

Early-stage practicalities of implementing computer aided education: Experience from India

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Abstract

Projects reaching computers to low-income areas to bring some form of technology equity have been in effect since the 1980s. Such initiatives have tended to assume a developmental motivation in the endeavor, especially in poor nations. Investment in such ICTD projects has risen out of a growing faith among state and private agencies that knowledge of computing is an important link in the human development, and that early introduction has important long-term dividends. In this paper, we look at free computing in public schools in rural India. Observing patterns that signify “success” at both the communal and individual levels, this study proposes a framework for studying computer aided learning projects in low-income schools, and raises questions about learning and project organization that researchers in ICT in education may look at for hypotheses generation.

1. Introduction

After several years of installing computers in schools, it still is difficult to make definitive claims that the impacts of such deployments are necessarily positive. Studies have shown that development can be lop-sided.[1] and that the importance of instructors can lead to classroom pedagogy being reflected in the use of the computers[2][3], that for instance, children from marginalized groups may end up doing drills whereas those from better empowered groups get access to the more creative aspects of computing. Despite evidence that computers do benefit children’s learning [4] it is clear that the cognitive benefits from computers are only one part of the equation in a larger range of mostly social factors that impact the running and adoption of computers in schools [5]. This importance of social issues is a theme consistent with our preliminary findings, and is reflected throughout.

India runs the third-largest educational system in the world, and despite its recent increases in primary school enrollment, only a fraction of the population makes it out of high school.[6] Data shows two important trends – first that even among the children that remain enrolled, there are dramatic shortcomings in the actual ability to read or even do basic math. Almost a third of children in the ages of 11-14 were unable to read at the expected level for class 2, and almost half were unable to do basic division. The second disturbing trend is teacher attendance is a problem, which is further exacerbating the already impacted learning environment with a high student-teacher ratio.

Computer-aided learning centers (CALCs) in primary schools are common in almost all the states of India. These aim to supplant the teacher in the pedagogical process, by using computer-based interactive content. They also act as a first introduction to technology for children in low-income areas where access to computers is otherwise limited if not entirely absent. By November 2005, over 16,000 rural public schools in India had been covered by such schemes. These schemes broadly involve two things. First computers centers are set up within school premises, second – software is provided along with a curriculum that is implemented in the schools. Such computer aided learning centers (CALCs) typically have anywhere between 3-20 computers per school (sized between 250-2000 students).

1.1. Functioning of computer aided learning

Though the asset costs for these projects are usually borne directly by the respective government, the software and project implementation are often done by private groups – the largest of which is the Azim Premji Foundation (APF), which had already administered CALC projects on behalf of various state governments in over 10,000 Indian schools in 2005.

Each CALC class normally has one grade of children per active session. Children aren't in what could typically be classified as a "computer class" but instead use various learning content CDs to learn something that is part of their existing school curriculum. Even though the project is meant to serve children from grades 1-7, it is less common to see children below grade 3 using the PCs. Observations showed that at a time, anywhere between 3-10 children use each machine in an active CALC session. In such cases, all the children generally operate the I/O themselves without any immediate supervision.

The content designed for CALCs is usually in the form of auto-run CDs, designed by the APF. These are typically meant to be self-explanatory, and modular – thus each CD is meant to be a standalone package for a specific topic (say human anatomy, or mathematical fractions) and children are generally expected to be using CDs relevant to material covered presently in their classrooms. Almost all the CDs are designed to be interactive, with some component of narrative, and some multiple choice game segments. A typical CALC in session is noisy. The CDs have multimedia content, which includes video/sound – and all computer units come with speakers, most text content is generally reinforced through audio content. Each CALC session is supposed to last the same period as a typical 'class' – thus about 35-45 minutes.

This study, through 22 schools between May 2005 – Jan 2006 and was interpretive, rather than hypotheses-driven. Our main methods were interviews and observations. The list of 14 selected districts includes Bangalore, Bellary, Coimbatore, Cuttack, Dakshin Kannada, Gadag, Ganjam, Kodagu, Mayurbanj, Mumbai, Pondicherry, Puri, Raichur, Udipi. The total research included 14 observations and 136 interviews from 22 schools. Interviews ranged 3 min. to 180 min. In all, 18 school heads were interviewed, 28 subject teachers, 7 computer teachers, 27 students, 15 parents, 4 village council members, 21 community members, 5 government officials, 8 agency administrators. For the sake of brevity, the details of the methodology are omitted here, but available at other documents related to the same research.[8] The work in this project has also led to the development of a multiple-mouse application to support multiple users at single PCs, an issue of relevance to most developing regions. [9]

2 Organizational issues impacting CALCs at early stages of operation

An important question for CALC implementations is on the level of structure versus creativity in the functioning of computer centers. There are three basic issues here – first, the question of 'Curriculum Mapping' – ie. creating a plan for how exactly the curriculum is administered in relation to the classroom courses. The second issue is that of 'Interaction Modeling' – ie. the interaction between the children and CALC modules – both time spent and material viewed, and in the teacher's role in the CALC center. The third issue is that of 'Operational Implementation and Transfer' – ie. issues surrounding the implementation of CALCs – mainly between the school itself, and the new actors in the equation that are either directly involved with the school due to the CALC set-up process, or passively involved through training. These factors though do are all layered over one paramount fact – that children loved computers (and jumped quickly to the interactive/game pieces on the applications) in every site visited, and rarely would children miss a computer class.¹

2.1. Curriculum Mapping

The mapping of the curriculum – or the plan of time allocation for various academic topics is done at a high level - for instance, state boards draw out rough timetable plans for the subjects a child needs to learn over a period of a year, and offers some recommendations for how these may be implemented. The same applies for CALCs – implementing agencies such as the APF require that schools with the CALCs create timetable plans to make sure the computer lessons are incorporated into the weekly curricula. During our research we found that CALCs found it difficult to implement timetables, in part due to the irregular nature of access to electricity, technical problems, schedule changes due to factors such as absence from the CALC session – either due to assignment of external tasks, or due to In the first round of visits to CALCs, which included 18 schools, only two were running to timetable on the day of the visit.. During the second round of visits, in 3 of 4 schools, timetables were being perfectly implemented on the day of visits – and all classes entered and left the CALC at the requisite hours. This second set of schools were all recently started, and each had uninterrupted electricity during school hours. Moreover, since a

¹ Perhaps the only complaint we got from children was that their favorite film stars were not adequately represented in the CD content

CALC is rarely large enough to accommodate all students, it was sometimes the case that half or a third of the class had more access to the CALC.

There are two problems with curricular mapping to timetables – first, it does not estimate worst case scenario benchmarks in adaptive situations. Thus, there is no way to track what child has had how much access to material – since the information is not collected by individual child. An effective timetable curricular mapping system can be organized around micro-benchmarks that include worst case scenarios such as the absence of a teacher or the lack of functioning computers for a certain session, and thereafter recommend a proposed course of action for subsequent classes.

2.2 Interaction Modeling

There are several ways of modeling the interaction - with two main variables – first what level of control does the child have over the seating and use of computers, and second, what level of instruction and explanation does the teacher give. We found significant variance in the teachers’ role inside the CALC. In some only some cases, the teachers did not let the children use the computers at all, instead they used the PC as a “display” device, end classes were held with the teacher talking about various aspects of the computer and a program by running it on screen. In only one observed case did the teacher run through the material step by step with the children (and on the day of the visit, this was not being done). In a majority of the cases, the children used the CDs unsupervised, though they were usually given instructions on which CDs they could or could not use. The seating patterns for the children were also ad hoc. In three observed schools, there were selected groups of children who were “first trained” to use the computers, and were instructed to control the mouse during CALC sessions, and be trainers for their co-students.

Table 1. Seating pattern and mouse control by classroom performance

	Left of Mouse	Mouse	Right of Mouse
Below Average Performer	32	0	38
Average Classroom Performer	36	27	33
Above Average Performer	32	73	29

Standard Deviation	0.82	0.48	0.86
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(n=72, significant to 95%)

An important finding related to this study was our discovery of self-enforcing patterns of seating among children. Children who sat at the mouse controlling seats tended to those that were better performers in school, and also financially better off (though the causality between those two is not clear). It was clear that in any given session, there are children with more access than others. Typically, the child seated at the center and controlling the mouse would have the most control and pace the rest of the group’s interaction with the electronic content.

A very important cause of variation on teacher involvement at the CALCs is the shortage of teaching staff. Since the CALCs are not usually large enough to accommodate an entire class, teachers typically break their classes into two parts – with one part being assigned to the CALC, and another remaining in class. In this case, the teacher must leave one of the two groups unsupervised. Teachers claimed that since the children at a CALC tend to be more self-contained than a group of unsupervised children in class, it was worthwhile to leave children in CALCs busy with the computers while the others were taught in class.

2.3 Operational Implementation and Transfer

The trickiest area for CALC functioning was that of implementation and training of schools. Every school visited was completely new to computers, and none had even an administrative computer on the premises before the CALC was set up. Not a single headmaster surveyed had ever used a computer before the CALC, and most teachers were similarly new to computers. As a result, the initial training period was critical.

We observed that the maximum training attention was directed towards teachers, and while the training focused mainly on computer aided learning, the teachers felt not trained enough in the basics of computer usage. Although headmasters played a vital role in the projects, the training spotlight was on teachers – this resulted in headmasters often lacking sense of ownership of the projects, relating to the computer aided learning as something their juniors took care of. In general, cases where head teachers were more integrated into the system, the projects in general seemed to perform better – in terms of clearer timetable implementation and childrens’ access to the CALCs. In two cases observed, most children were not

allowed to use the computers due to fear of damage – in both cases the headmasters themselves expressed such fears. Neither headmaster had prior access to computers, and nor were they trained for the CALCs.

There are two lines of thought on importing teachers to run CALCs – on one hand, there are those (including several at the administrative levels of government) that believe it is counterproductive to bring new staff into schools, and instead the focus should be entirely on training local teachers to run the programs from scratch. On another hand, there are those that believe separately appointed teachers are a must to ensure effective operation, at least in early stages of a program. The APF in some states began its program by training a local youth to be a ‘computer teacher’ at each school, a person permanently stationed at the CALC. It was observed that CALCs where an active computer teachers was present were more likely to have a functioning class on schedule, and the existence of a teacher explicitly responsible for the CALC also created much greater accountability and recording of student progress. On the other hand, in three of the six sites where such a teacher had been appointed, a year down the line there was no funding available to support the teacher, since this person was not a state employee. The exit of the teacher in such cases had dramatically affected the CALC, since the school had come to be dependent on the teacher, and the existence of this computer instructor made the other teachers less inclined to learn to either run the CALC programs or maintain the machines. Two of the three schools that had ‘lost’ computer teachers had machines in need of repairs lying unattended to.

3 Social conditions around CALCs at early stages of operation

In addition to the organizational factors, there are social issues around the adoption of technology in the community that impact the operation of the CALCs. There are two broad areas that were observed as impacting the CALC - the ‘Socio-aspirational Value’ of CALCs deals with the factors that encourage parental support of the programs, the ‘Community Adoption Paradox’ which relates to the CALCs in the larger community,

3. 1 Socio-aspirational Value

In no place visited during the three months of research did we meet a single person who had never heard of a computer before. Only one among all the non-teacher interviewees had ever used a computer,

and several parents confessed to never having seen one outside of advertisements. When asked for their opinions on what a computer can be used to do, people came up with a variety of answers – ranging from fairly accurate descriptions of office applications to complete bewilderment at the question. However, most interviewed adults felt that the computer was a good addition into the community, and parents frequently expressed hope that the computers would help their children move to better lives.

Due to the lack of an adequate sample size, it is hard to make gender-related assertions, however there were perceptible differences between girls’ participation in CALCs in coastal areas as against in dry agricultural areas. An instructive anecdote from one of the coastal villages was of a CALC instructor, both of whose parents were landless day laborers, who was referred to by other youth of her age group as being very respected in their colony because of her knowledge of computers – she herself admitted that because of her job profile being associated with computers, her parents were willing to let her work outstation and live by herself, unmarried.² In a high school in Udupi, for instance, the CALCs was being used after school to train teenaged girls in computer use, all four randomly chosen interviewees on site were children of landless laborers. It had become common for young girls to get basic computer training in this specific village of Udupi, after finishing high school (class 12), In fact, this points to a really crucial factor that was observed in almost every location surveyed – there are general ‘thresholds’ of education, especially for girls. In the case of Udupi, respondents stated that girls ‘generally’ studied to Class 12, in Raichur and Bellary, the norm was closer to Class 8, whereas in Pondicherry, there was expectation that girls would at least begin college. This threshold is often a very important factor in the perceived ‘importance’ of CALCs among parents of children – since the general expectation is not that the children will learn better math or physics at a CALC, but that they will learn ‘computers’ and that this has value in both economic and social terms. Conversely, the CALC deterrent for girls is the fear of ending up ‘too knowledgeable’ – thus making it harder (and more expensive in dowry

² Both the chauffeurs who drove us around in Tamil Nadu had unmarried graduate daughters working in call centers in the state capital. Both chauffeurs had only completed middle school – in both cases, this was the first time any female member in the family held a non-agricultural job.

terms) to find fitting groups. In all, though, the CALC program seemed to encourage lesser absenteeism and dropout rates, especially in schools where there were frequent parent-teacher interactions.

3. 2 Community Adoption Paradox

One thing the APF insists before setting up a CALC at any school is that the local community around the school agree to 'adopt' the CALC once it is well established. The main item in this 'adoption' is the payment of expenses such as an instructor salary and some minor maintenance related to the CALC. APFs experience has been that even though every single community signs onto a document pledging such support, there are virtually no examples of communities actually collecting and spending funds for the CALCs. This possibly points to two factors – first, that the general enthusiasm for computing does not translate to community funding priorities. This is possibly true even at much higher levels of funding decisions, where disbursements for ICTD projects are frequently pet projects of specific champions. The second factor, more specifically related to this project, is the lacking sense of ownership. In part due to the association of the government and the APF with the project, the community sense of operational responsibility was transferred onto the organizations, rather than the immediacy of village councils and other local institutions. The community adoption paradox however is not an entirely negative factor. The acceptance, for starters of such projects within the areas surveyed, which are very rural and disadvantaged, is a sign of aggregated hope for some positive impacts from these projects, and although there are no immediate disappointments, this is an important factor of the larger politics of CALC insertion into communities that researchers need to be mindful of.

4. Conclusions

This paper is a 'social factors' residual of what was primarily an HCI study. The cognitive findings about CALCs are available at the other two studies related to this work.[8][9] It is meant primarily meant to be instructive to technical researchers and project planners working in the field. Though the observations form the basis for more theoretical social science work in technology for education – several important themes covered here can educate modular design of content, incorporation of more games, and possibly greater use of children in the design process. An intended contribution of the study has been to encourage researchers to step back and look at the specifics of

local issues with computer-aided learning problems, while recognizing that many of these local problems have meaning outside of their micro-contexts that are useful in hypothesizing about technology in education as a whole. Our approach in using this research to make generalizations for CALC as a whole are based on the conditions in the areas surveyed. These ranged from the reasonably well-off villages in urban peripheries and coastal regions, to the very poor and desolate areas in dry regions. The same applied to the levels of infrastructure and issues related to the teaching such as hours of access, number of students per teacher, and training of teachers. This allowed us to come up with fairly general conclusions that can be applied with some variation to a range of conditions.

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