Innovation Diffusion Process Documentation: a case of Connected Learning Initiative (CLIx)

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Abstract: The current paper presents a study of innovation diffusion and technology integration in schools by examining Connected Learning Initiative (CLIx) as a case. Designed as a longitudinal qualitative study using a series of in-depth interviews with stakeholders at macro, meso and micro levels, the paper presents analysis of first round of data collection. Factors that inhibit and factors that promote diffusion of innovation are described along the axes of innovation, process of adoption and scaling, and roles and expectations. Given the paucity of material on innovation diffusion in developing country contexts, this work attempts to contribute to the field by providing a framework for analysing the process by capturing perspectives of stakeholders located at different levels of engagement.

Keywords: Innovation Diffusion, technology integration, Concerns Based Adoption Model (CBAM), Scaling

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The Connected Learning Initiative (CLIx) is an innovative field action programme launched by the Centre for Education, Innovation and Action Research (CEIAR) to improve the professional and academic prospects of teachers and high school students from underserved communities in India, and implemented in four states. CLIx incorporates thoughtful pedagogical design and leverages contemporary technology to provide quality educational experiences at scale across disciplines, available as OERs. The initiative was seeded by Tata Trusts, Mumbai and is led by Tata Institute of Social Sciences, Mumbai and the Massachusetts Institute of Technology. CLIx was awarded the UNESCO - King Hamad Bin Isa Al-Khalifa Prize for Use of ICTs in Education and the OER Collaboration Award for Excellence 2019 (https://clix.tiss.edu, https://clixoer.tiss.edu)

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Background

The success of an innovation depends to a great extent on what goes into it, i.e., ideas, technology, people and resources. But more importantly, it is the configuration of these resources that matters the most. For a successful diffusion of technology, one not only needs to consider diversity of technology, infrastructure on ground, scalability of innovation, but also the suitability and sustainability of the innovation. A continuous and effective diffusion of any innovation is difficult without an active participation of the community.

Literature review

Literature on innovation diffusion is largely based on experiences in developed countries. The current study is sensitive to the limitations that this may impose and is therefore ready to adapt the frameworks based on the Indian context and/or select from them based on the thrust and principles of the project.

Technology diffusion and integration in schools has been specifically studied to understand the process by which it unfolds. The levels of technology implementation (LoTi) proposed by Moersch (1995) identifies seven technology implementation levels in schools: (a) no use, (b) awareness, (c) exploration, (d) infusion, (e) integration, (f) expansion and (g) refinement. The work done at Unesco's Institute of Information Technology proposed the 'Morel's matrix' giving four distinct successive phases: (a) emerging, (b) applying, (c) integrating and (d) transforming (cited in OECD, 2010). The 'stages' approach in newer 'e-maturity' models focus on what teachers and pupils actually do when they use ICT in schools, something that the indicators approach deals with only in superficial ways (Butt and Cebulla, 2006; Underwood and Dillon, 2004). The theories and models on implementation of programmes for innovation and change such as the Rogers' Diffusion of Innovation model (2010) gave five stages of knowledge, persuasion, decision, implementation and confirmation; with attributes of innovations includes five characteristics of innovations: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability; Adopter categories- innovators, early adopters, early majority, late majority, laggards.

The Concerns Based Adoption Model (CBAM) (based on Hall and Hord, 2011) went a step further and offered three diagnostic dimensions to study innovation diffusion. These are: a] Innovation Configuration - What does the innovation look like when it is in use? What would you see in classrooms where it is used well? (and when it is not used well), What will teachers and students be doing when the innovation is in use? b] Stages of Concern – experiences, thoughts and feeling about the change process including 4 broad categories (unrelated, self, task, impact) and c] Levels of Use – behaviours towards change initiative that transform across the eight levels which includes Level I: Orientation, Level II: Preparation, Level III: Mechanical Use, Level IVA: Routine, Level IVB: Refinement, Level V: Integration, Level VI: Renewal.

Drawing from these various frameworks, the proposed study intends to study the process of innovation diffusion by examining the views and concerns of the stakeholders with regard to the innovation as an important and enabling strategy to ensure their active participation in a bottom up model instead of limiting the entire innovation to a top-down approach. Dynamic ability to meet the changing needs of the community, and active participation of the stakeholders at macro, meso and micro level ensures sustainability and effective diffusion of the technology.

Why is it important to study innovation diffusion?

Studies on innovation diffusion, particularly in the area of technology integration in schools, are rare in the Indian context. The Connected Learning Initiative (CLIx) is a bold and an innovative initiative aiming to improve quality of education in government secondary schools by offering technology enabled curricular modules and avenues for teacher professional development. By working with schools in the underserved communities in four states, creating content in three languages, designing technological affordances for resource constrained schools is by itself challenging. Yet, working in partnership with governmental and non-governmental organisations, leveraging resources and schemes of the government allows for scalability and sustainability. Given that such bold, large scale initiatives working closely to develop teacher capacities and creating learning labs in schools are unavailable, we have almost no literature that tells us how large scale technology based innovative programmes work and get adopted by education system. It is therefore an imperative that these processes are documented and studied in the context of CLIx so that it provides evidence on this important area of innovation diffusion. Moreover, as an action research project, such an ongoing exercise of data gathering and reflection will help in strengthening the intervention at various levels.

The need to study innovation diffusion was recognised soon after the launch of CLIx and the Concerns Based Adoption Model (Hall and Hord, 2011) had informed two activities [1] the development of baseline study tools wherein concerns about technology integration held by various categories of respondents were studied, and [2] the exercise on Innovation Configuration Mapping which enabled all functional groups within CLIx to record how they imagined the innovation would look like when it is getting practiced. These activities provided a benchmark and triggered an interest in studying how CLIx as an innovation gets adopted and diffused and documenting the process of change and evolution. It is on this background that this study was conceptualised. Our work examined and described the innovation (CLIx), the Indian context before the innovation was deployed, and subsequently the context after integration of the innovation.

Purpose

The purpose of the Innovation Diffusion Process Documentation (IDPD) is to obtain perspectives from multiple stakeholders regarding their perceptions of the purpose, affordances, constraints, implementation, and potential impact of the Connected Learning Initiative (CLIx). Data will be collected at predefined intervals (see procedure) throughout the project to examine how these views shift as the intervention progresses and how that helps diffusion of innovation at three levels – the macro level (consisting of the CLIx core community), the meso level (state officials and field implementing partners) and micro level (school principals, teachers, students and parents). The study intends to document and analyse how an innovative intervention unfolds in the field and how the key concerns, roles, expectations and ideas of innovation evolve during the course of the intervention lifespan.

Thus, stakeholders for the purpose of this study are broadly classified into macro, meso and micro level in this project. The macro level participants are the funding agencies, principal investigators, domain,

technology, research and Teacher Professional Development teams. The Meso involves the state officials, implementation partner leads and implementation field teams. The micro level stakeholders are the principals, students, parents and teachers. The study examines how the innovation gets shaped and diffused through the various layers across different points of time in the intervention life-span.

The research objectives of the study are as follows:
1. To study and analyse the process of innovation diffusion across intervention life cycle
2. To identify the key shifts and continuities in the concerns, expectations, roles and ideas about the innovation among various stakeholders
3. To compare and analyse the similarities/differences amongst the stakeholders' views and ideas
4. To contribute to existing literature on innovation diffusion with specific reference to technological innovation in government high schools in India by analysing the research findings in the light of existing conceptual frameworks.

Methodology

The proposed study takes a longitudinal approach to studying the changing views and ideas about innovation and its implementation. Data is scheduled to be collected from the same set of respondents twice over the project intervention period marking specific milestones' during the project such as before the intervention and after the intervention has gathered considerable traction at the field level.

Sample

The study includes a cross section of stakeholders as respondents who have been categorised into three levels based on their functions, roles and locations:
Macro - comprises of donors, three Principal Investigators of CLIx, leads of all the domain teams, teacher professional development team, and technology teams.
Meso - comprises of field team leads of all the four states, and all the field team members including Field coordinators, /Field Action Research Fellows, Field Technologists, and Field Support Persons from each of the states.
Micro - One school from each of the eight districts covered was chosen (8 schools). The school principals of each of the schools, Math, Science and English teachers of Grade 9, 5-6 students and 2-3 parents per school were selected based on their availability

Data collection

This White Paper presents data gathered from Round 1 of the study. Data was collected using the following methods:
Interviews were conducted with macro level individuals, field team leads, field coordinators and Field Action Research Fellows, Principals, teachers and parents. Interviews at macro and meso level were recorded, transcribed and translated into English wherever required.
Focus Group discussions were conducted with [i] Field Support Persons and field technologists and, [ii] students. Focus group discussions were captured as mind-maps.

Tools for interviews and the guides for Focus Group Discussion was based on the key dimensions of the study, namely The Innovation, Process of Adoption and Scaling, and Roles and Expectations. A semi-structured interview protocol was utilized for this study (See Annexure 1 for Tools used in Round 1 Data Collection). This approach allowed the interviewer to probe respondents' reply to questions when additional explanation was desirable. The same tools will be used for all the rounds of data collection with respondents. Our interview protocol was developed from a framework combining previous work that explored adoption and diffusion of technology innovations. The CITE framework (Osterweil, Shah, Allen,

Groff, Kodidala, & Schoenfeld, 2016) provides guidance for exploring the adoption of technologies (generally software) either before or during the early phases of adoption. It was designed for the purpose of helping outside evaluators or stakeholders determine whether a technology is an appropriate fit for a specific context of student needs, pedagogical goals, and technical infrastructure. The ORACLE framework (Malpica & Rassekh, 1983) directs attention toward exploring adoption of larger innovations from a slightly broader perspective, considering the entire ecosystem and its inter-relatedness, as well as the supporting infrastructure. Information at both levels of granularity is germane to our purpose of examining the adoption and diffusion of an innovation like the Connected Learning Initiative.

The interview guide used for the macro level respondents was a sub-set of questions posed to meso level respondents. The micro level respondents answered questions that were particularly adapted to their specific role and position in the project. The MIT Research Team conducted interviews with individuals associated with the innovation at the macro level. The TISS Research Team conducted interviews and focus group discussions for the respondents at the meso level and the TISS Implementation teams at the state level collected data from respondents at the micro level.

Data analysis

Anonymised and de-identified transcripts were used for coding and thematic analyses. After establishing preliminary coding categories, data was analysed using the identified themes. Corresponding extracts and quotations from data were also tagged to the code categories. Factors promoting and factors impeding successful diffusion of the intervention were the thematic categories chosen. Findings in each of the dimensions of the innovation--context, technology, teaching with technology, adoption and scaling, roles and expectations--were recorded and patterns across different groups of stakeholders were analysed.

Procedure for Obtaining Informed Consent and Maintaining Confidentiality

Participant Information Sheet was given to all respondents (translated whenever required). All respondents were requested to sign the Informed Consent Form (counter-signed by parents in case of students) and these forms have been maintained in custody of the Project Director. The right to withdraw and not participate in the interview was been mentioned in the Participant Information Sheet. Identities of all respondents was kept confidential. All data was anonymised before analysis. The data shared and reports published using the data do not carry names of the respondents.

Findings

After reading the transcripts and doing one round of thematic coding, a schema for analysis was developed that would contribute to our understanding of the innovation--identifying and separating factors that promote innovation diffusion and factors that impede innovation diffusion. While these factors were not overtly identified in the interview protocol, they emerged as viable categories during the analysis of the data. The idea was to capture the characteristics of the intervention that were seen by the respondents as promoting or impeding its diffusion. The key findings are summarised and presented below in two sub-sections. Readers could also refer to Annexure 2 for a mindmap capturing these findings and Annexure 3 and 4 for details about the factors that promote and factors that impede respectively.

Factors that promote diffusion of the innovation

From participant responses, the characteristics identified as those that have a potential to promote diffusion of the intervention are grouped in the five categories, those related to [1] the Innovation

consisting of [a] Context, [b] Technology, [c] Teaching and Learning using Technology, [2] Adoption and Scaling and [3] Roles and Expectations. The key findings are discussed below:

[1] The Innovation:

There was a convergence among various categories of respondents about some of the factors that constituted the Innovation (in terms of Context, Technology and Use of technology for Teaching and Learning) and there were some outliers. The categories of respondents are marked with abbreviations[1].

Context - About the intervention

Factors on which there was convergence among two or more categories of respondents were:
1] CLIx creates alternate pathways of learning, and is trying to bring about a paradigm shift in the traditional school learning environment [Macro (C, L,T), Meso, Micro (HM, T, S)]
2] CLIx would help to bring integration of technology within domain pedagogy [Macro (I, C)]
3] CLIx was seen as a computer literacy/digital literacy programme that would help in improving digital literacy among students and the community [Micro (HM, P)]

It is interesting to note that while there was complete convergence on the point that CLIx creates alternate pathways across the three categories of respondents, there is a difference in the other two factors identified. While the macro level respondents (I, C) looked at technology integration in domain pedagogy, the micro level respondents (HM, and P) saw it as a computer literacy programme.

Outliers
1] Prepare local communities for a more techno-centric future [Macro (I)]
2] Prepare learning labs [Macro (T)]
Both these factors were expressed by those closely linked to the presence/creation of these enabling conditions within the intervention, which may explain why these respondents identified these factors as important for promoting innovation diffusion.

Context - About how the intervention is organised

1] CLIx is designed for scale, so provides a better chance of success than projects designed for small populations and then scaled up; involves partnerships as well as capacity-building for all partners [(Macro-C, T)]
2] CLIx works through partnership for capacity building [Macro (L), Meso]

These factors are inter-linked in a manner that scaling and partnerships for capacity building are integral to the way the intervention can be rolled out at scale. The fact that this is coming mainly from the respondents at macro and meso levels (designers of implementation and those executing the implementation is expected and indicates that those at the micro level (final beneficiaries) currently do not have insights into these details about how the intervention is organised.

Outlier
1] Improvement of lab infrastructure (Meso)

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1 Macro-L means CLIx Leadership/PIs, Macro-C means CLIx Domain leads (English, Math, Science), Macro-T means CLIx Technology leads, Macro-I means CLIx Implementation leads, Meso means field leads, field technologists, field action research fellows, field coordinators, field support persons, Micro-HM means School Headmasters, Micro-T means teachers covered under CLIx, Micro-S means students covered under CLIx, and Micro-P means parents of students covered under CLIx.

Only the meso level respondents identified improvement in lab infrastructure as a factor that will promote success of the initiative. This can be explained by the fact that it is the meso level respondents who are directly involved in creating this enabling condition on the ground.

Context - About what CLIx would do
This is organised into two parts - firstly, what CLIx would do for the teachers and what it would help the teachers to do and secondly, what CLIx would do for the students.

What CLIx would do for Teachers and what it would help them to do:
1] It would increase their confidence, and decrease their fear of technology [Macro (T, I), Meso]
2] Equip them to source or create their own digital material [Macro (L, Meso)]
3] Facilitate communication between teachers who will take charge, develop courses on our platform, and share with other teachers, professional growth [Macro (C, T, I)]

There is a strong convergence on what CLIx would do for the teachers and what it would help them to do among the macro and meso level respondents. The role of teachers as content creators is particularly limited to the macro and meso levels and has not been echoed by the micro level.

Outliers
1] Teach in an inquiry-based way; Help students learn "core processes" like critical thinking [Macro (C)]
2] It would change teachers' metacognition, knowledge construction, and have a Ripple effect [Macro (C)]

It is also interesting to note that it is only the macro level curriculum team respondents who noted the quality of teacher education and how it would help them improve their practice.

What CLIx would do for the students:
1] Students will learn to learn on their own [Macro (L, I), Meso, Micro (HM, T)]
2] Improve learning, collaboration; Experience collaborative learning [Macro (C, T) , Meso, Micro (HM, T)]
3] Reduce dependency on teachers [Meso, Micro (HM)]
4] Improve career choices [Meso, Micro (HM, P, T, S)]
5] Reach level of students from private school, help mobility to private schools [Micro (HM, T, S)]

Data showed a high degree of convergence on what CLIx would do for students in terms of helping them learn on their own as well as collaborate. Respondents at the meso and micro level showed convergence on the ability of CLIx to reduce dependency on teachers, helping improve career choices, which was not echoed by the macro level respondents. While reducing the dependency on teachers is inconsistent with the macro level respondents (discussed above) about strengthening pedagogy through teacher education, the fact that it is imagined as a feature of CLIx at the meso and micro level needs to be examined. This also needs to be seen in conjunction with the factor - students will learn to learn on their own - which had high convergence, but which does not by itself allude to reduction of teacher dependency. Interestingly, the micro level respondents pointed that CLIx would help the students reach the standards of private school and improve their chances of mobility to private schools, which has not been thought or expressed by those designing or implementing the implementation.

Technology:
1] Reliable electricity with some power back up [Meso]
2] Broadband connection available in some schools [Meso]

The question on technology was not asked to macro level respondents. Data shows that the micro level respondents did not bring this as a factor that would help promote innovation diffusion. Only the meso level respondents indicated the presence of these facilities as being important for promotion.

Use of technology for teaching and learning:
1] Interest among teachers to use technology [Micro (HM, T)]
2] Students better than teachers to use technology [Micro (HM, T)]
3] Student agency in learning, self-regulated learners [Macro (L, C)]
4] Improve learning outcomes [Micro (HM, T)]
5] TPD helped teachers learn how to integrate technology, develop confidence [Micro (HM, T)]

On the use of technology for teaching and learning, respondents at the micro level showed convergence on most of the factors identified, barring the point on student agency in learning self-regulated learners which was expressed only by macro level respondents. It may be important to note that use of technology for improving learning outcomes was identified by only the micro level respondents as a factor that would help promote the diffusion of CLIx.

Outliers
1] CLIx is beneficial for “exceptional teachers” who can use CLIx creatively and become exemplars to other teachers [Macro (I)]

This point about CLIx being beneficial for teachers who are exceptional to start with and who would serve as exemplars is identified only by the macro level respondents associated with implementation, implying it as a potential strategy for intervention.

[2] Process of Adoption and Scaling
1] Support of School Administration necessary for adoption [Macro (L, I)]
2] Support of government - ownership, teacher educators, involvement of local colleges [Macro (L, I, T)]
3] CLIx trainings and modules were received well in schools [Meso, Micro (HM, T, S)]

Data shows that the points related to support from school administration and government as factors that would promote innovation diffusion were expressed only by those at the macro level while those related to the quality of CLIx trainings and modules and its uptake at the school level was expressed by those closer to the schools, i.e. the meso and micro level respondents.

Outliers
1] Using CLIx is prestigious since affiliated to reputed institutions [Macro (C)]

Only the macro level respondents associated with curriculum considered reputation of the founding institutions as a factor that would help its diffusion, but this was not echoed by those closer to the field.

[3] Roles and expectations
1] Teachers role expanded, combines teaching + learning, more active and engaged [Meso, Micro (T)]
2] Role of students as learners has changed with freedom to learn differently, discuss with peers [Micro (S), Meso]

The changes in roles and expectations at the level of teachers was pointed out by teachers and the meso level respondents and the changes in roles of students as learners was pointed out by students and the meso level respondents which indicates that the respondents have reflected on how their own roles have

changed with CLIx which has also been corroborated by the meso level respondents what are in the field enabling and observing these changes.

Outliers
1] Teacher's role has not changed, peer discussions increased, teacher dependency will reduce with CLIx [Micro (HM)]
2] Field team roles expanded [Meso]
In contrast to what the teachers themselves indicated (as mentioned in the earlier para), the School Principals did not think that the role of the teachers had changed. Only the meso level respondents noted that their own roles have expanded over time.

Factors that impede diffusion of the innovation

The characteristics identified as those that have a potential to impede diffusion of the intervention were related to [1] the innovation, [2] adoption and scaling, and [3] roles and expectations. Within the innovation category, factors were further grouped into those related to 1) teachers, 2) labs, equipment, infrastructure, 3) student modules, 4) student learning outcomes, 5) implementation, 6) the overall intervention. Many of the interviewees described their vision of factors that would predict failure, rather than factors that were actually present at the time of the interview, e.g., “if this happens, CLIx will not be successful.” Occasionally, interviewees identified factors that, according to their perception, were occurring at that time.

[1] The Innovation:

Factors related to teachers:
1] Lack of teacher support for/interest in intervention [Maco (L, C, I), Meso, Micro (HM, T)]
2] Extra time and preparation required for teachers to teach with technology/ implement the CLIx modules [Macro (T), Meso]
3] Difficulty in changing existing teaching practices that focus on instruction-based pedagogy and preparation for exams [Macro (L, T), Meso]
4] Quality of training-Teachers are not prepared to implement modules using desired pedagogy [Macro (C,T,I), Meso, Micro (HM, T)]
5] Teachers’ low confidence to implement CLIx modules; inexperience with, and fear of technology [Macro (C), Micro (HM, T)]

There was convergence among the groups regarding teachers’ lack of support or interest in the intervention as a factor that would impede dissemination. Similarly, all groups stated that poor quality teacher training would also serve as an impediment. In this regard however, all groups had diverse views, and commented on deficiencies that they perceived to currently exist in the teacher professional development curriculum. The macro level respondents stated that the current training is too focused on the certification course with little time spent on allowing teachers to practice for module implementation; the training does not address practical problems or promote teacher autonomy; and the community of practice component has been weak, thus not a source of teacher support. The meso group and the headmasters from the micro group emphasized that teachers need more opportunity to practice with the modules after training. The teachers articulated that the training was not appreciated, in that it was primarily computer training that placed little emphasis on the CLIx modules or the subjects they teach.

Factors related to equipment/labs/infrastructure:

1] Poor labs/infrastructure [Macro (L, C, T), Meso, Micro (HM, T, S)]
2] Lack of secure storage of equipment [Meso, Micro (HM,T)]

All groups articulated the importance of functioning labs and infrastructure to the success of the intervention, whereas the problem of equipment storage and safety was articulated only by the meso and micro level respondents. These groups were ones with the most exposure to this issue.

Outlier:
1] Lack of regular access to computer labs [Micro (S)]

The student group recognized and articulated their desire for regular access to computing facilities. Many expressed that students were not allowed to enter computer labs at their school. This issue was not raised by any other groups during the interviews.

Factors related to the CLIx student modules:
1] Module content does not follow the textbooks or syllabus [Macro (L), Meso, Micro (T)]
2] Delay in development and production of modules [Macro (L), Meso]

Outliers:
1] CLIx value of equity may be contrary to cultural values [Macro (L)]
2] There is too little content (too few modules) [Macro (T)]
3] Module design does not utilize technologies well [Macro (I)]
4] Content is very basic and weak-students will like it, but smart students will easily complete tasks and then be bored [Micro (T)]

All groups articulated concern about the connection between student modules and the school syllabus or textbook. Those on the design/production/facilitation side (macro and meso participants) also articulated that delays in module production would serve to deter adoption, particularly if the delay occurred between the time of teacher training and module roll out.

There were multiple outlier comments related to student modules, with a greater number originating from the macro level respondents. Those from technology and implementation were concerned about the quantity of modules, as well as the appropriate use of technological tools, whereas the leadership group articulated concerns about the fit of CLIx values, particularly the value of equity, with the local culture of the schools and villages where the modules would be implemented. Lastly, teachers within the micro group articulated that the module content would not be challenging enough for students who learn quickly.

Factors related to student learning outcomes:
There was no convergence among groups related to student learning outcomes that would impede dissemination of the intervention.

Outlier:
1] Poor student learning may be perceived outcome of modules [Macro (L)]
The leadership group of the macro level respondents raised the concern that government school students may already be far behind their peers with respect to basic skills, and thus, any improvements after engaging with the CLIx modules may not bring them up to grade level. This could be perceived as a poor learning outcome from the modules, and would deter dissemination of the intervention.

Factors related to implementation of CLIx student modules:
1] Difficulty managing implementation of CLIx modules in large classes with small computer labs [Macro (L), Meso, Micro (HM)]
2] CLIx teachers feel overburdened, whereas other teachers in implementation schools feel left out [Meso; Micro (HM)]

There was convergence among the three groups regarding anticipated challenges in implementing CLIx modules with large classes. The meso level respondents stated that selection of particular domains for implementation of CLIx modules has created an issue within schools, reporting that social studies and other language teachers feel left out and do not join sessions even when asked. As a result science, maths and English teachers feel they are overloaded with additional work.

Outliers:
1] CLIx modules require more time to teach [Micro (HM, T)]
2] Time delay between teacher training and module implementation [Meso]
3] Difficulty maintaining students' interest [Meso]

Interviewees from the micro level felt that the additional time required to teach using CLIx modules would deter their usage. This concern exacerbates the aforementioned concern regarding teachers' pressure to complete the syllabus. The meso level respondents mentioned that the time delay between teacher training and module implementation poses a significant deterrent to dissemination, as this lessens teachers' motivation and confidence to implement the modules. The meso level interviewees also felt that students' disinterest in the modules or using computers to learn would be a potential deterrent to dissemination.

Factors related to the overall intervention:
1] Lack of shared understanding about CLIx [Meso, Micro (HM)]

The meso level respondents reported that even after the beginning of implementation, every stakeholder seemed to have a different idea of what CLIx is about. At the micro level, principals were unable to elaborate on what CLIx is, although their teachers had attended the CLIx professional development trainings.

Outliers:
1] Misaligned goals of Intervention [Macro (T)]
2] Lack of messaging around Intervention [Macro (L)]
3] Organization is top-down approach – teachers do not have ability to create their own content [Macro (T)]
4] Organization of project did not provide for cross-team coordination [Macro (C, T)]
5] Difficulty in maintaining motivation of field teams [Meso]

Interviewees from the macro and meso levels had divergent thoughts about factors related to the overall intervention that would impede dissemination. An interviewee from the technology group expressed that there was a "broken thread" from the original intent of CLIx; that the emphasis on exploiting technology for collaboration and communication has been lost in the current development. In the current modules, this individual stated that connectedness via communication, collaboration, working together, sharing, and feedback are not emphasized enough. Another point addressed by a member of the macro level was messaging around the intervention, stating that there is need for a better strategic communication plan to address "quality education at scale in India" and to communicate the Initiative's value proposition. Another interviewee felt that the top-down approach of the intervention would dissuade teachers from adopting and using CLIx modules; that teachers' inability to create their own content would produce a lack of

ownership and create a significant deterrent to adoption and dissemination. With regard to intra-CLIx team considerations, one interviewee expressed that the organization of the project did not allow for needed cross-team coordination. Lastly, a member of the meso level stated that maintaining motivation of the field teams would be a deterrent to adoption and dissemination, as they are the 'front lines' to teachers and headmasters.

[2] Adoption and Scaling

1] Lack of support for implementation by schools and government will cause failure [Macro (L, T, I), Meso, Micro (HM, T)]

Although all groups converged on the idea that support, both external and internal to schools, was crucial for adoption and scaling, each group articulated a slightly different emphasis when referring to the type of support. Within the macro level, the leadership group emphasized the role of governments as an "ecosystem partner" and felt that lack of this support may be a challenge to adoption. The curriculum and technology groups articulated that lack of technology support is a key issue, stating that schools need a resource person to assist with infrastructure development to ensure reliable resources such as electricity. The meso and micro groups placed the responsibility on the government, stating that government leaders and district administration should take responsibility for maintenance of ongoing programs and that they should order CLIx to be placed in timetables. Lastly, the teachers articulated that school management should take responsibility, noting that there are currently no incentives to encourage technology use.

Outliers:
1] Lack of strategic outreach plan [Macro (L)]
2] Lack of support from participating partners [Macro (T)]
3] Lack of local input for project [Macro (I)]
4] Negative perceptions about use of technology [Micro (P)]

Sub-groups within the macro level viewed three different areas as impediments to adoption. Lack of a specific strategic outreach plan and lack of ownership shown by participating partners were cited as factors. In addition, failure to tap into resources that would sustain the project was noted, e.g., teachers' local knowledge of how to best implement the program, advice from leadership teams like the headmasters, or local colleges. Lastly, parents' perceptions about the value of technology use for education is a consideration, as some parents articulated that children use mobile phones and computers for enjoyment and rarely for learning.

[3] Roles and Expectations

There was no convergence regarding barriers to adoption and scaling related to roles and expectations. However, significant barriers were articulated by specific groups of interviewees within the micro level, as noted below.

Outliers:
1] Headmasters feel they have no role, or they do not understand their role in the project [Micro (HM)]
2] Teachers do not understand their role in project. This was articulated as being in existence at the time of the interview [Micro (T)]
3] Perception that technology is a threat to teachers' role [Micro (T)]

Some headmasters reported that they did not know what their role was in relation to CLIx; a large number of headmasters reported feeling that they have no role in the project at all. Other headmasters expressed that their role is to maintain the school rather than projects. Teachers also articulated uncertainty about their role in the project, stating that they were unsure of how or when to implement the modules, and asking for support from CLIx personnel when trying to implement them. In addition, some teachers voiced their concern that the use of technology would replace them.

Implications and Future Work

As mentioned earlier, this White Paper presents the findings of Round 1 of Innovation Diffusion Process Documentation. The data provides a picture about the key visions, ideas, imaginations and concerns about the innovation largely prior to the intervention or, in the case of micro level respondents, soon after the intervention was rolled out. In order to study how innovation diffusion charts out and how the process evolves, it would be imperative to compare the current findings with a second round of data collection.

Upon reviewing the two set of factors discussed in the earlier section, it was evident that the responses across the three categories of respondents ranged on a spectrum from those that were envisioned as ideal characteristics before the intervention to those that were seen as pragmatic concerns before or immediately after the intervention. This pointed to the fact that before or soon after the innovation began, all respondent categories expressed a mix of both ideal scenario as well as real-life practical scenario. It would hence be important to study in the second round of data gathering how these imaginations and concerns evolve after considerable traction is achieved by CLIx on the ground.

It would also be important to study why certain groups of respondents express certain kinds of concerns or imaginations about the diffusion and what are the contrasts and gaps in these articulations over a period of time. In the foregoing section, while we have found convergence on certain areas across the three categories of respondents, i.e., teachers' lack of support or interest in the intervention as an impeding factor, and certain outliers, i.e., teachers' articulation that modules were very basic and weak, it would be useful to examine if these convergences or outliers sustain over time, as well as any further continuities and discontinuities in data.

Future work may also investigate factors that moderate convergence or divergence of respondents' characterizations of CLIx, such as teachers' completion of the Reflective Teaching with ICT (RTICT) program, or their active participation in communities of practice. These investigations may also provide valuable insights for scaling of educational innovations.

In summary, our work delves into the complexity of adoption and diffusion of an educational innovation, at scale, in its initial stages. Our findings highlight stakeholders' numerous expectations and uncertainties that accompany such an undertaking. As educational technologies become a more viable option for scaling quality learning experiences, it is important to understand these critical aspects of the adoption and diffusion process in the Indian context.

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Annexure 1
Tools used in Round 1 of Data Collection

To be inserted from here
https://drive.google.com/file/d/0B-8J9Z4MBdUgVEdJVkVNcU5GOGc/view?usp=sharing

Annexure 2
Mind-map on Factors that Promote and Factors that Impede Innovation Diffusion

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Annexure 3
Factors that Promote Innovation Diffusion

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Annexure 4
Factors that Impede Innovation Diffusion

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