ICT and Education interventions in India: Teachers' perspectives on challenges in government schools

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Abstract. This paper draws from three currently implemented ICT in education interventions by NGOs in government schools in India. Students from mostly lower socio-economic backgrounds attend government schools in India. These interventions can be classified as content or pedagogy focused using ICT. The objective of the study was to compare teachers' perspectives of challenges and values added by these ICT interventions. Inadequate ICT infrastructure in education and lack of school time has been well documented in the literature as the main barriers for ICT in education use by teachers in the developing countries. A sample of government schools teachers were interviewed at their respective projects to gauge challenges they face in implementation and value they attach to their respective ICT enabled interventions. The data indicated that regardless of the nature of ICT intervention (content or pedagogy focused), a majority of the teachers across the interventions reported external factors- technology infrastructure, connectivity, power, and poor computer/digital tool to student ratio as the main challenges they faced in implementation. On the other hand, the value teachers attached to these interventions varied as per the specific nature of the intervention. Suggestions to state and interventions are listed in the paper.

Key Words: ICT in Education in India, ICT in government schools, ICT challenges in schools

Keyphrases: Computer aided learning (95), pratham infotech foundation (79), digital education (70), information technology (70), foundation course (50), regular course (50), working condition (50), school building (40), education system (40), school teacher (40), digital literacy (40)

1. Introduction

National Policy on Education in India 1986, modified in 1992 stressed upon the need to include technology in school education to improve the quality of education. This policy led to two central schemes for ICT and Education mostly focusing on computer literacy and computer aided learning. In 2012, ICT policy in School Education came into existence with the mission to develop, accelerate, support and sustain ICT and ICT enabled activities and processes to improve access, quality and efficiency in the school system. Following the National Curriculum Framework, a curriculum for students and teachers' use of ICT in schools was developed guided by the National Policy on ICT in School Education. This curriculum guides on pedagogy of technology use, and availability of different software for enriching the learning process and creating opportunities for problem solving and critical thinking. It stated that use of technology should not be about learning only ICT skills, but to develop knowledge in the core subject areas. [1].

Although these policy documents and guidelines sound aligned to standards and practices in ICT in Education, there is a huge gap between these policies and curriculum suggestions and reality on ground. As per 2004 ICT in Education Asia report, 45% of secondary schools and 17% of primary schools in India do not have a computer lab [2]. There is no systematic data on whether these computer labs are even functional. In many parts of India, the digital divide is all too apparent and is mediated by the variables of gender, age and socioeconomic status (see, e.g., Eamon, cited in [3]). Socio economic status is the primary reason for the high dropout rate from school in many parts of India (see, e.g., Pankaj & Poornima, cited in [3]). The interventions discussed in this paper all cater to the underprivileged or lower socio-economic section of the Indian population. Besides dearth of ICT infrastructure, there is no robust plan for professional development of teachers in India to prepare them to use ICT in their curriculum and classroom practices [4].

Inadequate ICT infrastructure in schools have been well documented in the literature as a central barrier for use of ICT in education by teachers in the developing countries [5], Pelgrum, in [6], Al-Oteawi, in [6]. However, there are many other factors which determine successful use and integration of ICT in education. For example, competence of teachers to use technology [7] and [8] professional development in ICT use of the teachers [4], and teacher beliefs about technology use [9]. Numbers of researchers have grouped the barriers in different ways, for example Ertmer [9] grouped barriers into first level-teacher and second level. In the UK, Becta [8] report classified barriers as teacher-level barriers such as lack of time, confidence, and resistance to change, and the school-level barriers, such as lack of professional development and technical problems and lack of access to resources. Venezky [7] points out that depending on the nature of the ICT intervention, the demand for certain factors will be more critical than others.

This paper presents three ICT enabled interventions working in the government schools in India, out of which one of the interventions is also implemented in Madrasas (Muslim religious education schools integrating school subjects.) All three interventions use different methods and tools but all focus on use of ICT to improve student learning of subjects. These interventions are designed by not-for-profit organizations and run in government schools to reach the underprivileged sections of the population. In India, government schools are mostly accessed by children from lower socio-economic backgrounds. The central question that weaves through all the interventions presented in this paper pertains to challenges faced by teachers in implementing the NGO run interventions on ICT in education. The paper analyzes opportunities and challenges identified in each of the interventions and makes suggestions to the state, organizations and funders for improvement in the design of the ICT in education interventions in government schools. The three NGO run ICT interventions are listed below:

1. *Computer Aided Learning by Pratham Infotech:* Pratham InfoTech Foundation (PIF) is a non-profit organization that works in India to bridge the digital divide, facilitate the adoption of information technologies in education, and equip disadvantaged youths with skills, tools and capabilities that new global economy demands. PIF runs ICT based training, educational and community capacity building programs in underserved schools and communities. Computer aided learning program in government schools focus on educational software for learning of basic skills in Mathematics and English at primary level, and ICT skills at secondary level.
2. *Yadgir ICT program:* Kalike – Tata Trusts one of the biggest philanthropies in India implements a technology driven learning improvement program for 40 government high school students (grades 8th to

10th) in Yadgir district of Karnataka. The program aims to improve: a) The learning environment in the schools, b) Quality of student – teacher transaction process.

3. *Integrated approach to Technology in Education in government schools and government run Madrasas:* Integrated approach to Technology in Education (ITE) is an initiative of Tata Trusts, resourced by Tata Institute of Social Sciences, and implemented by NGO partners at 18 projects in seven states, Assam being the model scale up state. The program is currently reaching 29000 students across seven states in India. ITE is a pedagogic framework for integrating technology in teaching and learning where teachers undergo professional development to integrate ICT meaningfully in their lessons in the curriculum, and facilitate students to use ICT for knowledge deepening and authentic learning.

2. Objectives of the study

The objectives of this study are to identify:

- the value teachers attach and the kind of challenges teachers' face in implementing each ICT intervention in schools/classrooms.
- the types of challenges that are common across all three interventions
- suggestions to improve ICT practices in government schools in India

Four small studies were conducted focusing on the above objectives.

3. Study 1: Computer Aided Learning- Pratham Infotech Foundation

The Computer Aided Learning (CAL) intervention at Pratham Infotech Foundation (PIF) involves using educational software including games and tutorials in primary schools to foster basic learning skills in English and Mathematics. This CAL program is in English and Hindi languages. The Foundation developed partnerships with many corporate houses, government bodies as well as public and private schools. Since 2004 PIF has reached approximately 500,000 children in 1100 schools of 13 states in India. Pratham InfoTech Foundation (PIF) in partnership with Bharat Petroleum Corporation Limited (BPCL) partnered to initiate the Computer Aided Learning Program in the year 2009 with Zilla Parishad (government) schools of Uran block. Uran lies at the Western side of Raigad district, Maharashtra with a large amount of Marathi and other regional medium schools. It is situated east of Mumbai and is primarily a fishing village, which has developed into a special economy zone. The program was implemented in phases to cover 62 schools enrolling 15000 students in Uran.

3.1 Method

As part of this study one on one interview sessions were conducted with 10 teachers out of 62 teachers in 10 government schools in the Uran block. During the interviews, the teachers were asked close ended questions regarding the challenges they face implementing the CAL program in primary sections by PIF. The teacher responses were further analyzed and frequencies were measured for the emerging themes which are: infrastructural issues, pedagogical support, language compatibility, technology skills, lack of time and limited content.

3.2 Results

Analysis of the interviews identified the following themes for challenges teachers face in implementation:

1. **Infrastructure challenges:** 8 out of 10 teachers indicated that Internet connectivity is a major challenge in implementation of the CAL program.
2. **Lack of time:** 6 out of 10 teachers agreed that the integration of CAL program within their regular school timetable is a challenge. They further indicated that the assigned time for the CAL sessions is not sufficient.
3. **Training support to implement the program**: 5 out of 10 teachers indicated that capacity building for teachers in CAL program will equip them to help students during the CAL sessions.
4. **Teachers' capacity building/pedagogy support:** 4 teachers indicated that they are not confident using technology and that hampers the support they can provide at the CAL sessions.
5. **Language compatibility:**Asthe students' home language and medium of instruction at schools is Marathi, 4 out of 10 teachers suggested that it would be helpful if the CAL content is available in Marathi as well.

6. **Limited content**: 3 teachers indicated that CAL offers limited content and educational software and they often find students bored and distracted using the same tutorials, games, etc. in the CAL program. The teachers asked for challenging activities to sustain students' engagement.

4. Study 2: Kalike Education Program

Kalike Education program uses technology driven learning improvement program for grades 8th to 10th catering to students of 40 government high schools in Yadgir district of Karnataka. The objective of the program is to improve the learning environment in the schools, quality of student – teacher interaction in classroom, and quality of students' learning of subjects. Each learning center in the schools is run by an NGO facilitator in coordination with the school teacher. Based on the children's' strength, small groups (3 children in one group) are formed based on their academic performance of previous year. Each group has an average, below average and above average performing students to motivate peer learning and mentoring. Each group is provided with a portable DVD player, DVDs/Tabs preloaded with multimedia content for core subjects. The sessions are integrated in regular time table of the classroom. More than 400 Audio–Visual based digital content that complement the curriculum based chapters is designed for core subjects like Science, Mathematics and Social Sciences. The Re-Teach videos are helping 10th grade children to revise the syllabus of 8th and 9th grades curriculum. Revision videos and worksheets are used by the children to practice before they attempt the board exams. The audio-visual digital content is available in both English and Kannada language.

As part of implementation strategy, this program works with children, parents, school management, teaching community and key education functionaries. Besides improving learning of concepts in core subjects, the role of technology here is to also foster peer learning making the class highly interactive which is seldom achieved in secondary schools' due to large size and shortage of teachers.

4.1 Method

As part of this study, one-to one interview sessions were conducted with 10 out of 89 randomly selected government school teachers implementing this program. During the interviews, the teachers were asked questions pertaining to the value they see in the program and challenges they face during implementation. The interviews were recorded, and the responses were further classified under significant themes emerging and frequencies of responses in each theme were collated.

4.2 Results

Teacher responses related to value teachers attach to the Kalike-program:

1. **Increase in interest of students:** All 10 teachers indicated that the students find the materials engaging and their interest in their studies have improved with this program.
2. **Facilitating peer interaction**: 9 out of 10 teachers indicated that mix-grouping of students based on their academic performance facilitate peer learning, mentoring and self-evaluation. 7 out of 10 teachers also reported that this grouping help teachers understand students' learning needs, which otherwise is not is difficult to understand in large classrooms.
3. **Access to technology aided learning for the poor:** 9 out of 10 teachers reported that this program provided an opportunity for the rural and disadvantaged students of government schools to access technology aided learning. They say that this technology advantage was otherwise only restricted to students studying in private schools of urban areas.
4. **Teachers improving their subject knowledge:** The teachers acknowledged that they benefited a lot from the audio-visual materials. 9 out of 10 teachers indicated that they used the DVDs as additional reference resource material for their teaching preparation.
5. **Conceptual clarity for students:** 8 out of 10 teachers were of the opinion that examples related to local context in the audio-visual content resulted in better conceptual clarity in comparison to what is achieved through lecture method. As one of the teachers from The High School, Honagera shared: "The audio-visual material is helping my students in getting better conceptual clarity which adds value to my classroom instruction. Because of ability based mixed grouping of students, they are helping each other in learning. In my theory classes, mostly the sharp learners are able to grasp the content and concept immediately as I

teach, while the slow learners do not catch up. But with AV content, even the slow learners who are otherwise shy and who hesitate to ask for clarity are able to learn in their own pace with repeated visits to the same content."

6. **Opportunity to clarify doubts:** The students here are provided with paper chits to write their doubts and the teacher provides solution in the following class. 8 out of 10 teachers reported that this is a good practice, and provides opportunity for those students who otherwise hesitate to ask questions in the class.
7. **Improved academic grades:** 8 out of 10 teachers reported increased confidence among students and improvement in exam results.
8. **Used for 'proxy classrooms' sessions**: 7 out of 10 teachers reported that the audio-visual classes are used to optimize students' time in 'proxy classrooms' when teachers are absent.

The Challenges/Issues in the program:

1. **Infrastructure challenges:** Power supply was one of the major problems in the schools to implement this program. 8 out of 10 teachers indicated power failure as a major issue which disrupts sessions. They expressed that many times they feel helpless when there is no power supply to schools for one whole day resulting in drying up of batteries of the equipment and backup power supply.
2. **Needs improvement of Content Design:**
    a. More videos than still images: 8 out of 10 teachers suggested to add more content videos to the material, particularly for Science subject, where they feel that still images restrict the imagination and videos would give better conceptual clarity.
    b. Updated content: Since the syllabus set up by the education department changes quite frequently. 7 out of 10 teachers suggested updating the content by introducing the new content 'patches' as soon as possible so that they are enabled to cover the subject updates in time. Ms. Jyothi from Government Girls' High School, Yadgir shared that: "I personally use the AV content as additional resource material which helps me to prepare for next class. However, I become helpless when there is no power supply during school hours which interrupts the smooth implementation of the program. But then, this is a state level issue. In future, I suggest to add more animations or videos particularly for science subject, so that children get better clarity. You can still try to add more examples and content which is beyond our regular text prescribed syllabus."

3. **Need content deepening-outside the textbook:** 7 out of 10 teachers reported that the audio-visual content in the program are focused around the textbook and there is a need for more examples and supporting content beyond the textbook.

4. **Time issues:** Since the audio-visual content class is supplementary and does not replace the regular teacher lectures, 6 out of 10 teachers felt that adjusting the slots for the same in their regular school timetable is difficult.

5. Study 3a: Integrated Approach to Technology in Education in government schools

Integrated approach to Technology in Education (ITE) is an initiative of Tata Trusts, resourced by Tata Institute of Social Sciences, and implemented by NGO partners at18 projects in seven states of India, Assam being the model scale up state. ITE is a pedagogic framework for integrating technology in teaching and learning [3]. It provides adolescents an opportunity to authenticate their learning at school using ICT applications that are fast becoming requisites in the 21st century. The geographical areas of the program are resource poor, such as tribal and Muslim minority in Eastern and North-Eastern States. The program runs in supplementary learning centers, Madrasas (government aided and private imparting school subjects) and government schools [12].

5.1 Method

One to one interview sessions were conducted with 16 randomly selected master teachers amongst 42 master teachers implementing ITE in government schools in Assam. The mode of interviews was face to face (11 teachers) and telephonic (5 teachers). During the interviews, the teachers were asked questions regarding the value addition or value teachers attach to the intervention and challenges they faced while implementing ITE. This interview data was summarized and frequency of responses on value and challenges faced while implementing ITE in classroom were calculated. The common themes from the 16 interviews are described in the following section.

5.2 Results

Value addition of ITE in the teaching learning process in government schools in Assam:

1. **Ensuring active participation of students in the classroom:**13 out of 16 teachers indicated that ITE helps in creating an active classroom where students are actively engaged with classroom activities related to subjects.
2. **Increased scope for research skills in students:**11 out of 16 teachers indicated that ITE helps students to go beyond the textbook content and students have made it a regular practice to use Internet and various resources other than their textbook to seek information. As one of the teachers shared: "…the activities during ITE class are very important and adds value to the textbook content. The students can look for more resources beyond textbook."
3. **Shift in teaching-learning methodology in the classroom:**11 out of 16 teachers shared that through ITE they are able to bring a change in their usual mode of teaching methodology, by making their classrooms more activity based. They have tried to incorporate similar collaborative and group activities in their usual classroom teaching which may or may not use ITE.
    a. 9 teachers indicated that ITE has provided an opportunity for more dialogue with students.
4. **BYOD by teachers:** In ITE, teachers are providing their own devices to students to search for online resources.Many of the schools where ITE is being implemented have poor or no Internet connectivity which at times slows down the process of project making. Witnessing the increasing interest of students in ITE, teachers are motivated to provide their own devices (primarily mobile phones with Internet connection) to students for accessing online resources. 9 out of 16 teachers shared that they are in the regular practice of providing students with this support.
5. **Teachers using Internet for subject related queries:**ITE has nurtured a practice among teachers to use online resources to better prepare them for their lessons. 8 teachers have shared that since the time they were introduced to ITE, they have started using various digital resources beside textbook for preparation of lessons.
6. **ITE promotes higher order thinking among students:**6 out of 16 teachersindicated ITE as a process that enable students to achieve higher order thinking skills. While making lesson plans, the teachers design the activities focusing on the levels of Application and Analysis of Bloom's Taxonomy.
7. **ITE giving scope for authentic learning and practical application of knowledge:**5 out of 16 teachers indicated that students, rather than limiting their understanding of concepts to textbooks, use ITE method to connect the concepts in the textbook with their real-life experiences. A teacher during the interview shared: "…use of audio visual in classrooms were there in my school earlier, but students failed to make that connection between real life and what they read in textbooks or saw in the videos. ITE helps to build that connection."
8. **Scope for instant feedback and reflection:** 2 out of 16 teachers indicated that compared to periodic assessments and test, ITE has the potential to provide continuous feedback and reflection in the classroom

Challenges faced in implementing ITEin Government schools in Assam:

1. **Infrastructure related challenges:**
    - *Poor electricity supply:* 14 out of 16 teachers shared that due to poor electricity supply, the regular ITE sessions are disturbed. Most of the schools do not have power backup.
    - *Internet facility:* the remote locations of the schools worsens Internet connectivity. 10 out of 16 teachers indicated that due to poor connectivity the students are not able to search resources online. Some teachers give their own devices to students to search online resources.
    - *Lack of adequate computer lab/ space and required number of functional computers:* 8 out of 16 teachers indicated that in spite of having a computer lab in their school, most of the computers are non-functional.5 teachers reported that their schools lack space to conduct ITE sessions.
    - *Poor computer- student ratio:* the lack ofsufficient functional computers in the lab results into a higher student computer ratio. 7 out of 16 teachers were of the opinion that this poor computer- student ratio is affecting the process of project making. Whereas 3 teachers also shared that they are struggling to provide opportunities to all students to participate during the ITE sessions.

2**. Lack of adequate school time for ITE:**

- *Time allocated is insufficient for an ITE class:* 6 out of 16 teachers were of the opinion that the 45 minutes time period assigned for the sessions is insufficient to conduct an ITE session.

3**. Limited access to ITE for teachers:** *In a given school, not all teachers are trained in ITE approach.* 6 out of 16 teachers shared that since all the subject teachers in their respective schools are not exposed to ITE training and approach, it limits the scope of ITE covering all the subject areas.

4. **Challenges related to teachers' skills to integrate ICT with lesson plans:** Since integrating ICT with curriculum and teaching method is central to ITE, a few teachers also expressed the need for more help in this area. Four teachers indicated that they still struggle in selecting topics that has scope for successful integration of technology. Three teachers indicated that they face difficulty in choosing appropriate learning activities for selected topics from their syllabus. Two teachers shared that they have difficulty in integrating technological applications in subjects like language and literature. 3 teachers felt that at times it becomes challenging to incorporate 21st century skills and authentic learning opportunities in their lesson plans.

5.**Language barrier while searching resources online:**Two out of 16 teachers reported that unavailability of authentic online resources in regional languages limits the scope of research on topics during the process of ITE project making.

6. Study 3b: ITE in madrasas

Madrasas are Muslim religious schools and the Madrasas selected for ITE implementation also impart education of school subjects. Only Madrasas run by state government were included for this study. These Madrasas are similar to other government schools, except that two religious subjects apart from school subjects are also taught.

6.1 Method

One to one interview sessions were conducted with 9 headmasters (out of 14 headmasters) and 12 assistant teachers (out of 78 teachers) who are directly involved in implementing ITE classes. Teachers were asked questions regarding the value ITE is adding and challenges they face while implementing the program. The interview responses were further analyzed and frequencies have been measured under significant themes that emerged from the interview data.

6.2 Results

Value addition of ITE implementation in the government Madrasahs in Hooghly:

1. **Students' interest in ITE:** All the headmasters and teachers interviewed (21) indicated that students have shown eagerness to participate in the ITE classes. Sometimes they even work on ITE projects during their lunch break. Overall, they felt that students' curiosity to explore beyond textbooks has increased. All the headmasters and teachers also shared that the students from Madrasas do not miss classes on the day when ITE classes has been scheduled.
2. **Opportunity for higher order thinking***:* All the headmasters and teachers interviewed shared that once students are at the upper primary stage, they enter a stage where they need more challenge to be able to develop their higher order thinking skills.
3. **Eagerness to learn beyond textbooks***:* 18 out of 21 headmasters and teachers indicated that ITE has encouraged students to go beyond textbooks, to identify new things and situations related to their real-life experiences.
4. **Confidence in students has increased:** According to 17 headmasters and teachers, after introduction of ITE in the Madrasas, students have become more confident in their articulation. They are able to respond confidently to questions pertaining to the topics used in ITE projects. In the regular non-ITE classes also they were found more confident in their interaction with teachers.
5. **Use of Internet for research:** 11 out of 21 headmasters and teachers indicated that students use Internet for finding any new information or answering queries related to topics from their curriculum.
6. **Scope for developing problem solving skills among students***:*10 headmasters and teachers reported that students have developed problem solving skills by using ITE.

Challenges faced in implementing ITE in government aided Madrasas in Hooghly:

1. **Poor/no Internet connectivity:** Madrasas are located in remote villages where connectivity is a regular issue. Students struggle every day to access Internet for searching required information for their projects. All the headmasters and teachers shared that their Madrasas have poor or no Internet connectivity, except when they have an access to a dongle during ITE classes.
2. **High student to computer ratio:** All teachers and headmasters expressed their concern regarding high student to computer ratio which impedes progress of projects and students' interest in completing projects.
3. **Insufficient time allocation in ITE classes:** In the government Madrasas, time allocation for ITE classes is 180 minutes which is four classes in a week. All headmasters and teachers reported that this time is insufficient for ITE classes.
4. **Shortage of teachers:** 15 out of 21 headmasters and teachers reported that no recruitment is done in the government Madrasas in the last five years and they are facing a huge number of teacher shortage, which affects teachers' contribution to ITE classes.
5. **Inadequate space/lab:** 11 out of 21 headmasters and teachers shared that their Madrasas have no separate room to conduct ITE classes.
6. **Teachers' proficiency in computer applications:** 8 out of 21 teachers and headmasters indicated that many teachers are not comfortable with computer applications which hinder their participation in ITE implementation.

7. Comparing values teacher attach to the interventions and key challenges across interventions

Pratham and Kalike interventions were focused on content mastery using ICT with the aim of improving understanding of the specific concepts in syllabus and basic skills in English and Math. In contrast, ITE was project based learning within the curriculum using ICT focusing on pedagogy and going beyond textbooks. All interventions were implemented in government schools in rural areas for students from lower socio-economic backgrounds.

7.1 Added Value

The addedvalue or value teachers attach to the intervention across interventions did not have common themes. Except that access to technology was seen as an added value at both Pratham and Kailike, and increase in students' interest emerged as a common theme at Kailike and ITE. This could be because teachers perceived value addition as very specific to the individual nature and design of the interventions which were different here. For example, Kalike intervention which focused on ICT use for conceptual understanding, a majority of teachers here expressed main value addition were increased interest in students in studies, and the conceptual clarity for teachers and students. Also as the intervention design required students to work with other students, peer interaction and interaction with teachers also emerged as major value addition. ITE which emphasizes on 21st century skills, and is based on teachers designing lesson plans and students creating projects using ICT, the value added identified in the interviews mostly pertained to students' increase in interest in subjects covered in the curriculum, student participation, higher order thinking and research skills, going beyond textbooks, and more importantly improvement in teaching methods.

The teachers' responses on value addition at two different ITE contexts mostly showed similar trends (higher order thinking and research skills-21st century skills, interest and participation). However, it was interesting to note that madrasa teachers' responses indicated an increase in student's confidence in classrooms which was not identified for ITE in government schools in Assam. It could be that students' confidence at madrasas is perceived as a significant achievement since madrasas are perceived to be more traditional spaces. On the other hand, Assam teachers' responses brought in teacher related added value which did not emerge in Madrasa teachers as their responses were very centered to student gains only. For example, Assam school teachers in general felt ITE contributed positively to their teaching methods and that teachers shared their own smartphones with students for connectivity. This difference could be due to the difference in the two cultures, socio-economic (smartphone access) or religious (student gains emphasized as priority on moral grounds) - in Madrasas in government schools and government madrasas, or due to the maturity of the program at two contexts; government madrasas being fairly new implementation than the former, and the realization of ITE as a catalyst for overall pedagogic change in teaching may have not emerged yet.

7.2 Challenges

ICT infrastructure challenges emerged as the highest frequency themes based on the responses of teachers across all interventions. Although, not accounting for the highest responses from teachers at all interventions, time constraint for implementation has been found as a common challenge across interventions for many teachers. These findings are consistent with the literature which emphasized infrastructure challenges as key to ICT interventions in schools of developing countries [5], Pelgrum, in [6], Al-Oteawi, in [6]. The barriers to use ICT intervention in secondary schools in India were studied by Prasad et al [10] who found that infrastructure was one of the key challenges. Lack of adequate time to implement ICT interventions has been also indicated by Becta as teacher level barriers. Khan et al [11] study on barriers in ICT in schools in developing countries and focusing on Bangladesh also found lack of time and infrastructure support as key challenges. These two challenges if viewed from Ertmer's internal and external factors framework, clearly fall into the category of external factors. Since these challenges were self-reports of teachers, it is expected that the teachers find it easier to externalize the challenges and perceive them as key barriers hindering their implementation of ICT interventions.Homogeneity of socio-economic contexts of government schools in India could be identified as another reason for the emergence of this common theme. Although the interventions were very different from each other, and each one was implemented in different states of India, they all shared the context of working with and for underprivileged children with more or less resource poor settings, in terms of distribution and maintenance of ICT infrastructure.

As Venezky pointed out, depending on the nature of the ICT intervention, the demand for specific factors will result in more critical challenges than others. Such challenges were specific to the design of the intervention. For example, at Kalike and Pratham, where the intervention was focused on content and basic skills, there was demand for video based content and upgrading of the content, and opportunity for going outside the textbook (Kalike), and need for content in local language (Pratham). For ITE, the major challenge apart from infrastructure was time constraint because teachers are required to design and integrate ICT activities within their classrooms. It was interesting to note that 'scope of students to go beyond textbook' was a value expressed in ITE but was expressed as a challenge by the teachers at Kalike.

Table: Comparing Value and Challenges across interventions

Name of the Intervention	Type of intervention	Method used	Sample used	Key values added	Key Challenges
Pratham Infotech Foundation	Skill based (technical)	Structured Interview or Survey	12.5% (10 out of 80 teachers)	a)Increased students' access to technology b)A lab with functional desktops	a)Infrastructural Challenges (like unavailability of internet, power supply) b)Lack of time to integrate program with their class time table c)Training support to implement the program
Kalike	Content based and student worksheets	Structured Interview	11% (10 out of 89 teachers)	a)Increase in interest of students in studies b)Facilitating peer interaction both inter & intra group c)Access to technology aided learning for the poor	a)Infrastructural challenges (like -unstable power facility and lack of power backup facility) b)Needs improvement of Content Design (like - inclusion of more videos than still images) c)Needs content deepening- outside the textbook
Integrated Approach to Technology in Education in government schools	Project and Problem based intervention	Structured interviews	40% (16 teachers out of 42 teachers)	a)Ensuring active participation of students in the classroom b)Increased scope for research in students c)Shift in teaching-learning methodology in the classrooms	a)Infrastructural challenges (like - poor electricity supply; poor Internet facility b)Lack of adequate school time for ITE c)Limited access to ITE program for teachers in a particular school
Integrated Approach to Technology in Education in Madrasas	Project and Problem based intervention	Structured Interviews	64% headmasters and 15% teachers, total 21	a)Students interest in subjects has increased b)Opportunity for higher order thinking c)Eager to learn beyond the textbooks	a)Infrastructural challenges (like - poor Internet connectivity) b)High student-computer ratio c)Insufficient time allocation for ITE in madrasas

8. Suggestions for interventions and State

- Although this study was limited to teacher responses and the sample was very small, it is rare to find studies like these which compare values and benefits of ICT interventions in government schools in India. The Indian government schools have many ICT interventions, the results of this study can guide a

systematic and large-scale review of value and challenges will be very useful for resource allocation and policy decisions.

- Create a consortium of organizations and companies working in the area of ICT in Education in government schools and facilitate a dialogue amongst them to learn and build on each other's' strengths and influence to improve design and implementation.
- Enable ICT interventions to adopt local language in their design and implementation, research and analytical skills in students and teachers, and connect concepts to real life-beyond textbooks.
- Facilitate integrating ICT interventions to maximize benefits for teachers and students.
- Improve infrastructure in government schools, decentralize maintenance and allow School Management Committees or teacher groups to monitor infrastructure procurement and maintenance.
- Leverage teachers' time within school hours to implement the interventions, design lesson plans, explore resources etc.
- Integrate ICT intervention components within the assessment system to justify students and teachers time spent.
- Allow flexible time-tabling for ICT integration and student projects.
- To avoid redundancy and monotony of the content which is expensive to develop and update, focus on teacher skills to adapt or identify readymade open content resources.
- Invest in rigorous preservice and in-service programs that provide professional development on teachers' skills to integrate ICT within curriculum, technology skills, foster student use of ICT, project and problem based learning, equip teachers to identify and adapt content and resources, and foster authentic learning using ICT.

9. Limitations

- The study suggestions and implications are limited to teacher responses only.
- The sample is very small across interventions and not all sampling procedures were randomly assigned.
- The interview and survey tools used across interventions were a little different but they all focused on challenges and values.
- Two out of three interventions were in secondary schools whereas one was from primary schools. This difference may have influenced some of the results.
- All the states for the interventions were different and these differences due to cultures of the state are not analyzed and discussed in this paper.

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