources in curriculum and pedagogy.

It is important that the course offerings developed in CLIx are amenable to refinement and modification. Such changes emerge from the field realities and experiences during the process of implementation. Our processes will enable teachers to engage and innovate by presenting local examples, alongside the content of the modules or courses developed by our curriculum teams. Thus, each of the curricular offerings or modules would be reviewed and redesigned after the first round of large scale roll out, based on the feedback from the implementation process. In Maths and Science subjects modules will be based on the state curriculum and in English subject modules will support teachers and students to acquire general proficiency in communicative English. The teacher professional development (TPD) would precede, run concurrently with and succeed each modular offering and course. The TPD is designed in the form of courses that are offered through MOOCs and in which teacher educators will be involved as instructors and mentors. These courses will be certified by Tata Institute of Social Sciences within the existing programs and through additional certificate and diploma modes.

4.2 Open access

Open access of curricular offerings is critical and integral to the implementation of the CLIx initiative. Once registered, teachers and students would be able to access the courses and modules on their own via the CLIx platform. We envision that once rolled out, the platform will draw learners by establishing a reputation for credible and emotionally satisfying learning. Processes for certification of learning through these open modalities are being evolved. The platform will enable the field implementation teams as well as the research and monitoring teams to understand the learners, their motivations and their experience throughout the course offering.

4.3 CLIx learning lab

CLIx offerings are blended in nature, it includes hand-on activities, project work, games, simulations, discussion with peers and teachers, etc. It is important that students and teachers have access to the required tools and space to engage with them. CLIx is proposing setting up of a learning lab to all the intervention states. This is a space which has the necessary technological infrastructure, network connectivity, science lab materials, low cost and recycle material and equipments, a collection of books on science, mathematics and English, and various tools for hands-on learning. This is envisaged as a maker's place for exploration and self-learning. Access to the learning lab before and after school hours and during holidays is crucial. This will provide opportunities as well as resources for students and teachers to create and become engaged as a community of practice.

4.4 Sustainability - Nurturing a local ecosystem

An ecosystem approach, with sustainability and integration of technology are at the core of the CLIx approach. Through this, we envision communities building processes and sharing knowledge with each other. Sustainability will rely on developing such an ecosystem that can promote scholarship and involve continuous collaborations in an open ecosystem of partnerships around the core values of the initiative. Ecosystem is to be nurtured both at local level and across the states. It is the local ecosystem of a particular geography that will ensure the sustenance of new pedagogical practices. Local ecosystem involves communities of learners comprising teachers from school systems who are participating in the initiative as well as those who may sign up independently to study courses that are offered. Members of the educational community (including student teachers, teacher educators, curriculum developers, researchers and academic experts), students from local science and engineering colleges who have capability to use, develop and integrate education technology into their work and support teachers and students will participate. Constructive and symbiotic engagements with a range of partners from academia, government and non-government and the private sector is the central to this initiative.

4.5 Working at scale

Usually interventions are first trialed or piloted at a very small scale, which is very resource intensive but then challenges are faced when these interventions are scaled up. This usually happens because of not factoring many components while designing the program on a small scale. In CLIx, scale is an input to design, which means scale is part of the design, implementation and framework of the program.

4.6 Mobilizing existing resources

A digital innovation of this scale requires different kinds of resources for its implementation. Our primary approach has been to mobilize and build on the existing resources. Teacher professional development delivery is planned with the existing state structures. Government has accommodated our training within their yearly training schedule. These teacher training programs are also supported by state. Teacher groups are formed as communities of practice within the official structure of the state.

5. Way forward

Connectedness is an idea which is central to learning. The first and foremost objective is to create a vibrant environment in the schools, where technology is the method to connect learners and teachers. It is expected that the government supports this, recognizes the values of a digital innovation as compared with conventional pedagogy. Large scale implementation requires skills in information technology as well as technology enabled communication among the communities selected for the intervention, such as students, school teachers and teachers educators. This teaching learning process can be sustained through continuous knowledge building, maintaining and sustaining relationships, as well as critical reflection and analysis in order to evaluate the CLIx efficacy whether through formal or informal evaluative methods. Although content and pedagogies are not independent concepts but it is important to recognize that they influence one another. A more complete and effective integration of curriculum, technology and devices can evolve with professional practice and establishing the network among teachers educators, teachers and learners.

'Technology' in schools is synonymous with computer. A transformation in this imagination requires a lot of advocacy with the government for continuous support. Research and monitoring tools can help estimate or describe what impact did the innovation have, how did the innovation take place and how can it be sustained as well as scaled up. It is important to separate enabling components and core components of intervention from the beginning and this can be exemplified through the tangible activities that a teacher or field staff would do when working within setting of classroom and a school. This indicates that we need to understand and work on at least two categorical challenges: first, exploring how to choose alternatives to conventional pedagogy with a clear rationale based on pedagogical principles, perspectives, research and assessment; and second, establishing the extent to which alternative pedagogical design can strengthen the school curriculum and widen horizons beyond. Developing readiness of the school (both technology and stakeholders) is an important starting point but as our preparatory fieldwork indicates, there is a definite need to go beyond what is obvious and what is available. A digital innovative program of the scale and complexity such as CLIx requires a continuous praxis that will close the gap between what is doable and what is done in Indian high schools.

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