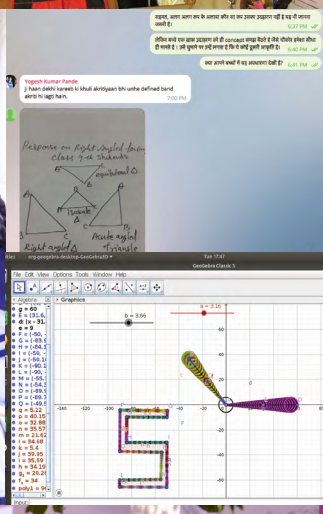
Connected Learning @ Scale

Positions, Practices, Policy and Partnerships



*Winner of the 2017 UNESCO - King Hamad Bin Isa Al-Khalifa Prize for the **Use of ICTs in Education** for its outstanding contribution to the theme "Use of ICT to Increase Accesss to Quality Education"*

*Winner of **Open Collaboration Awards for Excellence 2019** from Open Education Consortium*

CLI

CONNECTED LEARNING INITIATIVE

An initiative seeded by

TATA TRUSTS

Led by

Massachusetts Institute of Technology

TISS/CEI&AR/CLIx/Rp/SY/05Mar'20/12

The Connected Learning Initiative (CLIx) is a technology enabled initiative at scale for high school students. The initiative was seeded by Tata Trusts, Mumbai with Tata Institute of Social Sciences, Mumbai and Massachusetts Institute of Technology, Cambridge, U.S.A. as founding partners. It offers a scalable and sustainable model of open education and is a bold effort to bring innovation, and global best practices adapted to the Indian context, to meet the educational needs of students and teachers.

CLIx incorporates thoughtful pedagogical design and leverages contemporary technology and online capabilities. Resources for students are in the areas of Mathematics, Sciences, Communicative English and Digital Literacy, designed to be interactive, foster collaboration and integrate values and 21st century skills. These are being offered to students of government secondary schools in Chhattisgarh, Mizoram, Rajasthan and Telangana in their regional languages and also released as OERs.

Teacher Professional Development is available through professional communities of practice and the blended Post Graduate Certificate in Reflective Teaching with ICT. Through research and collaborations, CLIx seeks to nurture a vibrant ecosystem of partnerships and innovation to improve schooling for underserved communities**.**

The Connected Learning Initiative (CLIx) was awarded the UNESCO King Hamad Bin Isa Al-Khalifa Prize for the Use of ICTs in Education for its outstanding contribution to the theme Use of ICT to Increase Acceess to Quality Education, March 2018. CLIx won the Open Education Awards for Excellence Resources, Tools and Practices under the category of Open Collaboration in 2019 from Open Education Consortium. (http://clixoer.tiss.edu).

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01 INTRODUCTION

Education technology has been around for several decades now and is expanding rapidly with increase in access to devices. Alongside optimism about innovations for better student learning, there is need for pragmatism about what the technologies can and cannot achieve and what it takes to do it well. Engagement of scholars and practitioners is crucial to the design and development of educational technologies, addressing concerns regarding quality and scale, partnerships and directions for research. One of the main areas of focus in the sector has been the achievement of curricular integration and teacher professional development for transformative impact. Principles that guide curricular development, openness and connectedness are issues and considerations that must inform practice and research. This book brings together a collection of thought pieces from scholars and practitioners that draw our attention to these key issues, organised under the themes of positions, practice, policy and partnerships.

Positions brings together thought pieces that are from the vantage point of the drivers in education technology today. Teachers' knowledge and commitment lie at the core of education innovations. Teachers speak reflects the rich knowledge they have of the context and domain that imbues pedagogic value to the innovation. Their reflections on experiences of innovations can provide new directions for design thinking and research. Higher education institutions can lend their expertise beyond evaluation research in designing and incubating field action programmes, providing much needed understanding of the systems and processes that work in meaningful ways. Foundations play a key role in identifying and developing innovations in the field and supporting their expansion for impact at scale. They must leverage their unique positioning to explore ideas that address problems that are broad in scope, are transformative in their approach and have the potential to influence policy directions.

Practice includes several exemplars of innovations in education and reflective pieces on the need for development of designs that can be iteratively tested and adapted in their respective fields of practice. Providing a rich environment where the learner has freedom to fail and learn in an iterative manner through authentic experiences and collaborations is at the core of successful designs for learning. Such design considerations inform not just curricular but also monitoring mechanisms for interventions at scale. Practitioners from the field reflect further on the principles of their practice, such as commitment to open learning, collaboration and communities of practice.

Policy is a critical lever that guides and shapes education technologies from infrastructure to curriculum. The thought pieces on policy provide critical perspectives on what has worked in ICT policy, where we stand today in terms of what ICT policy means for curricular change and what can be expected in the near future.

Partnerships in education technology interventions at scale are built on collaborations across private, government and non-government sectors to leverage mutual strengths in technical expertise, fields of practice, pedagogic knowledge and research, and. An eco-systems approach to partnerships is regarded as the preferred model to effectively address concerns and challenges typical to large scale initiatives.

The International Symposium on Connected Learning, conducted on the 8th and 9th of August 2018 in Mumbai on the themes of connected learning and scale, brought together practitioners and researchers to share their experiences and collaborate on design and development of innovations for quality learning at scale. The thought pieces in the book were based on or emerged from the deliberations during the various panel discussions and parallel sessions of the symposium.

02 THE CONNECTED LEARNING INITIATIVE (CLIX)

On the idea behind the CLIx programme, its objectives, what it set out to achieve, the principles behind the design of the programme, the challenges and the larger questions, ***Nayantara Sabavala****, who anchors the education, urban poverty and livelihoods portfolios at Tata Trusts, says:*

CLIx grew out of an idea that emanated from a discussion that our chairman Mr Ratan Tata had when he was on a visit to MIT. He came back with an intent to create an intervention that would bring the best technology available to address the needs of the Indian education context. This was a very broad intent and quite a challenging one. When he came back with this idea, the two objectives that we began working on were:

1. To bridge the digital divide between the very small section that has access to the best in the world - the best technology, the best devices, the best educational content - and the vast majority that has nothing
2. To use technology as a tool to resolve some of the very pressing and urgent challenges that we face in the education system, rather than as an intent

What we saw around us was a very loose use of the word "technology" so everything from replacing blackboards with smartboards was being labelled as technology and innovation. Just converting textbooks from paper to digital content was being labelled as technology in education. But what we really wanted to do was create a learning initiative that would engage children and deepen their understanding of concepts that they were struggling with. All the research showed that the three most challenging areas, particularly at the secondary level, were mathematics, science and english. Therefore, we chose to focus on these three domains.

We also recognised that, in order to do this, we would have to engage deeply with teachers. A year-long operational planning process actually preceded the rollout of CLIx. We went through a long struggle. There is this strong desire to really jump in quickly and execute, but we took a conscious step back and decided that we would need time to actually understand the challenges, although many of us have been working in the sector at various levels. The field reality is quite different and diverse. So, we took a conscious pause and decided to spend a year on research. We actually went about doing ground level studies and consultation with various stakeholders before we considered even getting something out there. Despite the fact that we took this year-long pause to really put efforts and time into planning, I think nothing really prepared us for what we were to face on the ground.

For those who don't know Tata Trusts so well, I'll explain that we work in some of the most challenging geographies of the country. This is to ensure that we actually reach underserved and

rural communities. Right from the outset, this has also been the drive of CLIx. However, this setting posed a number of challenges pertaining to infrastructure availability, subject teacher availability and also student readiness. CLIx implementation actually had to grapple with all these multiple odds right from the outset. The platform also had to be designed for offline implementation, keeping in mind the non-availability of Internet connectivity in these remote locations. Although you will see a lot of buzzwords like Digital India being flashed around, the reality is that in most of our schools, forget connectivity, we don't even have electricity and we certainly don't have devices. So, this is the other reality that we had to contend with. Therefore, in regions where even a land setup is not possible, the CLIx platform had to be installed on standalone computers so that we could use the modules.

The other challenge was that, because of the diversity in our country, the modules needed to be available in multiple languages to ensure that we teach the students who are our target audience. A lot of external quality resources are today available only in English, and non-English-speaking students are therefore disadvantaged for lack of resources in local language. So, this was another factor that CLIx had to contend with.

To deal with the issue of scale and sustainability, we deliberately choose to work with state resources. This was a much more difficult route to take; it would have been easier though more expensive just to provide that infrastructure. We chose to work with state infrastructure because we felt that this would be a sustainable route in the long run. CLIx has a very strong teacher professional development component. Creating a cadre of teachers and educators is another route that we chose in order to attain sustainability. This model is doable in Telangana, because Telangana also has a cadre of trained teachers and educators. In Telangana the Tata Trusts programme management unit is looking at the possibility of shortlisting schools in one of the Niti Aayog aspirational districts because here, infrastructure is available from the state.

All the resources and tools developed will be released as open education resources. This is another conscious strategy that we chose, and we have been engaging with government departments and teachers and training them in the use of open education resources. This is another route to ensure sustainability because then you ensure that there are capacities built within the state system for using quality open sources, which can then benefit a larger number of students. CLIx has also worked to determine and influence the specifications for ICT lab equipment functionality and maintenance.

What are some of the challenges that we faced? One is that students are not at the correct grade level. Since CLIx is working at the secondary level, this is something that we had to contend with, especially since time for mediation was not available. I have already touched on the reality of dysfunctional computer labs and lack of electricity. Development of content actually took longer than we had anticipated. Also, creating that fine balance between when content was ready, when teachers were trained and when infrastructure was available for rollout was a challenge.

The learning has been that we need greater state ownership right down to the last official. We need documented evidence that CLIx does deepen learning, and we need greater bind from teachers. The way in which we can address that is by giving teachers what they need rather than what we want to give them.

In the situations where education goals of quality and equity still remains very elusive even after 70 years of independence, and in many schools even the basics are not in place, why has the Tata Trusts and the collaborative intervention with MIT and TISS chosen to work on an area such as technology in education. The intervention involves actually getting teachers into classrooms, getting

them equipped to deal with multilingual and multi-grade students, addressing lack of physical infrastructure of schools and ensuring that teaching and learning is happening at a greater and appropriate level. I just like to say that the Trust is continuing to grapple with all these questions, but what CLIx has demonstrated for us is that in a small way we have shown that we can include our children in the best technological advances available globally and use that technology in a way that deepens understanding and joy of learning.

03 POSITIONS

Foundations' Role in Supporting Educational Technology Initiatives

- M. S. Vijay Kumar, Massachusetts Institute of Technology

As the role of education expands and diversifies across the globe, new and innovative educational technology solutions are being sought to address enduring problems of quality and access. Not surprisingly, foundations are becoming increasingly important to explore and to realise the impact of educational technology efforts worldwide. Their role in identifying and catalysing innovative opportunities, as well as in scaling up these programmes and creating the conditions for their sustainability, has become central to educational transformation.

Foundations have supported a range of ed-tech initiatives. Their efforts have varied in scope and been directed toward different goals, from developing technological solutions to addressing educational problems, helping institutions understand and negotiate change to informing the development of policy for large scale change. Consider these examples.

The Bill and Melinda Gates Foundation has supported educational transformation by facilitating collaboration across pK-12 initiatives. The Foundation has put together a collection of resources for K-12 educators shared freely via its website (The Bill and Melinda Gates Foundation 2018). Gates has also lent its support to Next Generation Learning Challenges not only in the form of grants, but also by using the Foundation's online presence to support NGCLC's own grant-making activities, in the form of 'challenge grants' funded in partnership with the William and Flora Hewlett Foundation (The Bill and Melinda Gates Foundation 2011). The Bill and Melinda Gates Foundation supported 'Conversations on Quality' (MIT, Gates Foundation, n.d.), a symposium hosted by MIT with the aim of exploring issues relating to quality online education for the K-12 demographic.

The US National Science Foundation supported the Learning Science and Online Learning Symposium at MIT to engage leading researchers and educational practitioners in a discussion of how findings from the learning sciences can inform the development of meaningful online learning experiences, particularly for science, technology, engineering and mathematics (STEM) disciplines, and how the implementation of these experiences can in turn contribute to and shape future research on learning in STEM.

The success of MIT's OpenCourseWare (OCW) is due in large part to the Hewlett Foundation's sustained support from the project's inception through its early, high-risk growth and development stages.

The Mellon Foundation supported the Open Knowledge Initiative (OKI) as well as Sakai, both

initiatives to address infrastructure development to support and sustain educational initiatives at scale[6].

The Qatar Foundation International (QFI) defines its mission as follows: 'QFI operates as both a grant-making organization and a convener of thought leaders on issues related to global and international education, open education and education technologies as they intersect with the three core QFI programmatic areas: Arabic language and Arab culture, STE{A}M (STEM plus the Arts), and Youth Engagement' (Qatar Foundation International 2018).

The Tata Trusts support the Connected Learning Initiative (CLIx) to provide access to quality education at scale to students in underserved areas in India. The Trusts' role can be understood not only by its financial contribution but also by the partnerships leveraged across the country. By connecting MIT designers with TISS (Tata Institute of Social Sciences) and other local partners, the Tata Trusts facilitated useful dialogue and cooperation between the two halves of the educational technology equation: the technologists (i.e. the designers and engineers) and the education professionals who would put their designs into action in culturally and linguistically diverse communities across India. The progress of CLIx can be partially ascribed to its funder's understanding not only of the challenges inherent to educational technology development but also of the specific challenges of working with a diverse population, reaching various socioeconomic, linguistic and ethnic groups on levels tailored to their individual needs. This awareness is explicit in the organisation's self-description: "[Our] programmes, achieved through direct implementation, partnerships and grant making, are marked by innovations relevant to the country" (The Tata Trusts, 2018).

The unique role of foundations. Foundations are uniquely placed in their ability to support the exploration of innovative educational technology solutions. Foundations must seek out and support ideas with transformative potential, taking risks on less proven approaches, on approaches not tried by traditional funders in industry and government. Corporations and governments tend to address important problems, but ones that are much narrower in scope. They may focus on large scale infrastructure efforts or areas of more obvious ROI-for example, where the path from research to finished product with clear outcomes is more direct. Educational technology, by contrast, is not a very clearly understood domain (and less understood when its focus is on education and not technology) where projects typically have longer term payoffs. A case in point is the success story of MIT OpenCourseWare (OCW). OCW began as a simple, if ambitious, idea to publish all MIT course content and make it freely available on the web for educational purposes. The potential impact was difficult to articulate and generally not well understood. What allowed the initiative to launch was the largesse of the Hewlett Foundation and the Mellon Foundation to support this open publication effort as a large-scale proof of concept. In retrospect, we know that this idea turned out to be a "pebble that disturbed the educational universe" (Vest, 2004). OCW took the internet as a way to equalise access, recognising that its potential to facilitate a free and open sharing of resources was integral to its revolutionary character.

What must funders do to ensure substantial and substantive change? Considering that achieving impact is a long and systemic process, foundations must be willing to engage in long-term commitments, understanding the importance of sustained support for an area that requires extended

6. The Open Knowledge Initiative (OKI) was funded through a grant from the Andrew W. Mellon foundation to implement a service oriented architecture (SOA) to achieve interoperability among applications across a varied base of underlying and changing technologies. The Sakai Project is a $6.8m community source software development project founded by The University of Michigan, Indiana University, MIT, Stanford, the uPortal Consortium, and the Open Knowledge Initiative (OKI) with the support of the Andrew W. Mellon Foundation.

incubation and growth periods. They also have a role across the process from initial experimentation (sometimes a considerable amount of early experimentation) to creating capacity for enduring impact. Thus, projects cannot be abandoned at early stages of transformation, and the beginning of a project should not be confused with its middle or its end.

Ultimately, the goal is to create new educational ecosystems that will enable sustainable educational change. The Hewlett Foundation's 'all in' approach helped to not only to make MIT course content available as originally envisioned but also to help launch the open education movement. In addition to OCW at MIT, the Foundation also supported other open course initiatives around the country and the world, helping to seed an open education ecosystem. The Foundation facilitated awareness and consideration of technology and policy issues related to this movement, a significant effort given its eventual impact on national educational policies in many areas of the world.

Foundations and sponsors have to move beyond traditional models of engagement and look for ways to co-create sustainable solutions to common problems. Funders may be well served to join forces with different organisation to complement their resources and strengths and to best leverage their investment in educational impact at scale. They might consider collaborations across private and public spheres, casting a wider net to secure relationships with non-traditional funders or to negotiate new types of relationships with traditional funders. Examples include the following.

HCL Foundation's mission statement affirms the need for interconnectedness among funders, 'HCL Foundation is a collaborative organisation that believes we can only have limited impact when acting alone. We are passionate about building partnerships with people and organizations who share our vision and are engaged in path-breaking work' (HCL Foundation, 2018). The foundation has 30 partner organisations, both funders and NGOs, including Child in Need Institute, Foundation for Ecological Security, HOPE Foundation, Lions International and the Wash Institute.

Through its membership in Fund for Shared Insight, Hewlett further exemplifies the principles of collaboration across foundations to solve systemic problems. Fund for Shared Insight is a collaborative effort launched in 2013 by Rockefeller Philanthropy Advisors with the motto 'Philanthropy. Open for Improvement' (William and Flora Hewitt Foundation 2018). Their mission statement reads, 'We believe that foundations can be more effective and make an even bigger difference if we are more open to sharing what we learn and also open to taking input from others, including grantees and especially the people we seek to help with our funding' (William and Flora Hewitt Foundation 2018).

Atlassian, through its collaboration with MIT SOLVE (William and Flora Hewitt Foundation 2018), is committed to providing long-term support and leveraging relationships with governments and NGOs, including Australia's Department of Foreign Affairs and Trade, to address both local and global issues. Their explicit focus on 'preparing 10 million disadvantaged youth for the workforce' (Atlassian Foundation, 2018) reflects a necessary focus that foundations need to have on addressing large enduring problems.

Summing it up. In order to adequately support the growth and proliferation of educational technology, foundations must pay attention to identifying enduring difficulties inherent to education and help find forward-thinking solutions to them.

- The shifting parameters of a fluid ed-tech universe reflect an industry that is developing in real time, one that presents great opportunities but also involves experiments in many fields,

requiring foundations to have an increasingly entrepreneurial orientation.
- Funders and developers alike must pay attention to cycles of innovation and the systemic nature of innovation diffusion.
- They must move beyond traditional models of engagement and look for ways to co-create sustainable solutions to common problems.

We call upon foundations, with their unique capacity to identify and address society's greatest challenges, to bring together the capabilities of institutions and individuals who can point the way toward solutions.

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ICTs in Indian School Education: Is There a Role for Higher Education Institutions to Play?

- Padma M. Sarangapani, Tata Institute of Social Sciences

'Equality, Quality and Quantity: The Elusive Triangle' was the title of a short treatise written by J P Naik, one of India's foremost education planners in the 1970s. Equality, for Naik, was the core requirement of Indian education that had to ensure that social justice is addressed in a system that was designed to exclude rather than include-on lines of caste, gender and linguistic, cultural and religious minorities. Naik proposed that quality is a systemic characteristic that involves having educational aims and a curriculum that is relevant to the context, and engages learners in active learning, ensuring that this is done efficaciously so that all students learn and achieve standards. Quantity was the problem of being able to provide for quality and equality at scale-reaching the hitherto unreached and providing access to equality and quality to all Indian students. This triangle of achieving quality, equality and quantity is the prime requirement of India's education system and of many education systems in the developing world and the global south.

Our histories of colonisation, the stratified character of our societies, and resource constrained character of planning in education, have meant that mass education is generally rote learning based, and this education rarely translates into enabling poorer sections of society to use education as a means of transforming their social condition. Scaling good pilots and small effective interventions is usually at the cost of quality. What works in 'small pilots' does not seem to scale well. The assumptions and the inputs into the former do not seem to be the right ones for the latter. This problem is worth formulating and examining as it is not simply one of not having enough resources and not getting the logistics right. Scalability-if it is not to be achieved through micro management or reductionist offerings that are contrary to our idea of quality-needs to be examined as an important developmental problem in its own right. Attending to the elusive triangle of equality, quality and quantity in education, with a view to figuring out how to make it tangible and graspable and realisable, is a worthy aim for higher education to be engaged with, especially in relation to a pervasive new medium: technology.

New inequalities can be created through the use of technology even while technology holds the promise of democratising access. Technology can enhance and deepen quality of learning experiences and also render learners and teachers passive, deskilled or controlled. Technologies can be used to give access to scale and reach, but at the same time they can also massify and render teachers and students into mass consumers without any agency. It can ease communication and enable networks and collaborations, but also overwhelm, depersonalise, isolate and become a vehicle of propaganda and fake news with ease. Even as devices improve and speed of access increases, we find ourselves trapped and even harassed by a constant spiral of having to renew, change and update, and endlessly exposing ourselves by the pressure to reveal and log information about ourselves, our activities, our friends, and our private and public lives. Already, most of us are experiencing almost all of these aspects of technology use in our everyday lives. We have all encountered and perhaps also harboured both the visions and delusions of the possibilities of ICT for education.

The ethos in the Indian public education system motivates approaching 'ICT in education' as a 'practical problem', involving deployment and field action, fixing and maintaining systems, monitoring and holding accountable. Without doubt, having worked at scale in the state system, these are very important worthy preoccupations of the state's systems and getting these to work and do what they are intended to, leave alone get them to change and do things differently is a non-trivial management task. Even before technology was added to its functioning at the scale and level at

which it is being considered today, the Indian state has struggled in its ability to adequately address school improvement and social justice in a system of universal education. Small wonder that the expertise of management consultants and engineers or the action-oriented commitment of the field practitioner seem to be more in demand than that of the educationist in a higher education institution (HEI)! Voices of HEI are currently largely absent in discussions on quality at scale. Our expertise is shaped and nurtured in an institutional ethos of academic freedom, rigour, reflection, critical examination and peer review, and oftentimes grounded ideologically in social justice concerns, with a focus on knowledge application, knowledge creation through enquiry. We are not perceived to be able to speak to the field and action, beyond evaluating impact and producing 'evidence' for policy.

Of course, we believe that impact evaluation and evidence to guide policy would benefit from adopting rigorous approaches that HEI researchers are trained for, and it is important to have deep unbiased understanding of what does not work, what works, for whom, and in what contexts, which does not compromise on the conception of the 'what' that needs to work, or the 'how' of the working. Impact evaluation should also be able to provide us with a detailed sense of field reality and readiness, enable us to theorise systems, adoption and diffusion, and contextual and regional aspects. While we often speak about geographic spread and diversity in India, we have little understanding of how this influences processes. We also have limited systematic understanding of factors that support or impede teacher adoption and change.

These considerations are exemplified in our understanding of the impact and efficacy of continuous professional development for teachers using technology. The preliminary questions are: 'What is the access and use of technology by teachers and how has that changed?' 'What are teachers learning?' 'How much of their learning is translating into their classrooms?' To find out 'what needs to be scaled in professional development, informed by our theory of teacher learning' we must also ask 'Has it been possible to scale professional connectedness and reflective, autonomous sense of purpose using new media and technology?' Our work with teachers in different contexts has been showing us that this is a slow process-that is, it does not show results quickly-and that there is considerable interstate variation in teachers' sense of professional autonomy as well as trust in state action. Similarly, the question of impact on classrooms could be further elaborated to also ask: 'Is it possible to change professional practice of teachers, drawing on their own practice as the object and the central lever of CPD efforts?' Our research is drawing our attention to the importance of making such practices visible in the professional peer group and the role of peer support, and relationship building and mentoring to support adoption into the classroom. We are currently also investigating the question of how professional communities can be built and structured so that they are meaningful to their members and have longevity.

Our experience tells us that as researchers we can contribute to designing field action through design-based research-the process of iterative design as a process of research that leads us to examine our assumptions and theorise on interaction, learning, artefacts and processes. Moving out of common sense or experience as the basis of design, to a deliberative, research-based approach can lead to better design of resources and processes for education. These resources can then incorporate core learning principles and aims of education into design, shifting the focus from the top layers of the 'learning objectives' to deeper layers of the pedagogical principles that should underlie the learning process. The DBR process also enables us to respond to contextual aspects that can inform design or to which design needs to be responsive. For example, we have through DBR worked on design of curricular resources that draw on and leverage student autonomy. Also, we learnt through the DBR process that the 'problem' of resource constrained nature of the school ICT lab of only 10 machines could be dissolved by foregrounding collaboration in learning, where two or three students work

together on one machine and a set of learning tasks. We have since designed our platform to enable a group of buddies to be logged and the group to receive formal recognition and presence on the platform. In both these ways, we have contributed new knowledge for practice. DBR would also be the research methodology of choice to investigate questions such as whether technologically enabled practices and resources can be designed and used to address inclusion and provide channels for devolution of social capital across geographic and class divides. There is also need for much greater understanding of the forms of new media and technology that support meaningful and active learning and when and how they can be most meaningfully used.

Beyond research, HEIs have another important role to play, or rather contribution to make, and this is with regards to wider social responsibility, not very different from social responsibility that corporates have begun to pay attention to. Ensuring inclusion into higher education is one of the most important social responsibilities of universities. The conception of 'connectedness' is the central conception giving quality, equality and quantity a unique thrust and character. When Foucault noted that knowledge is power, he was not merely drawing attention to the possibility of powerful knowledge and ideas that enable powerful action on the world, but also because the process of acquiring knowledge, which is a process of becoming a part of a social network (along with its social capital), itself empowers and is empowering. It is through both that knowledge acquires its transformatory properties and character. Problems of access to quality education in stratified societies are exacerbated by problems of access to social capital which mediates access to knowledge and more powerful communities or elites. This has been one of the reasons that distance education programmes that only give access to knowledge or content but do not induct learners into the knowledge community is experienced as being limited. This is one area in which ICT, with the emphasis on community and communication, offers the possibility of changing the terms of meaningful access to both knowledge and its social capital.

In CLIx, as members of higher education, we have tried to pose the problem of equality, quality and quantity as a problem of developing inclusive conceptions of knowledge and knowledge communities. Along with quality of learning and access to powerful ideas presented in meaningful and interactive ways, we have tried to develop practices that engender inclusive communities of which we are ourselves a part and to use ICT to extend these networks. Democratising access to knowledge has gained through the 'open education resources' (OER) and creative commons licensing movement. So also, access to knowledge communities needs to be democratised, and as members of HEIs in the knowledge business, knowing that it is membership and participation in these communities which in fact enables the knowledge-based practice to form and express itself, we have a responsibility to make this happen.

Teachers Speak

Previously, I didn't have any knowledge of technology. But after the CLIx programme, I learned a lot and am implementing CLIx in my school. This has been very useful to students and teachers. I am very happy to say that I have trained many science teachers in our mandal and they are also implementing CLIx programme successfully. I have observed five schools in our surrounding area and have found a lot of change in ICT learning outcomes. Students are interested to learn as they use ICT audio tool Audacity for experiments related to the Sound module in CLIx and the Run Kitty Run game of the Physics Motion module.

There is a power problem in the schools, which is why these days we are using UPS. Also, student strength is more than 200, and that is why we have divided students into groups of 5 and they take turns learning the computers.

When we complete the syllabus planned for a particular month, we conduct CLIx classes. Also, when a teacher is absent, we make use of the period to conduct these types of classes. There is no special timetable for CLIx classes.

Odelu Kumar
Physical science teacher, Zilla Parishad High School Pacchnur, Karimnagar, Telangana
Connected Learning Initiative (CLIx)

Coming from very rural areas, students have never seen computer, keyboard and mouse. Earlier, they were very afraid of even touching it, fearing that they might get a shock or the computer might get damaged and they would get scolding from the staff. But after I started the CLIx modules and they became familiar with it, they began to explore more and more on their own. I just started with the ICT module in which the basics of computer are taught. They find it interesting because, whereas they had thought that a computer is always an English-based practice, they find that in i2c, they can type and interact in their own local language. This is very interesting for the students.

In mathematics, they find Geogebra and Police Squad game fun. Students find the Geometric Reasoning module very interesting because they feel in that module they can learn according to their own ability. The more intelligent the student, he can get to level 1 to 4 according to that. If the student is lagging behind, there is no problem, he also learns to explore. In the Geogebra tool, all the shapes and pictures come alive and that is very interesting for students. Students have started to love mathematics, which otherwise was thought to be a very difficult subject. With the use of this technology they have developed an interest in maths.

Regarding challenges, actually, the number of students is large and the computer lab is small. Because of this, some students are sitting outside the class and they are not able to use the computers with their own hands. So, I made a group of 3 students, and there are 10 computers. Every student gets to use it turn by turn. And if there is any problem, then all three of them discuss that problem and work on it. Student interaction is more, and I only guide them. They solve the problems on their own. If they face any problem in using any tool like Turtle logo or Police Squad game, they consult me. All three of them try to solve this problem by discussing with each other, and they also interact with other groups and solve it.

Earlier there was a problem in implementing CLIx modules, but we have realised that if students first get the concept by using technology, then afterwards completion of syllables becomes easy. Otherwise, teachers write on the blackboard and students copy it irrespective of whether they are

getting it or not. Some students get it only by teachers writing on the blackboard, but there are some students for whom, when mathematics comes alive, they get it more easily, and then completion of syllables becomes easy. That is the plus point of this technology.

Shweta Gupta
Mathematics teacher, Government Girls' Senior Secondary School, Goner, Jaipur, Rajasthan
Connected Learning Initiative (CLIx)

To be honest, I had no basic knowledge of how to integrate ICT in my teaching before. I attended a training of ITA, that is, Integrated Approach to Technology in education. After completion of the training programme, I tried to implement my learning in the classroom. It had great influence on the students. They became interested in the new system of teaching. I joined an ICT certificate course and learned how to prepare lesson plans using ICT with 21st century skills and its impact. After this course, I was more motivated and convinced of my ICT integration. Students have engaged themselves in the preparation of projects. Other teachers of the school have also become interested in observing my classes and after orientation from me they have started to implement ICT.

We decided to implement ICT in our classes instead of regular teaching. We helped each other in this regard and a WhatsApp group was created, where we discussed classroom processes and strategies. Earlier, I used to give them homework and there was no scope to go beyond the textbooks. When I started integrating ICT, I saw that students started to use technology. They learnt to use the internet, web search, Google and other applications. They learnt to prepare lesson plans in different subjects from their textbook, and then they learnt to prepare lesson plans using different applications like PowerPoint, Excel, block, digital stories and photo stories. This influenced me to go on, and I must say that they are able to gather knowledge which is not available in the textbook.

For example, there is a lesson in class 10 taken from Nelson Mandela's autobiography. In that part, there is no mention of Nelson Mandela's parents, date of birth, date of death, etc. So now the people of our school are able to find all those things using the internet. They prepare different types of projects. There are projects on herbal medicines from science, and they have to prepare project on global warming and its effects on the people of Assam.

Jogen Rajbongshi
English teacher, Borkhopa High School, Baksa, Assam
Integrated Approach to Technology in Education (ITE)

After doing the ICT course from Tata Institute of Social Science, my students have become more vibrant and empowered. They have prepared various projects on ICT. For example, they have prepared a virtual salt analysis that is connecting the virtual world and the real world. They prepared it by taking different videos from YouTube.

In another project, students have made a model on concave mirror diagram and I just helped them. When I saw only 2 or 3 students (only first benchers) are interested in learning, I decided that my students should make a group and do research on wave and present it. They prepared a multimedia project on concave mirror diagram and presented it in front of all students. I saw to it that each and every student participated in learning. When I asked, "How will you identify the concave mirror", each and every student could answer. This is how the real world and virtual world are connected together.

And I have to talk about the module that I am using in the classroom with the help of TISS team. Once after I taught my students and was going to evaluate them, I asked them to download the module app when they go home. I told them we will do the quiz on the module. This saved my classroom time. The students, after going home, downloaded the app. Next day they told me that it is a very good app and that we must use it often. This is how we are using the module in our classrooms.

One day a group of students came to me in school and told me that they want to do something unique for the school golden jubilee. They told me that they were going to do a global warming stage show. They explained that they will do web search and download different videos and photographs of effects of global warming. We helped them to make videos. They have done a stage show in front of the entire public, showing them how global warming is affecting us. So, these are my experiences. I get some positive feedback and positive gesture from my students.

Sajid Hussain Ansari
Science teacher, Khanna High School, Kolkata
Integrated Approach to Technology in Education (ITE)

I started using technology in the late 1990s and 2000s. At that time computers were not good. Even the school where I was working had only 7 to 8 computers in the computer lab, and that was a school owned by Tata in Monar. In the computer lab, computers were always being used for lab things, computer teaching, ICT teaching, etc. Therefore, I bought my own computer and started developing my own lessons on it. I was teaching social science at that time, and I found that the lessons were very monotonous, especially after lab sessions. Hence, I was wondering about how to change this. In the beginning, I started developing some PowerPoint slides. Later, I started recording some video clips from the National Geographic channel, History channel, etc., and started taking this material to the classroom. This made the class very lively, and children started getting interested even in history and geography.

Later, I thought that just having video clip which is prepared by National Geographic is not enough. We can make it more localised if we can use some animated things. Then I learnt Flash and started developing small modules of my own for creating motions on the screen with PowerPoint. When I started using all these things, student's interest increased, not only in learning history, geography, etc, but even they wanted to know how they could develop it themselves. They started staying back after school hours and wanted me to show them how to use Flash.

Next, we wanted to localise our curriculum. Hence, we started taking children to record some of the local things and develop small projects. That also worked very well. And ultimately, we had our own curriculum.

By 2006, after seeing all this, my principal decided to go for IL and FS. At that time, Kyan was introduced to school and, at that time, it was a wonder for everyone. I started using it for social science. Then later on other teachers were also motivated to use it. For social science, we need a lot of teaching resources like globes, maps, etc. Carrying all this to class is difficult. But showing three-dimensional pictures using technology becomes very easy; collection of resources becomes very easy. Even to convince the children becomes easy.

There was a girl called Anup in 6th standard. When I showed the class a video of the marriage of a Moghul emperor Shah Jahan and Mumtaz Mahal, the girl asked, "Sir, at that time also there were very good videographers?" This shows how much they get involved into it that the child really felt

that it was recorded at that time. That was the involvement I could get from the children, and it really improved the scores of the children. The principal and others were really doubtful about whether I would be able to complete the portion. I could see drastic change in the scores of students because rather than mugging up, they started writing on their own. When the results came, many children scored 99 and 100 even in social science without much reading. That is the impact I could see by using technology.

The use of technology has drastically changed my career. I am currently working in an international school as a principal. I got this because I leveraged technology to the maximum. Even in the administrative aspects, I could achieve 100% paper-free office system by using technology.

In TATA ClassEdge, we are using technology even for formative assessment. It is very easy because there are different tools for that. Lesson planning also became very easy for us by using Tata ClassEdge. In addition, there is a question bank having about 2.7 lakhs questions, and teachers can very easily make question papers using the same. They just need to indicate the number of short questions they need, or the number of knowledge level questions they need. They can then easily mix questions and generate their own questions papers. So, the work of teacher also became very easy with the coming of technology and it is very time-saving.

If we want to use technology, we have to work hard at home. If we work hard at home and prepare well, in the classroom, we can just relax and facilitate. It is easy for us to facilitate if we go with a plan in the classroom, and that is what teachers are doing nowadays. I have used technology a lot during my career as a teacher. Hence, I am now able to guide my teachers well. In my school, we are using a lot of technology. Tata ClassEdge has brought another feature: teachers can create their own content and include that into Tata ClassEdge. Hence, teachers are creating their own things. I am able to support teachers as I am very much familiar with video editing. Hence, I can say that I could establish a tech environment without losing the human context.

Radhakrishnan C
Principal, Peevees Public School; CBSE Coordinator, Malappuram district, Kerala
Tata ClassEdge

Suggestions for Policy Makers by Teachers

Odelu Kumar. My advice to administrators and policymakers is to provide infrastructure and training to all school teachers in rural and urban areas. Moreover, they should monitor implementation of programmes regularly. School heads must ensure that every teacher gets a period in the computer lab. Next, teachers should get trained in their respective subjects, and they have to implement students' programme in their schools, and also, they have to show improvements in the children.

Shweta Gupta. Infrastructure is the main problem. For a class of 100 students, there are only 10 computers. Hence, government must look into this. Everyone who can help raise resources must contribute. Secondly, knowledge of computers or the CLIx programme is not scored (or marked). Therefore, teachers don't take it seriously. They don't consider it as a subject at all. This needs to be resolved.

Jogen Rajbongshi. Policy makers should see to it that infrastructure supports both curriculum and pedagogy. They must also assess the use of existing infrastructure; without adequate support existing infrastructure is going waste.

Sajid Hussain. ICT has to be included in our syllabus so that every teacher and student uses it. For this, some additional infrastructure, like ICT lab, will be required. Also, there must be strict monitoring of implementation.

T. Radhakrishnan. Government and also NGOs should take the initiative to train teachers in learning dashboard. This will help all teachers to understand where the child is weak, not only in academics, but even in terms of behaviour where they need improvement.

For collaboration and online networking, government can think of providing free internet connections to teachers on their mobile.

The [education] department still insists on lesson planning in the traditional way, whereas using ICT, we can come up with different ways of preparing lesson plans. Department must insist on technology integrated teaching practice. This kind of change must also seep into BEd curriculum, where we must insist on student teachers using technology integrated lessons. BEd curriculum has to be revised to incorporate teaching using technology.

Government needs to relook at the infrastructure provided. Systems that were provided 5 years ago have now become outdated. There should be collaboration between government and the private sector. As an international school, when we approach government school headmasters or assistant education officers and ask them to send their children to our school for learning ICT, they say 'no'. I can't understand why. Government must take initiative for collaboration between private and government sector because private sector could also contribute a lot in modernising government schools. There are good teachers in private sector who can train government school teachers in ICT.

Interaction Between Audience and Teachers - Q&A

Question (to T. Radhakrishnan): You mentioned that your school was ready to provide facilities to children from government schools, but government officers were not interested in that. What reasons did they give for that, as government is generally ready to take help?

T. Radhakrishnan: In Kerala, there is not a friendly relationship between government and other board schools like CBSE, ICSE, IB. It sees private schools as a threat to children seeking admission in government schools. We also feel that if government wants to encourage public schools, they will have to improve the quality of service. As most of the time, parents' expectations are not met by government schools, private schools are mushrooming. It is another matter that all private schools are also not serving the purpose of parents.

Question: Are your peers, other teachers, enthusiastic about technology? Do you work with them in the school? What can you say about your peers?

Sajid Hussain: In my school there are 18 teachers. I am the only one using ICT. My peers make fun of me and ask why I am working so hard and how I will benefit from that. I tell them that this is my work and I do this because it benefits my students. I use technology to clarify doubts of students. My peers do not take it seriously. I have suggested to my colleagues to do ICT course so that they will understand how technology will be useful.

Shweta Guptaect. But when a teacher reaches the age of retirement, he/she is not keen to learn new things. Using computers for the first time at this age is difficult.

Jogen Rajbongshi : In my school there are 2 sections in class IX. I teach one section, and another teacher teaches the other. When I implement ICT in my class, my students discuss it with students from the other class. Then students in the other class ask their teacher to use ICT. That is when he comes to me, and I help him.

Question: You have talked a lot about your children's learning and how that is being impacted by your ICT integration. I was wondering about your own experiences with your engagement, maybe your own learning or improvement that you have gained. Has there been any impact on your own teaching and your own content knowledge?

Speaker: Because of syllabus change, we have to update our knowledge all the time. This is where ICT in education training is useful.

Shweta: The Geogebra tool has been very useful for my own professional development. Many theorems can be proved easily and in such a way that I had never thought about before. I found this tool very interesting, and there is so much to explore.

Jogen: Before coming into contact with IT or ICT, I didn't have a smartphone. Now I have one, and I can check my email and share on WhatsApp. I can use internet and teach my students also. If every teacher learns ICT or learns to use smartphones, it will do them good.

04 PRACTICE

Making Educational Technology CLIx

- Eric Klopfer, Massachusetts Institute of Technology

I am often asked by organizations in other states and nations about how they can adopt CLIx in their own location. While the CLIx platform, modules, and professional development are unique and valuable, the real value of CLIx is how contextually relevant it is. CLIx is designed for the Indian states in which it is used. Each aspect of the project takes into consideration the affordances, constraints and cultural context of each of the states for which they were designed.

So, what does implementing CLIx in a new location look like? CLIx is a *process* more than a *product*. That is, it is a verb more than a noun. Implementing CLIx is about replicating this process which considers the context, goals, constraints and affordances of the particular location. As a pivotal piece of CLIx, the design of the educational technology components demanded a thoughtful process grounded in both research and practice.

The first part of the process is determining what role technology can serve. In practice, there are many uses of educational technology that are simply replicating existing pedagogies - doing old things in new ways. Using educational technology effectively involves thinking about the way that technology can enable new kinds of interactions and experiences - to do new things in new ways. In fact, in CLIx we see technology as the way to inject new pedagogy into the schools. This process has been referred to as 'the Trojan Mouse' (Klopfer 2008); it is a way to slip new pedagogy into practice 'inside' the computer mouse.

Another consideration is that technology is not just bits and chips. Technology is part of a human social system, and design of the technology must reflect understanding of that complex system. Design must consider who will be creating, using and even evaluating the technology. How the technology will be perceived by the community, administrators and politicians must also be incorporated in the design. Thus, expertise must be drawn from each of these areas and interactions with the requisite groups must be ongoing.

The process for designing this technology draws upon the rich tradition of design-based research (Reeves, 2006). Design-based research (DBR) starts with **analysis of practical problems.** It is grounded in the real challenges faced by teachers and students. That means we must truly understand where and why students struggle, as well as where their teachers may face challenges. It also incorporates the constraints of the systems. The next step is the **development of potential solutions**. This involves rapid prototyping. It is about creating designs quickly using low cost and low effort methods. This may be literal paper prototypes or cheap digital prototypes. Regardless, they draw upon what we know about affordances of the technology - how they may be applied

effectively. Next is **iteratively testing and redesigning in practice**. We put the prototypes into practice either in front of individual students for observation or in classrooms to understand where they are working or not working. That process helps to refine the prototypes. Finally, after many rounds of those iterations, there is **reflection to distil design principles**. DBR produces both a product and the design principles that help us understand why the refined designs succeeded or failed. Ultimately, it is these principles that will endure. They can be adapted to new situations.

Within this process of DBR, we also rely on a process within the development of potential solutions. Often, digital activities have a superficial connection to the intended learning outcomes, but that connection can be greatly strengthened through an explicit process. Evidence centred design (ECD) (Mislevy, Almond and Lucas, 2003) has been a widely applied methodology for making these connections. Balanced design (XCD) (Groff et al., 2015) is a simplified version of ECD made accessible to designers. There are three components of XCD - the **content model**, the **evidence model**, and the **task model**. The content model is the most obvious, it is the skills or knowledge that the activity is targeting. The evidence model is a description of how you will know the student has mastered the content, what you might see them doing that would show their understanding. The task model is the tool or activity that the student will do to generate that evidence. The key is that the task must be able to show the necessary evidence of competency.

So what design principles have we distilled from CLIx? The seven Cs of CLIx design can be described as follows.

Constructivist, or Constructionist, Learning. The primary pedagogical shift that we wanted to create in CLIx was a move from instructivist, teacher-centred pedagogies commonly in practice to a much more student-centred constructivist or constructionist pedagogy. Students would build their own understanding through activities (the hallmark of constructivism) on and off computers, rather than being told what they should know. In many cases, they would build shareable artefacts, from digital art to computer programmes, that are the cornerstone of constructionism.

***Connection*.** As it is the Connected Learning Initiative, it is not surprising that connection is an important principle. Connection means many things within CLIx. It is about connecting learners to the technology and to each other. Learning is a social process, and CLIx embodies that social process in the technology through teacher-student and student-student interactions. It is also about connecting teachers to new pedagogies and to the activities of their students.

Context. Designing for the present context is critical. The metaphors, language and experiences embodied within the technology need to be designed and connected to the current context. The references and stories that resonate in one context may be entirely unfamiliar in another context. Content cannot simply be reused in a new context without adaptation.

***Constraints*.** In the context of design, constraints can make the process easier. Knowing what you cannot do helps to focus on what can be done. The technology constraints need to be seriously evaluated, tested and considered in design. This includes what the available technology can provide in terms of computation, screen size and connectivity, as well as numbers of devices, access to devices and maintenance of those devices. But those constraints also include things like classroom management, curricular flexibility and teacher capacity.

***Capacity*.** The design must consider the current capacity. That includes the current capabilities of teachers, designers, developers, and trainers. What are the skills, capabilities and time that these people have, and how can that be used most effectively? But it is also about building capacity.

How can the process of technology development and implementation increase the capacity of these groups? Through collaborative work, training, feedback and mentorship the skills and capabilities of all involved can be increased.

***Collaboration*.** Many participants are required in the design process. Contributions must be made by technologists, teachers, students, researchers, content experts and many others. This process can happen most effectively when this is truly collaborative and not just a division of labour. Technologists and content experts must work together and iterate on their designs to create effective interventions. Teachers and researchers must be able to speak the same language and communicate their needs to have workable solutions with measurable impact.

Continuous. Design-based research is not a linear process with a distinct start and finish. It must be continuous. Designs are never finished, rather they are merely ready to be tested again. The entire process needs to be in motion all the time. Learnings from small scale trials can be fed back into designs, which are then scaled to larger trials. But even when implementation is at scale, there should be opportunities to bring the outcomes as feedback into the design. Another aspect of the continuous nature of the process is the acknowledgment that change does not happen overnight. Change in classroom practice, student outcomes, and systemic change take time. Teachers may not implement everything with high fidelity in a first iteration. They must be given time and space to adopt and adapt, and the design should accept or even embrace this pace of change.

Many of the technologies that were designed as part of CLIx were educational games or embodied some of the critical components of games as part of their design. This is not just because games are entertaining and popular with young people. Rather, it is because games have the structures that make them productive learning spaces - elements like providing feedback, presenting meaningful choices, and giving input for the goals that they pursue (Klopfer 2015). Games must provide this structure to give the player/learner a sense of agency while still providing them with the feedback and direction necessary to advance. But they also must be playful. Osterweil (Klopfer, Osterweil and Salen 2009) has described four freedoms of play that are embodied in such design - the freedom to experiment, the freedom to fail, the freedom of effort and the freedom to try on identities. One must incorporate these freedoms well as the structures to have meaningful and engaging learning experiences.

There is one last C that is necessary in designing educational technologies, particularly when thinking about the scale of CLIx: **Community**. Community is perhaps the most important factor. You need to create a community of the design team in order to create a coherent experience. You need to create a community of practitioners in the field to learn from each other and engage in classroom practice. And there needs to be a community of learners in the classroom to foster the constructionist learning that CLIx is designed around. Ultimately the community is the bedrock of the technology design. It must be there to create, sustain and scale meaningful learning.

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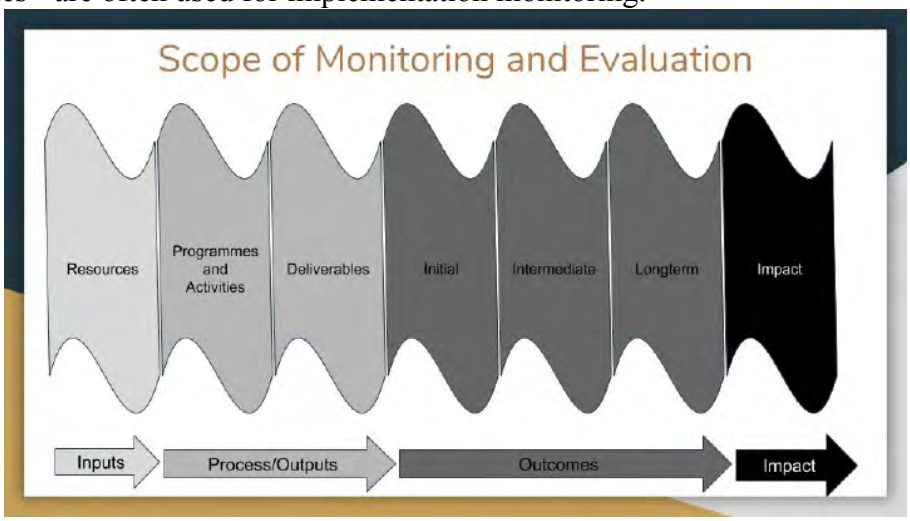
Implementation Monitoring at Scale: The Good, the Bad and the Difficult

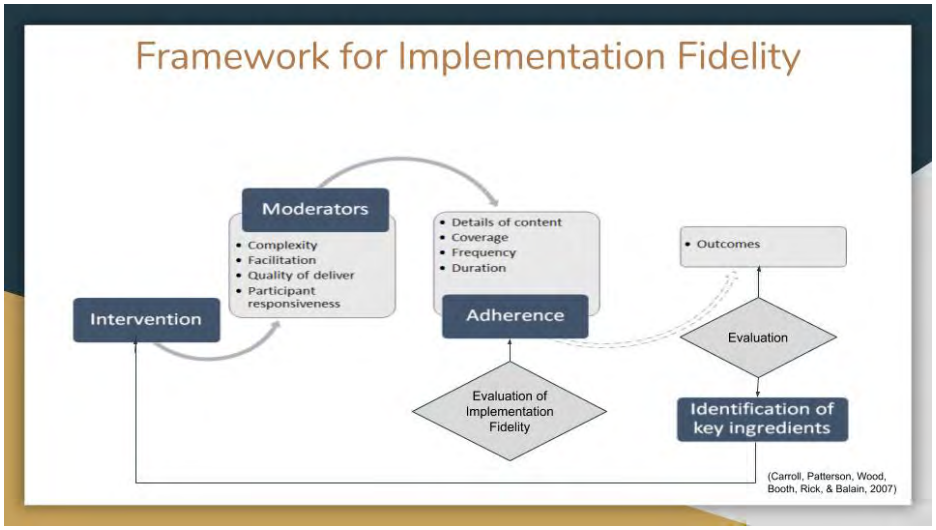
- Archana Mehendale, Tata Institute of Social Sciences and Glenda Stump, Massachusetts Institute of Technology

Monitoring requires study of the process of implementation and tracking achievement of process goals throughout the course of an intervention. It strives to find out if the intervention was executed as planned and to what extent the participants engaged with the intervention. To accomplish this, interventions must first have monitoring indicators in place so that one can track how the implementation is progressing.

The representation of a logical framework (a.k.a. logic model) shown below illustrates the lifecycle of a project and delineates the scope as well as temporal placement of monitoring and evaluation. Monitoring involves tracking the process and outputs of an intervention. This information can also be utilised to improve the intervention as it progresses. On the other hand, evaluation generally focuses on the outcome goals and measures the extent to which the outcome goals have been achieved.
This representation also shows the type of indicators that are associated with each stage of monitoring and evaluation. The indicators associated with process and outputs - programmes, activities and deliverables - are often used for implementation monitoring.



Fidelity to design of the intervention is key to monitoring implementation of an intervention as well as determining its outcomes and overall impact. The facilitators then presented a framework (shown



below) for thinking about implementation fidelity (Patterson, Wood, Booth, Rick and Balain, 2007). This framework points out four moderators of fidelity, which are aspects of an intervention that affect adherence to the original design. These moderators are: 1) Complexity of the intervention: More complex interventions have potential for greater variation in delivery, thus creating a possibility that one or more components may not be delivered as planned. 2) Facilitation includes strategies to optimise fidelity, such as provision of manuals, training and feedback to those who are administering the intervention. 3) Quality of delivery measures whether or not the intervention was delivered in a manner that would lead to the expected outcomes. 4) Participant responsiveness is acceptance and engagement in the intervention by the intended recipients.

The moderators described above are hypothesised to have an effect upon the more direct measures of fidelity, which are considered to be 1) details of the content, 2) coverage, 3) frequency and 4) duration. These measures essentially refer to whether the important content is included, and the 'dosage,' or how much is covered, how often, and for how much time.

The framework organises various pieces of data that can be used to model the extent of implementation fidelity as well as the factors that affect it. As mentioned earlier, these can be analysed frequently during implementation of an intervention so that course corrections can be made to improve project outcomes.

Also noted in the above framework is identification of key ingredients. As intervention outcomes are evaluated at the conclusion of a project, it also becomes important to differentiate which components of the intervention were essential to produce the outcomes that are noted. For example, if no facilitation strategies were used (no training for those who implemented the intervention) and the expected outcomes were still achieved, this moderator would not be considered as a 'key ingredient' to the intervention's success. On the other hand, if analysis of the outcomes revealed that participants who experienced a decreased exposure to the intervention (a lower 'dosage') had poorer outcomes, dosage would be identified as a key ingredient that must be emphasised for future iterations of the intervention.
During the symposium, the authors conducted a session about this topic. The participants were then divided into four groups. Each group was provided with a case study from a developing country context. The participants were asked to distinguish between the following:

Good - The positive opportunities that monitoring provided

Bad - The challenges in designing the monitoring framework

Difficult - The issues that emerged when the monitoring framework was put into practice

The groups reviewed their case studies and presented their analyses in response to the three parameters above. This exercise helped participants to think about different tasks related to each phase of monitoring and developing the prerequisite monitoring indicators, considering available resources, feasibility of gathering data, and using data for course correction. After the teams took turns in presenting their cases and responses, the facilitators clarified and explained some of the points brought in the discussions by the participants.

Drawing upon the experience of CLIx, the facilitators then talked about the 'good', 'bad' and 'difficult' aspects of monitoring large scale programmes.

The 'good' refers to the multiple purposes for this type of monitoring. As described, implementation monitoring can determine fidelity, or whether the implementation of a programme is as designed. However, it also serves other important functions. It is a form of action research, showing direction for improvement of an intervention while it is happening. It provides a better understanding of how and why an intervention works, thus contributing to evidence-based practice. Lastly, it provides evidence of accountability and data for reporting to stakeholders and recipients. Implementation monitoring data also provides valuable information to the implementers themselves, who may be experiencing the 'halo effect,' associating one or two experiences with the overall success or failure of the intervention when, in reality, the data shows otherwise.

The facilitators then introduced technology as a valuable aid for intervention monitoring. Technology can be used for data collection, organization, analysis, and tracking or trending results. The Intervention Monitoring Tool (IMT) developed and used in the CLIx project was described as an exemplar of technology use. The IMT is hosted on the Open Data Kit app and is designed to be completed every time a visit to a school has been made. The tool consists of 41 questions divided into 6 general categories - Lab Functionality, Module Implementation, Teacher Professional Development, Student Observations, Teacher Observations and Concerns, Comments, Opinions. Responses to questions are scored and used to categorise the overall level of adoption of CLIx at a particular school, district or state. Apart from the fact that the tool is developed on open source software, the advantage of the tool is that it can be filled offline and be uploaded onto a server whenever the internet is available.

The 'bad' refers to problems related to designing the monitoring framework. Among issues that pose problems for monitoring design are lack of clarity about outcome goals, unit of analysis, frequency of data collection and depth of understanding expected of the monitoring tool. Collection of large amounts of data can not only lead to wastage of time but also make it overwhelming at the time of analysis to draw any meaningful insights that would improve the intervention. There should be clarity on what constitutes an adequate sample that would reflect a representative picture of the implementation. The use of technology can also pose initial challenges.
The 'difficult' refers to problems that arise when implementation monitoring is rolled out. There could be conflicting priorities and interests among those involved in the intervention itself. When resources are thin, there could be a conflict between what should get more attention and resources, 'doing the implementation' or 'monitoring the implementation'. The process of monitoring the monitoring process is crucial but often the difficult part.

'Difficult' also refers to determining on course corrections at scale. This is tricky, as freezing on a data set that will serve as the representation for the large data set is difficult. It gives rise to questions such as, 'How much data will be enough?' or 'What kind of data is enough?'

The session ended with an opportunity extended to the participants to visit the CLIx Implementation Monitoring stall in the poster exhibition and discuss any questions or observations with the facilitators and the teams at the stall.

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Open Learning

Spoken Tutorials

- Kanan Moudagalaya, Indian Institute of Technology, Mumbai

The key idea behind IT training through spoken tutorials is to improve the employment potential of youth and prepare them for employment in IT industry by giving them the opportunity to practice IT related material on their own. Thus, this focus on self-learning also addresses the problem of shortage of teachers in IT. This is a very user-friendly tutorial. The length of the tutorial is not more than 10 minutes. It is designed in such a manner that students can adjust the size of the screen to enable them to watch the tutorial video and practice side by side. The script has been translated in many Indian languages and also dubbed in some foreign languages. It is also easy to download and use in adverse conditions where there is no internet connectivity or electricity. All this ensures good reach of the tutorials.

Vision Guiding Design of CLIx Platform

- Sadaqat Mulla, Tata Institute of Social Sciences and Nagarjuna G, Homi Bhabha Centre For Science Education

Technology by itself cannot solve educational problems; it needs to be thoughtfully designed and built in such way to achieve educational objectives. From the beginning of CLIx, it was envisioned that we need technologies that can foster connected, collaborative and constructionist learning. In the education milieu, culture is more important than content. So, we need to create technologies that foster a culture of creation and working with computers than simply consuming video lectures. Therefore, we wanted to provide technology solutions that students and teachers can use to learn together, interact with each other and create artefacts on a safe virtual space in a networked environment. Also, we strongly felt the need to create free, open-source, and flexible technology stacks that can work even in resource constrained contexts so that the best of learning opportunities are available to some of the most underserved communities. Many innovations emerged in this processes of collaboratively developing education technology solutions. There was also enormous knowledge sharing and capacity building between different partnering institutions. The experiences of designing, developing and deploying learning technologies strengthens our belief that a thoughtfully designed, distributed and decentralised network of open education resources can go a long way in expanding learning opportunities.

Open Education Resources

- Indu Kumar, National Council of Educational Research and Training

Dr Indu Kumar presented the core principles and ideas of the National Repository Open Educational Resources (NROER) as a national platform or repository for teachers and educators to be able to access quality OER for use and enable teachers to discuss OER by sharing experiences of its use in classrooms. In the Indian education context, we need OER in multiple Indian languages. The NROER provides this platform and process for multi-language translation of content. The repository includes a variety of resources including basic games, simulations and assessment modules apart from text and video-based resources. Practitioners are encouraged to create OER and contribute to the repository to enrich it with a diverse set of pedagogical ideas from the ground. The NROER has developed rigorous evaluation standards to ensure high-quality of the OERs submitted by practitioners. Increased participation at all levels - usage, curation and creation - will provide the teaching community diverse and rich pedagogical ideas as well as content in Indian languages to enhance their practice.

Student as Learner

Adaptive Learning

- Pranav Kothari, Educational Initiatives

Adaptive learning determines what a child's current level of attainment is and what he/she should learn next. IT becomes the teacher's assistant in effective lesson planning and instruction. The data provided can be used by teachers to identify common misconceptions and gaps in knowledge of the class, the pace of the class in learning a certain concept, and the weak as well as the bright students. With time, teachers are able to plan their lessons so that misconceptions are cleared before they become a gap in knowledge and understanding. Adaptive learning in programmes like Mindspark becomes complementary to the teacher and in fact an unobtrusive professional development tool for the teacher himself/herself.

Social Motivation with ICT

- Roberto Araya Schulz, CIAE Institute, University of Chile

The key principle behind Conecta Ideas is students' motivation, and the programme uses 'competition' to keep them motivated. Competition within a classroom is common, but Conecta Ideas has taken the competition to the next level by hosting interschool testing tournaments. It has devised tests for students and developed software through which data of students' performance could be shared across different schools during the test. After every 5 minutes, the scores of all the classes participating from different schools are shown on the board. This keeps children motivated even during the test. Students who are doing well on activities are selected as teaching assistants. Students can even create the questions. The software keeps track of questions and answers given by the students. The software has succeeded in keeping the children motivated for months.

Traditional Indian Board Games: Social Platform for Collaborative Learning

- Sreeranjini, Kavade, Bangalore

Traditional Indian board games offer opportunities to use games to see connections across cultures. Different groups within geographies might play the same game with local innovations. Trade routes historically helped carry games from place to place, with modifications emerging for play globally. For example, Ludo, a race type board game, exists in many forms across many cultures. Many a times, social experiences stemming from game play were designed to touch upon values and religious sensibilities of earlier times. Games helped players from diverse backgrounds to work together with improved communication skills. Thus, though ancient board games were slow-paced compared to many of the more current styles of digital game play, they provided a platform that was collaborative in nature. Games to mark occasions, the change of seasons, festivals or relationship building rituals were inherently collaborative and nurturing social experiences.

Teachers' professional development

Teacher Communities of Practice

- Mona Thakur, Million Sparks

The online teacher community is designed like a social media website based on a 90-9-1 assumption for community participation: 90% of the participants are lurkers; 9% are intermittent participants; 1% are heavy contributors. Resources are organised by language, subject and grade. Teachers select resources to save to their resource pool. Training courses are organised like resources and are bite-sized. Each training is divided into many modules, and teachers can leave a comment or share resources. Teachers respond to posts initiated by faculty. Google forms (embedded) are used for quizzes and assessments. The teacher's wall on the 'community of practice' enables organisation of their resource pool and tracking of their training.

Push and Pull Strategy

- Sarita Sharma, The Teacher App

In order to achieve acquisition and consumption, TheTeacherApp developed two distribution strategies: push and pull. **Push strategy** is about integrating TheTeacherApp within the existing training infrastructure provided by the state, through establishing state partnerships. **Pull strategy** is about applying established principles of consumer sciences to build teacher behaviour conducive to learning by using the digital platform provided by TheTeacherApp.

As part of the push strategy, TheTeacherApp runs the 'Digital Teacher Support Program'. In this, it provides free high-quality digital content on hard spots for in-service teachers, integrate their content within DIET's in-service training curriculum and take the support of cluster resource coordinators and block resource coordinators (CRC/ BRC). This programme works with SSA and SCERT with the objective of gaining 30% active users over 4 years. The objective is to drive acquisition and usage using existing state communication channels.

As part of the pull strategy, the app runs campaigns for teachers such as 'Humans of Indian Schools' (a blog series that recognises teachers' contribution to students' learning, their socioemotional well-being and their communities) and 'Resource Contest' (a contest for teachers to share their classroom innovations). The objective is to understand how recognition and community sharing opportunities impact teachers' learning behaviour on the platform. Additionally, they have also tested the impact of in-app and push notifications on user behaviour and it has been very positive.

Online Teacher Communities of Practice: What Does It Take to Sustain Them

- Bindu Thirumalai, Tata Institute of Social Sciences

The communities of practice are envisaged as epistemic communities, and the goal is to enable teachers to generate knowledge of their practice collaboratively. To facilitate knowledge generation, and to trigger discussion within the teacher community, faculty members design and upload posts on a regular basis. This has helped to sustain continuous teacher participation and engagement in the CoPs. In the Telangana mathematics teacher CoP groups for 2018, where faculty consistently uploaded posts every Friday, quantitative analysis shows that there is a 27% increase in posts on Fridays compared to other weekdays. The discussion of mathematics content such as solving problems and puzzles generated much more activity than the posts related to mathematics teaching and learning. It has been noted that engagement is greater in the communities as the membership numbers increase, a significant feature to enable scaling.

05 POLICY

Policy on ICT in Education

- Archana Mehendale, Tata Institute of Social Sciences

A conducive policy environment is a critical lever, a key enabler for meaningful integration of technology in education and for achieving connected learning at scale.

The context within which policies are currently being made could be seen as chaotic and with agendas and approaches in a state of flux. Rapid technological advances offer newer options to improve the quality of learning experiences and eEducators are trying to push, stretch and test what technological possibilities can potentially do for education transformation. There is plenty of experimentation happening in ed-tech space with innovative platforms, content, approaches and analytics. Edu-tech is becoming an attractive entrepreneurial option, witnessing the entry of corporations, large and small, in the field of education and the government curating and creating resources and encouraging teachers to use technology in classrooms. Despite these developments, we continue to witness persistent triangle of challenges, viz., access, equity and quality in school education.

These challenges have brought in a sense of desperation as well as openness on part of the government to try to accommodate different actors, try out different products, and use different approaches for bringing in the teachers. These initiatives are aimed at achieving better learning outcomes and for skilling young students with 21st century skills so as to reap India's demographic dividend in the rapidly changing global economy.

In this context, what are some of the key issues that need to be examined with regards to policy on ICT in education as well as its implementation.

First, there is a need to articulate clearly the vision for use of ICT in education. How do we imagine the use of ICT in education, and what are the pedagogical assumptions and principles that lay the foundation for ICT policy in education? It is important to examine the extent to which these assumptions and principles align with the national curricular norms and international evidence and standards. While clarifying such a vision of ICT use in education, it is also important to explain the role of teachers, their professional development, their access to technological tools and their autonomy in using technology organically within their pedagogic practice.

The second question that needs to be examined is: what should be the role of a policy framework on this matter? Should the policy remain restricted to 'provision', as what is currently evident as part of ICT in schools scheme which is subsumed under the Rashtriya Madhyamic Shiksha Abhiyan

(RMSA) Or should the policy also serve a 'regulatory' function by laying down certain non-negotiable standards on quality, openness, innovation and what would help serve public interest? Another important role that the policy can play is stipulating the resources required to guarantee effective and optimal use of technology, including access to internet connectivity and regular maintenance and upgrading of technology. Such a framework should also consider proposing pooling of funds, efficient distribution, involvement and empowerment of the schools and local administration, minimising the role of third-party vendors and a long-term plan for sustainable ICT integration in schools.

The ongoing processes for the formulation of a new National Policy on Education need to be seen in the light of a progressive National Policy on ICT in School Education that has existed since 2012 and the need to renew the vision and strategy for using technology to improve teaching-learning processes. It would also be important to clarify the goals that the policy is intended to serve. Is use of technology seen through a singular lens as a means of improving learning outcomes and celebrating exclusivity and meritocracy wherein the brightest and the best of the lot are awarded with an opportunity to access these limited technology resources? Or does the goal envision use of technology in resource-starved schools not as an end itself, but for the final purpose of ensuring social justice and equity by bridging the digital divide. The choice of the policy goal will determine the strategies we decide to adopt in the years to come.

Policy and Practice in Technology-Based Education

- Gurumurthy K, Director, IT for Change

The role of education policy is to guide and regulate the functioning of schools and the school system. Education policy covers aspects such as curriculum and syllabi design, teacher education, school infrastructure, financing and school management. Policy making is a complex process, and education policy making in particular is political and contentious. Governments try to control curricular policy to promote their ideologies, especially in subjects like history or science. Education investment requirements are high and policies relating to education funding can be difficult to design and implement. Policy processes in general are slow, and education policy making is more so.

Digital technologies (more commonly known as information and communication technologies, or ICT), on the other hand, are characterised by rapid change. ICT are general purpose technologies which affect almost all sectors of society and economy. Their far-reaching impact and power create a pre-disposition to valorise ICT as positively impacting social structures and processes. This is also seen in the ICT and education discourse. In the case of any new general purpose technologies, in the initial phase (before the technologies mature), the role and influence of the technology producers or experts tends to be high, as the relative ignorance of others regarding the technologies tends to be higher.

Thus, policy and programme design relating to ICT has tended to be disproportionately influenced by technology experts and vendors. This was seen, for instance, when MHRD[1] decided to develop a national policy on ICT in school education in 2008[2]. The committee formed for this purpose had representatives from large hardware, software and training vendors in the country and almost no educationists. After protests from educationists across the country, the policy making was anchored in the National Council of Educational Research and Training (NCERT), the apex body responsible for curriculum in India.

Distortions in policy and programme design. Practice (the actual use of ICT in education) tends to outpace policy, and ICT developments have been led globally by the private sector. ICT implementation in Indian school education, therefore, has been largely driven by the products and services of ICT vendors. ICT Hardware, software and content vendors, for whom the public education system represents a very large market as well as opportunities for standards setting, present their products as providing 'the solution' to pressing educational issues. Proprietary products create a vendor lock-in as the copyright and source code of the product is owned by the vendor and not accessible by users. Lock-in creates possibilities for perennial rent-seeking for vendors.

Ten to fifteen years ago, Microsoft entered into MOUs with many state governments in India, to run 'Microsoft Academies', where its faculty trained thousands of government school teachers on its proprietary operating system and office suite. While the investment of Microsoft was negligible in terms of establishing the ICT lab and providing faculty, the benefit in terms of creating a monopoly market for its products was huge. The MOU explicitly provided Microsoft a veto on the curriculum of training in these centres, ensuring that competing free and open source alternatives could not be introduced.

Today, with the National ICT Policy on School Education expressly preferring free and open source software, Microsoft is no longer focusing on pushing its dominance in school education through its proprietary desktop applications.

The danger now is from the 'cloud'. For instance, the 'Google for Education suite' along with Google Chromebooks have become popular in schools in the USA. Chromebook runs a proprietary operating system from Google (Chrome OS), for which the technical specifications and source code are not openly available. Apart from the old danger of vendor lock-in, the sucking away of personal data by the vendor presents a new, graver danger. In the Google for Education implementations, the Chromebooks mainly act as conduits to quickly access the internet. Google's proprietary software applications like Gmail, Google Photos, YouTube, Google Docs, Google Drive collect data of the students and teachers. A report from Electronic Frontier Foundation (EFF) has highlighted serious dangers from allowing Google to collect this information without the parents and students having a choice, or even being aware of what is being collected and used for what purpose[3]. This has dangerous portents for the life-long manipulation of young, vulnerable minds, by those who possess the data.

'Education is broken' narrative. Globally, technology vendors are also part of a narrative that the "education system is broken and needs to be fixed", obviously, fixed using the ICT products and services provided by them (Hendrick, n.d.). This discourse on 'fixing the broken system' is glib and ahistorical in assessing and understanding the complexities of public education, the progress made over the last several decades and contemporary sociopolitical challenges. This narrative misleads education policy-makers and diverts their energies and resources into quick fixes.

Situating ICT firmly within education. If we view ICT as a societal resource (as we would view any technology), then we cannot have any 'ICT in education aims', since ICT is a means and not an end in itself. The aims have to be educational aims, and the role of ICT would lie in supporting the achievement of educational aims, nothing more, nothing less. (One good way to assess the possible value of any ICT programme would be to check if its stated objectives concern educational aims or are related to real or imagined technological benefits; words like 'faster, quicker, easier' suggest the latter).

In the Indian context, the National Policies on Education, the National Curricular frameworks and policy declarations that are part of various plan documents provide educational aims. These include teacher empowerment and school autonomy, decentralization of the system of education, authentic and deep learning, holistic development of the learner and connecting learning with life. Any ICT programme should be concerned with these aims.

School autonomy and teacher agency. The actual design and implementation of curricular policy should be done by the school and the teachers, this has to apply to ICT programmes as well. Keeping with the spirit of decentralization, it is important for education policy to facilitate each school to design ICT integration based on its own needs and contexts, instead of imposing a one-size-fits-all scheme across all schools, which has mostly been the case.

Schools should procure ICT infrastructure (basically hardware) based on their contexts, needs and priorities, while the use of Free and Open Source Software (FOSS) and content will obviate the need for procuring any licences of software and content. Instead of stipulating a specific content, or a set of software applications to schools, it would be better for the public system to build capacities of teachers to use a wide variety of FOSS tools and OER repositories[4], and let them take local decisions. While proprietary technologies (software or content) do not allow teachers to adapt the resources or share them freely, free and open ICT are owned by the teacher and the school system, so they can freely use it, adapt it to their requirements and share with peers. Free and open ICT thus allows the school to make decisions on integration of ICT in its content and pedagogy, allowing for teacher agency. This agency is also essential for school and teacher ownership over the programme.

To ensure this, the teacher has to be brought to the centre of policy design and implementation. The teacher should not be seen as a mere user or consumer of ICT products and services developed elsewhere, but an active agent in their design and implementation. This requires significant capacity building, not only to appropriate ICT, but also to develop a critical understanding of ICT (as a part of digital literacy), to be able to look through hype, superficial functionalities and glossy promises and assess the educational value of a programme design. Teacher education institutions, usually ignored, have an important role to play in building capabilities of teachers for exploration and contextualisation. This will be time- and energy-consuming, but there are no short-cuts for meaningful ICT integration in education.

The NCERT ICT Policy, 2012, and the NCERT ICT Curriculum, 2013, have attempted to formulate ICT learning and ICT-based learning in terms of educational processes. The curriculum has thematic components such as *'creating and learning'* and *'connecting and learning'* which focus on the teacher and the learner and pedagogical processes, rather than on specific software or content. In fact, the entire curriculum document avoids reference to specific software products, usually the bane of curriculum and syllabi documents relating to ICT.

Principles for practice. ICT can convey information in a quick, simple and efficient manner. Hence, for some bureaucrats, it appears to be an excellent method of conveying content created by experts in the state headquarters to teachers across the state and asking teachers to use the same. The *'ICT as a pipe',* approach to transmit content is an extension of the notion of teacher as a 'minor technician'. In this view, the teacher is seen as incapable or unwilling to create curricular resources and hence instructed to transact content created by experts.

The NCF 2005 emphasises that curricular resources should be contextual, which means they are best created or adapted locally. No content created by experts can be relevant across diverse contexts. *'ICT as a pipe'* approach discourages local content creation and adaptation. On the other hand, ICT is itself a powerful method of creating and adapting resources. There are many ICT tools which can be used by teachers to create resources based on their local needs and possibilities.

A second problem is the equating of learning with the consumption of content. It is believed that merely making content available to learners is adequate, learners can read or consume it and will learn. However, cognition theory suggests that learning is not simply the consumption of content; the learner needs to 'construct' knowledge by assimilating and accommodating her experiences by actively interacting with content, teachers and peers.

ICT and society, the role for education. Lastly, the discourse relating to ICT and education has to urgently begin discussing larger, macro issues of the digital society, issues that go beyond classroom pedagogies or subject teaching. Over the last two decades, the global ICT revolution has also been associated with sharp rise in income and wealth inequalities. The monopolistic nature of IT companies, and proprietisation of and control over technologies and digital resources (data being the latest and most important) is an important cause of these inequalities.

Successive waves of technology-triggered automation led to the destruction of meaningful employment and creation of the 'gig' economy, whose harmful social and psychological consequences are still being discovered. The emergence of the large US-based transnational corporations and their close working with the US government[5] have also led to erosion of political sovereignty across the world, and the geo-political implications of these need to be interrogated. Big data is the next wave of colonisation, with developing countries providing their data free to these transnational

corporations and being dependent on their digital platforms. The surveillance implications of digital platforms have dangerous portents for individual rights, institutional autonomy and democracy as a whole. The environmental consequences of the IT revolution, whether from the fillip to global consumerism or from burgeoning e-waste due to the 'use and throw' culture or from increasing power consumption need to be addressed.

These dangerous socioeconomic trends cannot be reversed by more technological developments; only political will could arrest and address these. Education has an indispensable role in building perspectives necessary for developing such political will. Hence, developing a critical understanding of the role and implications of ICT in society has to form an important part of teacher education and school curriculum as well.

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A Critical Reflection on the Landscape of Technology in Education: What Have We Learnt and Where Do We Go from Here?

- Meera Chandran, Tata Institute of Social Sciences

In the fifty-odd years of its existence, technology in education has gone from being regarded as a panacea for educational problems to cautious pragmatism about its pedagogic value. There has been no dearth of interventions worldwide that have attempted to position education technology as the answer to problems in education, problems ranging from teacher quality to student learning outcomes. There is, however, very little evidence of these offerings leading to the kind of dramatic change in school education that they were touted to achieve. This was largely due to the singular focus on providing access. Larry Cuban's indictment (2001) pointed to the short-sightedness of equipping schools with hardware and software that led to no positive change in teaching learning, and instead led to sustaining practices that are best discarded. Despite these indications, countries like India followed the same trajectory of providing access to educational technology for well over a decade as a way of improving quality in schools.

The wide stratification of schooling in India translates into an iniquitous system of high-end private schools with access to state-of-the-art educational technologies on one end and government and low-cost private schools with little or no access to such technologies on the other. From a policy perspective, this inequity creates sufficient motivation to ensure that the vast majority of students that access government schools are provided with access to these technologies. The first decade of this century saw a massive mobilisation to equip government schools with infrastructure in computer hardware and software. This was typically done by outsourcing the entire process to private agencies that also provided training and employed their own resources to run the computer lab. This model emphasised digital literacy with little possibility for exploring the potential of information technology to improve quality of student engagement. In terms of pedagogic value or any kind of integration with the larger school curriculum, this approach fell woefully short. Teachers, in particular, regarded this form of ed-tech at best as a novelty for students to engage in or at worst a distraction from the real task of learning. With no ownership at the school level for the upkeep of the labs, most of them fell to disrepair once the novelty wore off or the contract with the private agency expired. As a policy document rightly observed, government schools had become 'graveyards of useless equipment' (NCERT 2006).

Many such initiatives were implemented through public-private partnerships that opened up the government schools to seemingly well-meaning interventions from private corporations. These initiatives were not subject to public audit and there is little evidence of their impact on the quality of schooling. Despite this, there is little abatement in the enthusiasm for educational technology and its potential for improving teaching learning. Is this optimism entirely misplaced? Where is it coming from, and how does one understand this seeming paradox? It appears that the ed-tech space can be characterised by two distinct set of approaches or ideologies: ed-tech as pedagogy and ed-tech as enterprise. It cannot be denied that education technology is at least one of the many markers of quality of schooling which is tied to the question of access. The issue of access as argued above, may be addressed equitably only when founded on sound pedagogic principles. Learning in this approach is necessarily conceptualised as meaning making in a social context. Interventions that exemplify such an approach are those that help teachers and students leverage ed-tech tools to create an authentic learning environment.

A major challenge to the ed-tech as pedagogy approach stems from the dominant discourse in education that regards achievement of student learning outcomes to be a measure of efficiency

and school quality. This discourse is fuelled by a regime of testing student achievements that have become a regular exercise in countries across the globe. In India, annual reports of poor performance of government school students and the increase in privatisation of schooling exerts pressure on policy makers to opt for solutions that provide quick fixes to achieve better quality. Approaches that offer quick and often superficial solutions that address student performance therefore tend to find favour with policy makers rather than approaches founded on pedagogies that aim to achieve broad educational goals.

Ed-tech as enterprise approaches have no doubt been responsible for a variety of innovations in the space. While they may not be devoid of considerations that underpin ed-tech as pedagogy, considerations of economic viability are by definition their guiding principle. Typical of these approaches are packaged digital products that can be consumed by teachers and students and align more or less with the existing pedagogic cultures of the school system. These products are more often than not preferred by school leaders and teachers for the very same reason, that these new technologies can be accommodated without challenging well-established school routines. Most importantly, these technologies neatly tie up with the performative approaches in education.

Debates within ed-tech with regard to access, quality, effectiveness and scale are arguably manifestations of these two diametrically opposing conceptions of what constitutes quality in education. What is important to highlight here is that these tensions are not unique to interventions in ed-tech but are symptomatic of those that characterise the very landscape of school education. There may be wider recognition of the importance of pedagogically sound principles in education. But it requires a certain tenacity of belief in such principles to go against the grain and insist upon the long arduous route of addressing school pedagogic cultures rather than succumb to the attraction of quick fix solutions that ed-tech can and does offer. Unfortunately, those that hold strong views about educationally sound approaches also hold a rather dim view of the potential of ed-tech in lending itself to meaningful pedagogies. This leaves the landscape wide open to initiatives that lean toward the ed-tech as enterprise approach.

The international symposium on connected learning at scale, was an attempt to bring together on the same platform, representatives from either side of this ed-tech debate. The context of the Connected Learning Initiative (CLIx) itself provided an example of education technology designed for pedagogic quality at scale that could provide pointers for similar initiatives. Most importantly, the symposium underlined the need for an open dialogue between stakeholders on what we can learn from the ed-tech approaches of the past and how these lessons can inform the future of ed-tech. It is amply clear that providing access to educational technology in schools cannot create any sustained impact on quality of student learning. Integration of an intervention with the school curriculum is the most challenging piece, and this can only be addressed by placing the teacher at the centre of the intervention. This is seen as a problematic by many as they consider teachers to be resistant and being in the way of innovations. This view is a limited one as it is blind to the institutional realities of the teachers' context. The teacher remains accountable to the school system that supports pedagogies that are contrary to the proposed innovation. The teachers may not be quite convinced of the efficacy of the innovation in promoting the students' learning (Chandran 2015). In either case, the teachers' knowledge of the institution, curriculum and students' context is essential to achieving any kind of sustained impact.

The ed-tech space is currently dominated by well-intentioned initiatives that aim to bring about qualitative change in school education. Some of them show an intuitive understanding of the issues outlined above. But these are initiatives, as Selwyn (2012) puts it, that are done to teachers

and students across schools in the country. What is required is a clear, unambiguous articulation of these imperatives that can provide a framework to assess the design of ed-tech interventions. Equitable access with pedagogic soundness must be seen as one of the founding principles of ed-tech interventions. The teacher must be placed at the centre of the ed-tech curricular design with the knowledge and expertise to draw upon educational technology, create, adapt and refine it according to the students' context. Finally, the educational system at large must firmly recognise that sustained change cannot be brought about through quick fix solutions and must resist its own propensity for such an approach to ed-tech intervention. Partnerships across institutional boundaries and ideologies must be forged to take on this difficult but important challenge.

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06 PARTNERSHIPS

What and Why of Partnerships in Large Scale Education Projects

Excerpts from roundtable discussion with participants, Ajay Singh, Tata Institute of Social Sciences (Moderator); Archana Mehendale, Deepa Balasubramanium, Tata Trust; Brandon Muramatsu, MIT; Nirada Devi, Govt. of Assam; Maarit Palo, IBM, Finland; Sylvia Garde Fit-Ed; Lalbiakdiki Hnamte, Mizoram University; Romen Das, Govt. of Assam; Omkar Balli, Tata Institute of Social Sciences; Manmohan Singh, Kaivalya Education Foundation

There are different types of partnerships that are hierarchical and non-hierarchical. It is necessary to recognise the nature of these partnerships with government and non-government organisations. It is possible to find ideologies that are similar or different in partnerships. It is possible that one enters partnerships to augment resources or fill in gaps in one's resources. In such cases, formalising partnerships in clear terms becomes necessary. While these need not be rigid and can be revisited with changing circumstances, it is nevertheless necessary to enter into clear agreements on shared objectives and deliverables. All partners need to go through an incubation period, taking time to nurture and build partnerships. This is necessary to align the culture and ethos of organisations. Trust and robust communication mechanisms are essential for healthy partnerships. At the same time, it is necessary to assess partnerships as one proceeds with initiatives.

From the point of view of funders, partnerships are needed to see the transformation of visionary ideas into reality. Achieving learning outcomes would require varied expertise that cannot be found in a single organisation and must therefore be sought in multiple domains. With ed-tech ventures, it is necessary for content, technology and curricular domains to work together. Working with government schools requires partnerships with state governments. It is also necessary to incorporate global best practices for which one looks at international collaborations. Research becomes key in ed-tech initiatives since, unlike in the West, the initiatives are still nascent in India and do not have any documented evidence of what works and what does not work. Also required is evaluation to determine impact.

In a partnership, it is important to fill in gaps - no organisation has everything. It is therefore necessary to build on a shared understanding and synergy between partners to achieve the envisioned goals. This takes time, since it is necessary to understand the cultures and interests of individual organisations.

There needs to be an understanding also of the requirements of a partnership and one's own work. Therein lies a challenge: the larger the vision and intervention of a project, the more established the partners, the more difficult it becomes to think beyond one's own beliefs. The scale and learning outcomes present further challenges, and the project continues to provide new learning experiences. Scaling presents a set of challenges, making it imperative to consider sustainability in the criteria

for partnerships. Sustainable partnerships that address curriculum, technology and scale can only happen with convergence. It is necessary to have clear goals and work with trust towards a common clear vision.

Dialogues between stakeholders become necessary to capture the gaps and address the needs of the partnership. The bigger the gaps, the greater the challenges and the greater the need to build further partnerships. It is necessary for partners to adapt strategies that address the local individual needs of a project. A good partner must understand the needs of the beneficiary and augment the collaborators' capacity with their skills.

Convergence of partnerships is important to reach a common goal. There has to be a clear and shared understanding of the problem among partners. One must try and understand what kind of integration is needed, and what its exemplars look like. At the same time, since each organisation comes with its own work culture, beliefs and practices, dialogue is critical in reaching common goals within partnerships. This purpose must drive all actions.

Expertise and experience of different kinds lie in different places and need to be brought together to capture a common vision. Awareness of the ability of partners, their backgrounds, their visions and roles in the project all become critical factors in considering the nature of partnerships.

Dialogue and trust that must support a common vision become one way of achieving a visionary idea on the ground. This includes involving stakeholders in the education system - like teachers, students and parents - in discussions. Humility, vulnerability and sharing of best practices are the means to an end of successful partnerships to achieve the stated goals of large scale ed-tech initiatives.

Working with Government

- Ajay Singh and Omkar Balli, Tata Institute of Social Sciences

Working with government includes an obvious meaning, that the organizations that want to work with the government are not part of the government but are willing to strengthen the government system. Usually, there are two types of organizations or institutions that work with government 1) organizations with larger social commitments 2) profit making organizations.

This paper deals with the experiences of selected approaches and negotiations for working with governments; for the first type of organization (as mentioned above).

1. ***Context: Belief and assumption about work with governments***. Organizations and groups working with government are operating under certain assumptions:

    - Whatever is happing in the government school is not adequate, and things need to be improved with support from an outside agency.

    - An outside expert body can facilitate government functionaries in general and teachers in particular.

2. ***We cannot evaluate technology-enabled learning with respect to traditional indicators.*** The education sector is at the cusp of a radical change. In the next few years (5-15 years), I hope we will see a much varied set of educational institutions using information technology to their fullest capacity for a healthy public school system. There are several reasons to believe this. Important for our attention are the negotiations and the compromises during these processes.

    Technological innovation is sometimes seen in a bleak light as a way to evade or avoid the prevalent system, one of the most powerful examples is the pattern of learning assessment or evaluation. Our experiences in the field show that not all innovative instruments have been successful with respect to traditional indicators, so it is important to formulate new indicators, of course in line with constructive and progressive pedagogies. These indicators must be constructed according to the stages of technology-enabled learnings.

3. ***Need to understand different phase of technology-enabled learning. CLIx experiences*** of the last three years show that there are three categorical phases of technology-enabled learning: 1) introductory phase, 2) exploratory phase and 3) mastery phase. Implementation design of innovations must address each of these three phases distinctly instead of merging them into one whole to make the implementation design viable. These phases can be defined - through the idea of morphic field - which may depend on a series of conditionalities. One clarification - I am referring to these phases for the system and not for the learners.

    When CLIx started in 2015, our reforms were guided by the need to increase the role of technology and improve outcomes, not in a traditional way but to ensure we had the right pedagogical approach. Throughout, our attempt was to **institutionalise the processes**, so that they would be both predictable and enduring. We wanted to do all this in a measured but a steady way so that the system could adjust to these changes.

4. ***Type of negotiations: Implementations of technology-enabled learning project***. To some extent, CLIx implementation experiences explain the need to deal with the issues ranging from

day-to-day classroom and pedagogical management to teacher's willingness to participate in the capability building process.

It is important for us to understand schools, particularly public schools, which are too complex and varied to be controlled centrally. In such a situation, the governments will need to withdraw from the commanding positions of curricular and pedagogical design and confine itself to providing infrastructure and governing framework, leaving pedagogical decisions to teachers, head teachers and experts. (We are happy to do so in the economic field.)

Module design should be based on or responsive to exiting technological infrastructure. We should not develop or plan to use modules that require a very sophisticated composition of machines and labs.

Like the CLIx module, any plan for teachers' professional development must address teachers' practices and beliefs and enable them to develop their skills in - 1) curricular negotiations, 2) pedagogical negotiations and 3) technological negotiations.

5. ***Approach for future: Sustainability and policy***

a) Construction of knowledge: Teachers and students should get a sense of construction and contribution to a larger pedagogical plan rather than being part of mere replication of the designed activities. (example- one teacher teaches quadrilaterals and is trying to sort the similar looking figures - eg rhombus where she is trying the - co-construction of knowledge while negotiating with the children, in making meaning)

b) Critical mass (number) for a successful intervention: Intervention will only work and sustain above a certain minimum number or mass. (The minimum seems to be one-third of a unit.)

c) It is important to differentiate between innovation in modules and the implementation of the module. Similar modules can be implemented in a variety of ways.

d) Innovation should respond to technology-enabled learning, if the system is ready to provide one hour daily to each student. What is the policy makers' ideas of a computer lab, which is different from a pedagogue's imagination? This difference can be seen as the gap between different stakeholders in education:
- Policy makers are targeting the introductory phase.
- Pedagogues are targeting the mastery phase.

One of the interesting points that emerges from the foregoing analysis of CLIx implementation experiences is that departure from standard and prevalent pedagogical assumptions was not considered as an idea based on 'outcome theory', though it incorporates all the components of the constructivist behaviour of teachers, which arises from distinct pedagogical considerations.
This involves the idea of connectionism. There is also a commitment to various pedagogical patterns, a violation of which was seen to be a fundamentally bad practice, and 'construction' was at the centre. We think we have to think about outcome; this can be seen as a continuous process of negotiation.

This idea was continuously negotiated with other pedagogical patterns, loyalty or adherence to which may not arise from any inherent valuation related to that pedagogical approach but from

instrumental importance of pedagogies. It may happen in one school or in a system, as we see the pressure on teachers to compete with curriculum and outcomes both.

The last consideration may be relevant even in some standard cases of failures of technology-enabled learning, of efficiencies arising from externalities (state or vendor). For the purpose of implementation, tackling these externalities may have to be reformulated altogether, if we intend to move away from a vendor regulated pedagogy.

The role of the field worker for technology-enabled learning needs to be established in a formal way. The naivete of the teacher in a workshop inhibits assimilation of technology-based learning unlike the constructivist learning that occurs in the actual site of learning, like a school. This occurs with the help of field workers as it did in the early 1970s and 1980s, in the context of activities for child-centric education.

Conclusion. We have tried to argue that technology-enabled learning can be substantially enriched by paying more attention to three negotiations of the teacher and a study of these negotiations can also benefit from closer contact with 'the phases of learning defined' (by the morphic field).

We also argue that even predictive and descriptive pedagogical approaches can be helped by making more room for technology-enabled considerations. In the long term, it may be useful for determination of the outcome, with newly defined indicators that may include social justice and equity.

We have not argued that these exercises would be particularly easy. This involves deep seated ambiguities and some cherished notions about education and are inherently complex. But the case for bringing pedagogy closer to technology does not rest on it being an easy thing to do.

Technology-based learning can be measured in terms of its impact on the future. We need to invest in the future rather than focusing on mechanisms and requirements only for the present.

07

APPENDIX

Connected Learning at Scale: An International Symposium

8 & 9 August, 2018 - Mumbai, India

Day 1- August 8

Keynote Plenary: Perspectives and Practices in Technology-Enabled Teaching, Learning and Future Directions

Practice based and scholarly perspectives on the future of technology enabled education, setting the agenda for the two days' engagement

Speakers: RCM Reddy, IL&FS Education ; Victoria L. Tinio, Fit-Ed; Vijay Kumar, MIT

Chair: Padma M Sarangapani, TISS

Tea break

Plenary 01: Connected Learning Initiative (CLIx): Quality at Scale

Designing and Implementing CLIx across schools in India: What did it take? Principal Investigators and core team leads of CLIx discuss the developments of the initiative, key findings and learnings since its inception in 2015.

Panelists: Padma M Sarangapani, Ajay K Singh, Amina Charania, TISS; Eric Klopfer, MIT; Tara Sabavala, Tata Trusts; Nagarjuna G., HBCSE

Moderator: Amrita Patwardhan

Poster Presentations

Parallel Sessions

Conecta Ideas: ICT supported teaching with a social motivation strategy - Roberto Araya Schulz, University of Chile

IT Training through Spoken Tutorials to Reach the Unreached - Kannan Moudgalya, IIT Bombay
Academic experts share insights based on their research on ICT enabled teaching and learning initiatives

Education Reform: Role of Assessments and Technology to improve learning outcomes at scale - Pranav Kothari, Educational Initiatives

Addressing student learning outcomes through progressively building teacher capacity-Abhinav Mathur, Million Sparks

Building a world where every teacher will learn and grow anytime, anywhere at zero cost- Vinod Karate, Teacher App

Leaders from these organizations share key insights and observations based on their work with teachers and students from K-12 schools in India

Continuous Professional Development for Government School Teachers - Amina Charania, TISS

Online Teacher Communities of Practice - Bindu Thirumalai, TISS
TISS faculty present experiences and research based findings based on two models of blended learning for practicing teachers

Tea Break

Plenary 02: Teachers' Voices: Opportunities and Challenges in Implementation of ICT Based Learning

Panelists: Odelu Kumar, Teacher, Telangana; Shweta Gupta, Teacher, Rajasthan; Jogen Chandra Rabongshi, Teacher, Assam; Sajid Ansari Hussain, Teacher, West Bengal; Radhakrishnan C, Principal, Nilambur, Kerala

Moderator: Amina Charania
Teachers representing national initiatives share their reflections on their ICT based professional development and practice.

Poster Presentations

Special Reception: A gathering to recognize CLIx partners' and teachers' contribution to the initiative

Day 2- August 9

Plenary 03: Policy and Practice in Technology based Education

Panelists: Gurumurthy Kasinathan, ITfC; Krishna Barua, Govt. of Assam; Mr. Gaurav Dwivedi, Govt. of Chhattisgarh; Prof. Pekka Neittaanmäki, University of Jyväskylä, Finland

Moderator: Archana Mehendale
This panel brings together government representatives from India and other contexts to address policy dimensions and their implications for large-scale education initiatives

Tea Break

Parallel Sessions

Building Design Capacity: A Model for Developing Teams' Design Expertise - Eric Klopfer, MIT
Presenter will share his experiences, successes and challenges of using a capacity building model with design based approach and participants will participate in a mini-activity.

Implementation Monitoring at Scale: The Good, the Bad, and the Difficult- Archana Mehendale, TISS & Glenda Stump, MIT
Participants will explore key considerations for implementation monitoring via case studies (examples and non-examples) from developing country contexts.

Designing Educational Technologies for Collaborative and Connected Learning at Scale - Sadaqat Mulla, TISS; Nagarjuna G., HBCSE
In this workshop, with a blend of discussion, demonstration and hands-on, presenters will share the experiences of how the CLIx technologies came into being, how connected learning in disconnected spaces is being experimented, possible approaches for scaling up and tools to foster connected and collaborative learning.

Demo Sessions

CEQUE, CLIx ,HBCSE, ITE , MIT, PARAG, PRATHAM BOOKS, SVYM, Tata Class Edge

Lunch Break

Parallel Sessions

Roundtable: Contemporary approaches to developing partnerships for large scale education initiatives

Maarit Palo, IBM Finland; Lalbiakdiki Hnamte, Mizoram University; Nirada Devi, Govt. Of Assam; Romen Das, Govt. of Assam; Brandon Muramatsu, MIT; Omkar Balli, TISS; Manmohan Singh, KEF; Sylvia Garde, Fit-Ed; Archana Mehendale, TISS; Deepa Balasubramaniam, Tata Trusts

Moderator: Ajay K Singh

Traditional Games - Sree Ranjini, Kavade
Followed by Fireside chat on **Games for Learning**

Discussants: Amit Dhakulkar, TISS & Judith Perry, MIT

Practice based Research in Educational Technology - Pekka Neittaanmäki, University of Jyväskylä, Finland

National Repository of Open Educational Resources - Indu Kumar, CIET, NCERT, India

Tea Break

Plenary 04: Looking Back & Moving Forward - Insights on building sustainable models for improving education

Shaheen Mistry, Teach for India; Sanjay Gupta, English Helper; Lucia Dellagnello, CIEB; Nidhi Pundhir, HCL Foundation

Moderator: Vijay Kumar

What have we learned the last two days and how do we extend that to other contexts? How do we create opportunities to improve education and employment prospects for underserved youth?

Closing Remarks

Demo Sessions continued

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