Perspective paper on ICTs in Education

Computer Learning Programs in Schools - Moving from BOOT Models to an Integrated Approach

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Abstract

Computer learning programs in schools (CLPS) in India have largely failed to achieve their goals of positively impacting learning processes and outcomes in schools. Implemented usually through 'PPP' (Public Private Partnership)[1] models, these programs have been treated largely as *silos*. Schools and teachers have not seen computer learning as an integral part of education, and the overall education processes, which has compromised their ownership over, and engagement with the program. As a result, CLPS have not got institutionalized within the schools and have found it difficult to be sustained across time. The outsourced model of content development / deployment and training has been failure prone, depending on poorly paid instructors, mostly without any education background, and without the aptitude or understanding required for meaningful outcomes in terms of educational aims. No wonder, research in this area largely concludes that computer learning has had little impact on the learning processes or learning levels in the schools these programs have been implemented in[2].

The CLPS in Kerala makes some significant departures from the popular PPP model, which may be interesting to study for the lessons it may offer. The program is integrated into the regular school education, by making it a part of the responsibility of the teacher educators and the teachers. The ownership and engagement of the teachers, along with an indigenous technology support system, makes meaningful learning experience a good possibility from the program. Adoption of a customised software distribution in local language has made this process both easier and more relevant to the education system. Schools find the Malayalam language application interface aligned to their regular medium of instruction. A local language software distribution has been made possible due to the conscious choice of free and open source software which has enabled the department to customise many applications in local language, and equally importantly to make available large number of educational software applications available to all schools at practically nil costs. Thus students are not restricted to learning only office automation applications – which most typically associate with 'learning computers'; they engage with computers on a variety of areas from mathematics to science to environmental sciences etc. The completely 'in-house' developed process and software design has also meant savings of crores of rupees that would have gone to vendors in the usual 'PPP' models, and this savings has supported the investments in further building in-house capacities for shaping new educational processes and curriculum using digital technologies, the role and scope of which in any education system will only keep increasing. This model also helps prevent complete dependence on technology vendors as well as resist their marketing pressures.

The Kerala model has some important learnings for governments seeking to implement computer education in schools. Some of these are: integration of computer education into the regular systems of school education, the decentralization of teacher training as well as hardware/software support, and finally the free availability of educational software in local languages, all of which have significant impact on the processes and outcomes of computer learning and computer aided learning in schools. Incorporating some of these principles and features and replacing the dominant BOOT model with an integrated approach to 'ICTs in education' may be essential for such programs to be meaningful and effective.

A caveat to the arguments presented in this paper is important to mention. This paper is intended primarily for decision makers on CLPS in the education department, including those at the levels of

1 The BOOT (Build Own Operate Transfer) is the most popular PPP model used in CLPS

2 For instance see the “Dipstick Study” done by the Educational Resource Unit, of the American India Foundation's of the “Digital Equaliser Programme”

Secretary, Commissioner or Director of education. Its focus is primarily on the 'roll-out' aspects of programmatic design. Though it discusses pedagogical implications of some of these design aspects, it does not cover these issues in detail, which the SCERT and other academic institutions need to consider in program design.

Background

It is widely accepted that we are living in an increasingly digital world and the role of software in our lives is becoming critical. Whether it is in booking train tickets, banking, using search engines for getting information, communicating with friends, political parties and NGOs, using the net for campaigns, individuals participating in virtual professional and social networks, accessing public services, including on entitlements from government schemes, over the internet or through tele-centers; computers and the internet have become critical to our lives. Software is a basic building block of the digital world and structures our social interactions. Being able to use relevant software applications for various purposes thus becomes an important ability to successfully negotiate the increasingly digital world. Learning to use computers, including learning it to use it as a media for further learning (called computer aided learning), is therefore considered increasingly important component of school education.

Thus basic knowledge of use of computers and the internet has become an important part of ones education. Learning how to use computers is also strongly perceived by people as an important factor in getting a good job and hence a ticket to a better life. Although many educationists have warned against introducing computer education in early school years or privileging computers over traditional learning resources including books and basic infrastructure that may still be missing in schools, there are strong parental / community pressures for introducing computers in schools. Some pressure also come from hardware and software companies for whom the public schooling system represents a very large 'market'[3]. (An aggravating factor is the well-known fact that 'catching them young' is a major marketing imperative for major IT brands, which helps develop an abiding captive market through shaping people's digital habits early in ways that best suits these brands). Public education systems in many states, responding to these different pressures - of public and private interests - have started planning and implementing computer programs in schools, in some cases focusing on 'computer aided learning' (using computers for learning existing curricular content) but in most cases, focusing on basic computer literacy (which has usually translated into learning basic office application and sometimes internet and email)

Scope of the paper

The paper basically aims to analyze the planning and implementation processes of the CLPS in the India public education system[4]. An analysis of the different components of the design of the 'rollout' (implementation) of CLPS in a couple of states and the lessons that may be learnt from them, precedes suggestions that future CLPS projects can consider.

3 For instance, most of the participants in ICT in education workshops and seminars are technology vendors, educationists are conspicuous by their absence (rather omission). The content of these workshops is limited to a display of dazzling technological possibilities from different products and solutions and rarely engages with the real issues and contexts of education system.

4 Here public education system is being treated as synonymous with the government school system

This paper does not get into the debate on 'should computers be introduced in schools at all, and if yes, then at what stage?' In most cases, governments have focused on secondary and higher secondary education (classes VIII - XII) and the need for basic computer literacy at these levels seems to be largely accepted. Given that a large number of students discontinue education at the class X stage, developing some basic computer literacy before that stage appears necessary. This view may however be controversial since the very causes for dropping-out in many cases may also negatively influence learning possibilities relating to computers during the high school stage. Yet it would be inappropriate to conclude that the relevance of CLPS comes only after all other learning infrastructure requirements have been satisfactorily met. Learning processes are complex and CLPS itself could impact traditional learning environments in ways as to make such sequentiality unnecessary. However, this paper does not propose to resolve that debate, nor does it explore in any depth issues like 'what are specific factors that need to be considered in designing the curriculum of CLPS as well as their integration with the overall curriculum', 'what pedagogical issues and processes are relevant to CLPS' etc. While those issues are indeed critical to any meaningful design and implementation of a CLPS, they are not the principal subject matter of this paper.

Computers have also been used in education administration, for purposes of program planning and monitoring, processing large volumes of data for decision support (DISE[5]), etc. Use of Computers in teacher training, in on-line assessments, providing text books on-line etc are also within the larger scope of ICTs in the education arena. This paper however, focuses on the school itself and does not intend to cover other sites of the education system.

The BOOT model

Many of the state governments have adopted an 'outsourcing' model to training their teachers on computers. The most common model to implement CLP has been the BOOT (Build Own Operate Transfer) model which is one of the popular PPP models. Under this model, the following are the usual steps:

1. A tender is floated inviting bids to set up computers (with basic software) in specified schools, and also to provide one or more trainers/ support persons in each school who will take care of training and support in that school, for a specified period of years.
2. Businesses respond to the bid and typically a vendor is chosen mostly on the 'least cost' principle, . The companies that mostly have been bidding for these CLPS are NIIT, Educomp, Everron, Aptech etc.
3. 'Site preparation', meaning setting up a computer room with furniture and power, in the identified schools, is the responsibility of the government.
4. The vendor installs the computers and software
5. The vendor deputes the person ('trainer') whose role is to be with the school regularly / daily and train students on computers as per the timetable of the school.
6. After the end of the specified period, the assets are handed over to the government.
7. The government in return makes a fixed payment (based on the tender amount) to the vendor on a periodic basis (from monthly to quarterly). These amounts can be quite significant[6].

5 District Information System for Education (DISE) is a school information system designed and developed by NIC and used by NUEPA for information analyses, as also by state governments for decision support. See http://www.dise.in/dise.html

6 Eg. the total outlay of Karnataka education department under the Mahiti Sindhu program over a period of five years (2001-2006) amounts to Rs. 210 Crores.

States that have opted for such a BOOT model include Karnataka (with Aptech, NIIT, and Educomp), Assam (Educomp and NIIT), Tripura (Educomp and NIIT), Delhi (Educomp), Orissa (Educomp), Andhra Pradesh (NIIT), West Bengal (Educomp and NIIT), Himachal Pradesh (EDUSATand NIIT), Chattisghar (NIIT), Maharashtra(NIIT), Punjab (Gemini Communication Ltd, Everonn), Haryana (Educomp, Everonn and NIIT) and Tamil Nadu (NIIT). States that have announced plans for computerizing schools based on a similar model include Rajasthan (with NIIT), Gujarat (with NIIT and Educomp) and Bihar (NIIT). This indicates the popularity of the BOOT model as well as the pervasiveness of the CLPS in India.

Objectives / assumptions in outsourcing

The BOOT Model of computer education appears to be based on the following assumptions.

Firstly, that computers / ICT is a new area which people in the education system are not familiar with and hence requires training from those who are 'experts' or more familiar with it. School teachers do not have the capacities (or motivation) to learn computers well, and quickly, enough to teach their students.

A second assumption is that existing teacher educators are too busy to learn such new things, and given their existing high work loads they will not be willing to take on additional responsibilities. Hence computer learning should not be a part of the regular teacher training systems.

A third assumption is that it takes a considerable time for the computer learning processes to stabilize, and the BOOT model leverages private expertise of the IT vendor in making a smooth transition.

A fourth de-facto assumption underlying the BOOT model, in most cases, is also that the objective of deploying computers is only, or largely, to promote computer literacy and computers need not have any special role to play in the mainstream teaching-learning processes in the school. Even in cases, where the policy and program documents speak about 'improving learning processes and outcomes' there is generally little information or clarification on how this is to happen and such mere mention of general intentions does not invalidate this proposition.

Issues with the outsourcing model

There are however some fundamental issues with the outsourcing model which can be very problematic.

Typically the bids for the program tend to be highly competitive. The winner is usually the organization who has offered to implement the program at the 'least' cost. The very low margins also mean that the computer instructor who is deputed to the school is a very poorly paid person. The primary cause for the poorly qualified trainer is that the monthly payment to the instructor is in the range of a few[7] thousands, far below what the teacher gets and what a a competent computer trainer would get elsewhere[8]. Thus the breadth and depth of understanding as well as skills in computers

7 Usually anywhere between 2 – 5 thousand rupees per month

8 The low margins also mean that vendors tend to cut corners wherever possible, including on hardware and connectivity. In one program, the vendor did not supply audio cards since they were not explicitly stated in the tender. Without audio cards, the program fails, since many children usually sit with a computer at a time and need to

of the trainer is usually inadequate (along with low motivation and job satisfaction) which defeats the purpose of having an 'external expert'. More importantly, the teachers and the school treat the program as an 'external' activity that is not a part of the schools primary purpose nor of its mainstream work-flows. The responsibility of 'computer learning' is assumed to be entirely that of the external trainer with the teachers having no role or responsibility[9]. Thus the program largely remains a standalone or 'special' venture, not integrated into the regular activities of the school. In addition, in some states like Orissa or Chattisgarh, the CLPS is itself not part of the academic programs of the department, and is instead part of the MIS (Management Information System) program of the department, which suggests the CLPS is seen even at the state level, as some kind of a 'technology' intervention rather than one related to learning.

Education reform research indicates that the school ecosystem tends to be complex[10]. Programs which require long term sustained involvement[11] of the school teachers are often 'implemented' in schools in a standalone manner in a mission or project mode. Without the active participation and cooperation of the teachers - the primary agent in the education system - they are prone to failure. When the project ends, the program activities also end, or at best, limps along. Thus computer learning programs that bypass the processes of building the active support of the teachers, both at a micro (school) and macro (the teaching community) levels have all faced uncertain future, not being able to figure out sustainability beyond the program. The lack of sustainability is such a common phenomenon that it has created what have often been called "computer museums[12]' i in schools across the country. This issue is acute in the computer learning field, given the high rate of technological advance and consequently obsolescence. The effort required to 'keep pace' is high and needs to be continuous, and the absence of ownership and involvement by the teachers proves a severe disability.

Another critical issue with the BOOT model is that it does not take into consideration teacher preparedness or school readiness. The program typically begins with the installation of the computers in the school and the 'teaching of computers' by the resource person of the vendor follows immediately, without any plan or design for developing teacher preparation and school readiness.

The Kerala government has attempted to go beyond the BOOT model in its IT@school program, which provides computer education and computer enabled education to 1.6 million students annually in 2,738 high schools across 14 districts in the state, covering standards 8th to 12th. The program began in a typical manner - IT was introduced in the eighth standard in the year 2002 after conducting training in IT for a large number of teachers. The teacher training was organised using help from Intel's 'Teach to the Future' programme, and this programme's course material, which was wholly based on Microsoft software, was used for the training[13]. However there were protests from the Kerala State Teachers Associations as well as the free and open source software (FOSS) community in Kochi and other parts

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be able to listen, which would have been obvious to the vendor at the time of responding to the tender. In another program, though internet connectivity was a part of the tender, in most schools, it was not provided, saving both the initial costs and the internet subscription amounts.

9 We also see this happening in some places where the implementation of the mid day meal(MMM) program has been outsourced entirely, the teachers treat it as a pure external activity and this has two negative implications – the opportunity for bonding between students and teachers is lost which has its own learning possibilities, and the accountability of the system to the student for the meal is also reduced, there is anecdotal evidence from states like Delhi or Tamil Nadu where the scheme implementation is largely outsourced.

10 Kenneth A. Sirotnik, Ecological Images of Change: Limits and Possibilities from The Roots of Educational Change, 2005. Springer (ed. Lieberman, Ann)

11 Any program that deals with the teaching-learning processes for instance. Purely infrastructural programs can 'succeed' in installing infrastructure without ownership, but even in such cases, the lack of ownership reflects in the poor maintenance of these assets and also impacts their sustenance and renewal

12 Another term that is used is 'computer graveyards'

13 See http://swatantryam.blogspot.com/2007/08/story-of-free-software-in-kerala-india.html

of the state against training teachers and students on proprietary software of monopoly vendors which would make the education system dependent on them. The department, on the other hand, also soon realized that their model would not help in the goal of integrating ICTs into the public education system in the state and decided to make some basic changes to the roll-out design. Some of these changes have clearly resulted in a much greater integration of the CLPS into the activities of the school and are discussed in more detail.

CLPS as a program of the teachers and the schools

The assumption that 'computer learning' is difficult and hence we need external experts is questionable. Universally, most literate people learn to use computers in a matter of days of being exposed to the environment, and require minimal hand holding. Applications are 'user friendly' or even 'idiot proof' and hence can be learnt easily, especially if such learning is of value to the learner. The 'hole in the wall[14]' project goes to the extreme in indicating that even illiterate, poorly resourced children can figure out how to use a computer. Basic computer literacy is easy to acquire and subsequent learning is best served by having time to play with different applications that have value for the learner. Secondly, any 'expertise' requiring to be developed can be taken care of by having well-qualified external experts train an initial set of master trainers, who can then train their colleagues. This obviates any need for the external 'experts' to be continuously required to train the entire teacher community. Since the initial training of master trainers is a small part of the entire training effort, it can be adequately invested in, to get high-quality trainers who can intensively prepare the master trainers. As mentioned earlier, using external trainers on a large scale to train the entire set of teachers has meant use of very poorly paid instructors who lack competencies in the area, and have very low motivational levels. The Kerala CLPS has avoided these pitfalls by integrating computer learning into the regular teacher training systems. See the box below for details of the teacher training process in Kerala for the IT@Schools program.

The Teacher Training structure in Kerala consists of two sets of trainers namely the Leading Master Trainers (LMT) and Masters Trainers (MT). There are a total of 10 LMTs and 200 MTs in the program. These 10 LMTs train 200 MTs who then train all the teachers in the state. Each district has a district coordinator (DTC) and a Master trainer coordinator (MTC). The DTC coordinates with the MTCs and MTs for the training. Training is done in an Approved Training Center which is usually located within the education sub district (block).

The government decided that the training of the school teachers would be done through the department's own set of teacher trainers. While the initial (very small) set of master trainers were trained through external experts, these master trainers trained other master trainers who then provided training to the teachers. Since the training faculty is in-house, it helps in scheduling training on a regular / continuous basis and making it a part of the regular in-service teacher training process. This process thus appropriately leverages the strong teacher training structures that are a part of the education department. (It is important to note that the government education system in India has one of the largest, if not the largest, pool of teacher trainers in the world - there are more than 80,000 teacher trainers at cluster, block and district levels, whose primary responsibility is teacher training, both in-service and pre-service). Most of these teacher trainers or educators have a degree in education and have teaching experience in schools.

14 See http://www.hole-in-the-wall.com/Findings.html

The table below has details of this structure in India.

Table – Teacher Education institutions

Level (India)	Name of Institution	Number of institutions	Number of faculty positions (approximate)
District	District Institute for Education and Training (DIET)	530	12,000
Block / Taluka	Block Resource Centre (BRC)	5,000	25,000
Cluster	Cluster Resource Centre, supports 20-40 schools	50,000	50,000
Kerala[15]			
District	DIET	14	375
Block / Taluka	BRC	165	825
Cluster	CRC	1,431	1,431

Thus, in Kerala, the teacher training structures which are fully responsible for the pre-service and in-service training of teachers are also responsible for training teachers on computers. Significantly, this shift has also changed the nature of the CLPS from being a 'centrally designed and implemented' program, with external resource persons, to a program of the school, supported by the school system. On the other hand, the BOOT model CLPS has adopted the 'para teacher' approach – using poorly paid, contractual employees, often ill-prepared for the job. To make it worse, the work of the para teacher is kept unconnected to the regular teaching.

It is quite ironical that in-spite of having such large and well-established training resources, who as a part of their work regularly engage with the school and the education system, the education departments in most states chose to opt for poorly paid and poorly equipped external faculty, who do not have any background in education and are unable to integrate their efforts with the mainstream teaching-learning processes in the schools.

Secondly, the real benefit of using in-house trainers to train teachers is the integration and internalization of computer learning to the context and needs of the teachers. Since the teacher trainers are part of the education support system, train teachers on a variety of subjects and areas, have studied education and have taught in schools themselves, their abilities to contextualise the computer learning within the larger learning arena is much higher. In fact, a recent program to develop educational leadership and management capacities in the education officials in Karnataka[16], used such a model which has paid dividends. An initial set of master trainers in educational leadership and management were trained by external faculty and these 'Management Development Facilitators' (MDFs) in turn trained their own colleagues. In many cases, the 'cascade' effort was richer and superior due to the higher levels of contextualization of the leadership and management discipline to the educational domain and contexts which the MDFs were much more familiar than their own 'external' instructors. The higher level of contextualization included identifying the priority areas for the content of the training modules, use of real life examples from the field, adopting the jargon of the schools and removing or demystfying management jargon, all of which helped in making the cascade model richer

15 State Report Cards 2006-07 from NUEPA

16 Management Development Program in education department of Karnataka. Reference – Kasinathan Gurumurthy 'A Monograph on Management Development Program in Karnataka" (unpublished)

and more effective.

The 'Education Technology' (ET) wing'[17] in the District Institute for Education and Training (DIET) has the responsibility of understanding the role and possibilities for the use of technology in the school system. Making computer training an in-house integrated activity of the school support system also serves as an opportunity to make ET faculty of the DIET faculty specialists in their areas. This will also partly address a critical lacuna of the government educational system – that of lack of specialization. The 'generic' nature of the job responsibilities of the government employee (which may be hugely helpful in moving people across positions easily to fulfill different roles) also affects the education department, while the DIET has seven wings, looking after diverse activities such as adult literacy, field innovation, curriculum development, education technology, planning and monitoring etc, the faculty in each wing often receives no preparation for playing the special role required. In fact faculty tend to be easily shifted across wings or from administrative roles, implying that no such preparation or specialization is required. But this process often ends up making each role shallow and indistinguishable from others, thereby defeating the rationale of the entire structure[18].

A certain degree of in-depth capacity building is also essential to move the DIET from the 'government culture' of 'anyone can do anything' to one of depth, rigor, excellence in keeping with its role as an apex academic institution in the district[19]. Thus making the ET (Education Technology) faculty responsible for CLP, including providing them with in-depth understanding covering the role of ICTs in learning and in society, different kinds of ICTs and the possible contextualised applications of each, the kind of skills required for using computers, ability to design and develop simple applications, etc, which they can pass on to other master trainers (at block or cluster levels) or directly to teachers will strengthen CLPS in the education system, making computer learning an integral part of the learning processes in the school. This will also add to the stature of the teacher educators as trainers in this 'new" arena of educational resources, methods and processes.

There is little justification in having only ICT training outsourced when all other kind of educational training is done in-house. If ICT education is seen to be a critical learning area, there is all the more reason to integrate it with the working of the education system, and use the existing capacities for in-service teacher education, instead of outsourcing the activity. ***This also implies that computer learning programs need to prioritize the needs of teacher educators and build their capacities for them to be able to work with teachers and schools, and this teacher preparation needs to precede the implementation of CLPS in schools***.

At the school level, it is a valid concern that the current work loads on teachers itself is high[20] and

17 DIETs are structured usually into 7-8 'wings', each looking after a functional area such as education technology, planning and monitoring, pres-service teacher education, curriculum design etc.

18 Similar concerns relating to the structures within DIETs and professional development of DIET faculty have been voiced by other reports too, see the DFID study on DIETs of three states in India, or the "DIETs- Potential and Possibilities" by the DQEP, Chamarajanagar

19 Similar role differentiation by rigorous professional development in other areas as research, curriculum development, adult literacy is also essential to bring meaning to the functioning of the DIETs

20 Currently, teacher recruitment is based on the average teacher pupil ratio across the state which is compared with the benchmark guidelines from the central and state governments. Such state level average is misleading since it averages out small schools which need to have a minimum number of teachers with larger schools which tend to have inadequate teachers. The norms need to be nuanced to provide a different teacher pupil ratio depending on number of pupils and grades which means it cannot be a single number at the state level.

hence adding CLPS may be an unacceptable additional load. However if CLPS is recognized as an essential part of educational content and process, it needs to be handled by the teachers as all other essential curriculum components. The long term solution is really to increase the number of regular teachers in the schools where there are inadequacies or deficiencies. The huge amount of money being spend in out-sourcing IT trainers can also be used towards this end. Kerala schools by and large have sufficient number of teachers and they have been able to have one teacher in each school take on the role of the lead computer teacher in the school.

The stated goal of CLPS in Karnataka includes "Enrichment of existing curriculum and pedagogy by employing ICT tools for teaching and learning[21]". However, the State's Mahiti Sindhu and ICT@Schools programs follow the BOOT model in keeping CLPS distinct from the regular teaching-learning activities of the school, which has resulted in little impact of the programs on the existing curriculum and pedagogy. The research conducted by the Azim Premji Foundation on its own CALP (Computer Aided Learning Program) also strongly indicates that teacher engagement and ownership over the program is critical for its success and when the program does not have such ownership the failure rate is extremely high. A study conducted to review the program found that the program was not at all functional in more than 50% of the schools where it had been implemented. Also in one earlier version of the program, where the computers were managed by a local youth, the integration with the regular learning processes of the school was found to be very poor and this led to the lack of any impact of the CLPS on the learning processes or outcomes[22]. Thus from a model of extensive implementation of the CALP[23] across thousands of schools, the Foundation has made a significant shift in the programmatic design of CALP, of implementing the program in a much smaller set of schools, engaging with the teachers in an intensive manner[24].

The experiments of other NGOs like American India Foundation (AIF)s also have had provide similar learnings. Putting computers in schools, and providing 'training and technical support' through an animator external to the school has by and large been a failure. Part of the problem has also been the failure of the government to honor its part of its agreements with these NGOs, in terms of providing support faculty or infrastructure such as battery backups or adequate maintenance support to the program. Apart from the economic aspect of wasting hundreds of crores of rupees on computer infrastructure (which could very well have had much better application), there is also the pedagogical issue of the impact of the program on the available learning time of students during the period of implementation.

Curriculum – the most critical factor

The importance of curriculum design in the learning process cannot be overstated – this is also evident from the controversies we have seen at the national level[25]. The process of designing curriculum, from creating curricular frameworks to framing syllabi and preparing text books passes through several processes and predefined structures (SCERT, text book boards and committees) and is subject to multiple reviews. However, when it comes to determining the curriculum for ICT education, this entire intensive 'due diligence' process is bypassed in the PPP models. 'Educational content' or 'educational software' manufactured by software vendors or educational technology companies is allowed to be

21 ICT@SCHOOLS program goals

22 Distinction also needs to be between "excitement and enthusiasm about the computers in school' and 'impact on learning processes and outcomes'. Computers evoke enormous energies due to their perceived potential as well as novelty, but this should be kept distinct from an appraisal of their actual impact in the program, on learning

23 The program was 'implemented' in more than 14000 schools in 12 states across the country.

24 The smaller number of such 'pilot' schools is also an essential pre-requisite to the intensive engagement.

25 The NCF 2000 and the NCF 2005 were both efforts at defining the curricular framework at a national level. Controversies over text books specially history text books have dogged many state government curricular efforts as well.

transacted in schools, with perhaps a minimal 'clearance', if any, done in ad-hoc manners.

The implications for pedagogy and learning arising from this casual approach to ICT and ICT-based curriculum include both making computer learning largely unconnected to the larger curricular design of the education system and not leveraging the best ICT-enabled possibilities for learning. Such ICT curriculum could in fact be inappropriate with respect to many pedagogical considerations applied in normal traditional curriculum processes, and those which may need to be additionally applied with respect to the known proclivities of digital content and processes.

For ICT education to have any probability of being relevant and effective, we need to begin by looking at ICT education within the framework of our educational goals and seeing what kind of ICT education can help fulfill these goals. ***This means that the CLPS content needs to be designed by experienced curriculum designers who are open to exploring the new possibilities provided by a new interactive medium. While the issues of a technology learning-curve cannot be minimized, it is certainly far easier for curricular experts to figure out the specific advantages and limitations of a new medium as ICTs than for technology experts[26] to figure out education philosophy, the social context of education or child cognition and psychology***.

At a superficial level, the role played by private commercial vendors in designing the ICT education curriculum may seem innocuous. However, at a deeper level, this perhaps is another road to the privatisation of education. On one hand, the increased privatization of the elementary schooling system is the result of the highly inadequate investments in government schools which affects their performance, thereby forcing parents to move their children to private schools. The second route to privatization may be far more insidious – what may be called as 'creeping privatization' within the public schooling system itself, of which various CLPS are a prime example, with the curriculum being determined by technology vendors and with the computer education teachers being private company employees who have little or no background or understanding of the purpose or role of education.

There are some inherently ambivalent or contradictory aspects in most ICT in school policy frameworks in India. On one hand there is a stated belief that computers and digital modes of learning increasingly are a critical part of learning, this is pushing governments to put computers in schools even when many other basic elements are still not being catered to. On the other hand, by handing over computer education completely to private companies, in terms of curriculum and pedagogy, the government is privatising what it otherwise seems to believe to be important and increasingly critical part of education.

The Kerala CLPS while perhaps not going so far as to having the IT curricular design explicitly proceed from the cardinal question 'how computer education can help fulfill educational aims' has still made a significant effort in aligning it to the learning contexts of the schools. Firstly, the department realized that Office automation software[27] (while important to learn) was not really the

26 The BOOT vendors are usually NIIT, Aptech, Educomp, Everron etc – Many of them are IT companies, and some are into training and some others into education technology. However education is not their primary area of work, and in any case private business interests can and would override public interest concern of appropriate educational systems.

27 An umbrella term that covers software applications such as word processor, spreadsheet, presentation software,

primary application for schools and that education really required a larger set of software tools and applications that teachers and students could use and tweak for their own learning. After all, as per the constructivist learning approach, emphasized by the National Curriculum Framework 2005[28], learning happens not when the learner is merely the object of predetermined learning material, but requires the active engagement of the learner with the medium itself. These two imperatives – a large set of software tools, and the necessity of the learner to actively engage with these tools, led to the realization that proprietary software platforms would not do – for these did not allow the learner to rise above the level of an 'end user', with no involvement in understanding the 'tools' and possibly 'co-constructing' them. Morover, the pay per license model of proprietary software would make computer education enormously expensive, and probably unjustifiable in the context of a country like India[29].

Kerala's education department thus wanted to begin with a customised software distribution[30] that would be relevant to, and appropriate for, its schools. While most computers come preloaded with Windows and a few other applications such as Office, with an English interface, the department realised that this would not meet its goal of building in a large set of contextual educational applications, with local language interface. The choice of free and open source software (FOSS) was thus logical. A FOSS based approach could allow the department to take an existing software set and customise it in two ways – make the software interface completely available in the language spoken in the state (Malayalam)[31], and to also bundle in hundreds of educational applications all available on a free and open source model along with the basic operating system. Since all these applications are available on a FOSS basis, there are no licensing constraints and hence the entire suite of software applications – the operating system, office applications, as well as hundreds of educational applications are all bundled and made available on a single DVD for easy and quick installation[32] See Table below for some of the educational applications that are provided to each school.

Table – Educational software used in Kerala CLPS

Subject Area	**Educational Software**
Mathematics	DR Gio
Geography	GCompris[33]

database etc bundled into a single application – for e.g. Microsoft Office. While these applications are the staple of the modern office and the primary work tool of the white collar information age worker, they may need to form only one part of the digital tools for a student.

28 The NCF 2005 is a curricular landmark in India. One of its significant emphasis is on the necessity of the active participation of the learner in the learning process and that learning is not 'consumption of information or knowledge'. This emphasis is even more critical in the computer learning space

29 Kerala's model is in this respect very different from the model followed by most states where computer learning largely centres around teaching the dominant proprietary software - Microsoft Office.

30 Set of software applications embedded within the operating system that runs a computer

31 Significant support for creating and maintaining the Malayalam distribution came from the local FOSS community in the state. One NGO (SPACE) played a crucial role in coordinating the work of the community in developing and supporting the FOSS applications

32 This is one of the features of the program, that has earned much appreciation from the teachers and students - while the software distributed to the schools has hundreds of applications provided along with, the installation is extremely simple and a singular task. On the other hand, in the proprietary model each software from a different vendor needs to be separately installed after the operating system has been installed. This makes installation process complex and cumbersome.

33 Gcompris is a suite of over 80 educational games and activities for kids age 4 to 10 to learn with. These include “computer discovery: keyboard, mouse; Algebra: table memory, enumeration, double entry table, mirror image * science: the canal lock, the water cycle, the submarine, electric simulation; Geography: place the country on the map; Games: chess, memory, connect 4, oware, sudoku; Reading: reading practice; Other: learn to tell time, puzzle of famous paintings, vector drawing” etc. See also http://edubuntu.org/UsingEdubuntu

Chemistry	G periodicals, Kalzium, Chem Tool
Assessment tool for teachers	Keduka
Astronomy	Sun Clock
Geometrical Drawing	KIG
Paint	TUX Paint and X Paint
Programming language (simple)	BLASIK
Image editing	GIMP
Word processing, spreadsheet calculations and making presentation	Open Office Suite
Internet browsing	Firefox

The software distribution was customised from the publicly available Debian GNU/Linux distribution which is known for its stability. The popular Edubuntu distribution which is specifically aimed at schools is also derived from the same Debian distribution and has more than 3,000 educational applications inbuilt.

Another major advantage of FOSS is that it reduces the overall costs of the program. According to a recent study[34], the Government of Kerala saved around 50 crore rupees as a result of opting for FOSS. Even more importantly, FOSS by reducing the costs of acquiring a computer helps in the faster and cheaper dispersion of computers outside the schools, in the homes of the students. Students and their parents are able to take the software used in schools and use it at their homes without having to either pirate proprietary software or pay huge license fees.

The issue of license fees is not restricted to the operating system or office applications, but extends to 'educational content'. The educational content offered by the large education technology companies is usually on a 'pay per license' basis, which would make scaling / replication expensive. This is all the more paradoxical when the marginal costs of replicating digital content (making copies of the CDs) is minimal, and a fraction of replicating physical resources like text books. ***Proprietary software and content systems are therefore especially inappropriate for public education system which use common content and processes on a very large scale.***

Exploring new possibilities for learning

Education through computers in schools has enormous possibilities[35]. Providing access to a wide variety of information sources (reliance on the single text book is an acknowledged limitation of learning possibilities in schools), connecting students to peers and other learning community members (which would transcend space and time), creating new digital artifacts[36] and publishing / sharing the same, are some new possibilities that can significantly impact learning processes. (At the same time, there are new skills that may be required to be learnt, for instance, learning to

34 Economic Impact of Free and Open Source Software – A Study in India, Professor Rahul De', Indian Institute Of Management Bangalore

35 Again this skirts the question of 'at what age of the student what kind of computer learning and computer based learning' is useful.

36 Making constructivism possible

discriminate and identify authentic from spurious sources of information, defensive access to the internet to protect against 'virtual predators' etc.) However for any of these possibilities, it is essential that the entire system of learning be grounded and integrated in the mainstream education system and its design and implementation driven by the members of the system itself - comprising of teachers, teacher educators, students and educationists.

There may be a view that the entire CLPS approach is largely irrelevant to mainstream processes of education, and therefore educationists including teachers and teacher educators need not engage with the program at all. Such a view is perhaps premised on both the area of CLPS being under developed as well as there being several more important priorities that need to privilege attention and resources over CLPS. However, this view is shortsighted and even harmful to the cause of education. Firstly, the very underdevelopment of the area is a reason for educationists to engage and develop it on sound and progressive principles. Their non-engagement would not result in a vacuum since vendors and technology experts would readily fill in. The latter are eager to design computer learning on they own, but not necessarily foregrounding these on educational principles and perspectives, with the larger public interest in mind. And the lack of attention and engagement by educationists may serve their interests well. Over time, the outcomes of the efforts of the vendors and technology experts would become the default curriculum which can have negative implications for learning.

This is largely the case with one of the most popular earlier ICT - television. The educational possibilities of the medium have not been meaningfully exploited and it has become primarily an entertainment medium. However, even an entertainment media – especially one as pervasive as TV - has its own 'educational' aspect, positive or negative. Research supports the 'dumbing down' impact of this mass medium thanks to commercially driven programs, many of which target children. New ICTs, being the computer and the internet, are far more potent than the TV medium and it is critical for educationists to engage with the potential of these media for both education and its converse of 'manufacturing consent'[37]. More and more schools will soon have computers and the internet, the pace of this implementation will be exponential and in no time some kind of computer education in schools will be a fait accompli[38]. In addition, young people are embracing this medium with much higher levels of enthusiasm than the adults around them often recognize them to be [39]! ***Figuring out the challenges and possibilities of this new media and suggesting ways of working around the emergent dangers, as much as leveraging the possibilities, is a critical pedagogical imperative***. Designing new ICT enabled learning processes that can support the goals of education may be a difficult process, but hardly one that educationists can ignore today. They need to explore, understand and identify possibilities for ICTs in education, as well as the challenges, starting from accepted aims and perspectives of the education arena.

Moving beyond computers to ICTs

While the computer and the worldwide network of computers (internet) is undoubtedly the most powerful of the new ICTs, the advances over the last couple of decades has impacted many of the older ICTs as well. Radio is now no longer only the centrally controlled state transmitted information

37 Manufacturing Consent is a term used by Noam Chomsky to explain the power of the media industry today. For some frightening aspects of the process of manufacturing consent using new powerful media, read Henry A. Giroux. Disney, Casino Capitalism and the Exploitation of Young Boys: Beyond the Politics of Innocence in http://www.truthout.org/041509J

38 Many studies have identified the strong desire in parents for English education and computer education. More and more schools will start catering to these needs.

39 See Mark Prensky's concept of digital natives and immigrants – *en.wikipedia.org/wiki/**Digital**_native.* Prensky suggests that children are 'digital natives' who will acquire digital space skills quickly while older people, which would include their teachers, would be 'immigrants' who would often need to face difficult adjustments to the digital world

medium; FM radio has given rise to local radio possibilities. Indian broadcasting policy has special provision for community and campus radios. These radio transmitters are very cheap to setup at a district or a block level and can be simple and inexpensive means of communication and information sharing amongst the teacher and student communities at local levels[40]. The national policy envisages that thousands of community / campus radio stations will be setup and many of these can be setup in Cluster Resource Centres (CRCs) and even within larger schools and can complement and support CLPS.

Video making has been significantly democratized, with the technology becoming both much simpler for laypersons to adopt as well as much less expensive. Local content or curriculum creation using these new radio and video possibilities, by teacher educators and, with their support and guidance, by teachers and students can enable achieving of many of the objectives of our curricular policy documents that call for local, contextual educational content as necessary for making education more relevant to the lives of the learners. As the internet itself becomes increasingly audio-visual, such local audio and video content creation capabilities coming from 'old-ICT' paradigms have important points of convergence with CLPS.

Integration of IT into core activities – a prerequisite for success

The learnings from the current models for CLPS in schools in India mirror those of the business sector as well. Initially, computerisation was driven by technology officers in the organization while the line managers responsible for the basic functions of the organization such as manufacturing, sales, procurement or strategic planning mostly kept away as they could not immediately see the relevance of IT to their work. Based on the perspectives and priorities of the technologies officers (CTOs etc), the IT applications focussed on financial accounting, payroll etc. – areas easy to computerise since they are largely rule based and highly quantitative . While they were easy areas for automation, their benefits to business were highly limited since these were not the focus area for the enterprise. The benefits were limited to saving the salary costs of a few accountants or book keepers but had little impact on the actual working of the business. It is only when the line managers took IT into their hands, directing the design of computerization to cover their areas of work that businesses began to change – applications for MRP (Material Resource Planning) aimed to streamline and integrate the purchase – production – sales functions in managing inventory cycles were developed. Concepts of Just in time; ABC[41], VED[42] models of inventory management which gave significant benefits to business were possible only through these MRP applications. MRP evolved to ERP (Enterprise Resource Planning) which extends the notion of resources beyond materials, and covers its people (HR, Marketing, Finance) as well. In this phase, the CTOs did not drive the conceptualization-design-implementation but only provided support to the line managers and the strategic leaders in the companies who owned up the entire process. ERP has been a significant cause for much greater integration of the work of an enterprise, enabling it to increase its

40 Again, the experience of IT for Change in the community radio program it designs and runs with Mahila Samkhya as a part of its Mahiti Manthana Project suggests that the challenges are in the techno-social processes of using the potential of the radio medium, while the pure technology aspects are relatively trivial to figure out.

41 Different models of inventory management – ABC model is based on absolute cost of the product and suggests expensive products (which will be few) need extensive attention while many products which have low costs should be abundantly available to the production process and avoid close monitoring.

42 The VED model classifies inventory items into Vital, Essential and Desirable and suggests greater monitoring of the first and second items.

scale and reach and still remain flexible and responsive, together providing much higher overall business effectiveness .

In the ICT in education too, we have been on the first phase for a long time. (While the context and the imperatives in the education arena are in many ways fundamentally different from business, there may still be important lessons to learn here). Right from the earliest CLPS interventions, we have a technological and not pedagogical orientation in introducing computers in schools. For eg, the CLASS project (Computer Literacy And Studies in Schools) jointly organized by Department of Electronics and Department of Education at the Centre, from 1984-85 basically consisted in distributing 12,000 BBC micro-computers to secondary and senior secondary schools through State Governments without any teacher preparation or support, even as its objective was to **"acquaint teachers and students of the range of computer applications and its potential as a learning medium**" (emphasis added). Subsequent CLPS programs too have ignored the role of teachers and have believed that putting computers in schools and getting 'external trainers or experts' to work with children, using content prepared on a centralized model, is sufficient for impacting the learning processes. This is perhaps the largest cause of the widespread failure of CLPS in India and elsewhere. While efforts to implement large scale programs at a school level without teacher preparation or involving the support structures of teacher educators is not unique to CLPS, the extent of such externalization is perhaps unprecedented in CLPS.

Professor Krishna Kumar[43] terms this process as 'fascination with the end point[44]'. Since change is finally desired at the school level, specifically at the student level, there is a great desire to begin and end at that level, avoiding critical preparatory processes. However, working with the intermediate levels of teacher educators and teachers is be essential to ground ICTs within educational objectives and processes, provide the basis for their successful deployment in schools, and to potentially trigger systemic reform. CLPS deployment models themselves have to be aligned with the explicitly articulated objectives of using computer in school and should attempt to answer the basic question - 'What is the purpose of using computers in the schools and how can it further educational aims?

For CLPS design to proceed in this manner, it needs to be directed by those who understand the system well and work with it – i.e. educationists, including teacher educators and teachers, at both the program design level and the school levels. Such a systemic design and preparation is essential for program effectiveness as well as sustainability.

Some factors that favored an 'Integrated model' in Kerala

The advantages of the 'integrated model' of ICTs in education have been discussed at length in this paper. It is equally important to focus on the specific factors in Kerala that helped such a model to succeed. One important factor was the involvement of teachers unions, who were consulted in the design and roll-out of the program. This helped get a greater support and buy-in of the teachers in implementing the program and putting in additional efforts required from the teachers for learning computers and implementing CLPS in schools. The involvement of teachers unions[45] also helped in getting support and participation of the teachers for FOSS as well. Teachers found installing and using FOSS simple and did not want the CLPS to use proprietary software.

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43 Director, NCERT

44 See Report on "National Workshop on ICTs in school education' held at NCERT in 2008, http://itforchange.net/media/NPISE/Draft_WKSH_Report_NPISE_Consultation_May2008.pdf

45 KSTA – Kerala State Teachers Association played a key role in sharing information with teachers, engaging their attention and interest in the program, funding computer purchases in some cases etc. This helped in getting much higher buy-in amongst teachers.

Secondly, the fact that most schools in Kerala are relatively well-placed as per the teacher-pupil ratio norms also meant that schools could spare teachers for participating in the computer training programs and have one teacher designed as a computer teacher in each school. Thirdly, the teacher training institutions of Kerala (DIET / BRC / CRC) are also well staffed and could take on the responsibility of learning and teaching computers.

While the above mentioned set of factors, are in many ways really within the influence of any education department, there are other factors which are perhaps unique to the state of Kerala . These factors, which include very high levels of literacy, greater urbanization (which means better availability of transport and communication facilities), availability of power etc., also may have played a positive role in the success of Kerala's ICT in education model though it is difficult to ascertain the exact extent of their impact. Kerala's 'Akshaya' program of the IT Mission in Kerala, which created computer infrastructure in villages across the state, in the form of tele-centres, and provided basic computer literacy to one member of each household, would also have helped in providing local capacity building and hardware / software support[46]. It must also be mentioned that the political-ideological inclinations of the left government in the state could also be a factor that favored the spread of FOSS in the state[47].

Role of technology vendors

Both in CLPS and the larger ICT in education space, technology vendors have played a prominent role. Apart from having their representatives continuously engage with the bureaucrats, even in public spaces such as workshops or seminars on this subject, typically more than half of the presenters are representatives from the larger vendors. There is no doubt that there is an element of 'technology expertise' that vendors have. However, such expertise is also easily available from academic institutions such as engineering colleges and universities and also from many NGOs. At the same time, it should be accepted that technological challenges are not so complex[48], the far greater challenges lie in the arena of figuring out how ICTs can advance educational aims – how they can support the efforts of teachers in addressing issues that are basically pedagogical in nature. This means educationists need to have critical roles in such seminars which purport to create/share knowledge in this area, however they are largely conspicuous by their absence. This imbalance often implies that such workshops basically become spaces for technology vendors to show and sell their wares to government officials. More insidiously, in disguise of providing expertise they strongly push 'ICT in education' model that that favor their businesses. This crisis is endemic to the ICTs sector, for eg. a workshop on public health is unlikely to mostly feature presentation from drug manufacturers though the pharmaceutical industry is also quite research intensive. ***This phenomena warrants urgent remedy to prevent the distortion in CLPS designs by the vested interests of technology vendors.***

Conclusions

The currently dominant BOOT Models may have been the way most public education systems got

46 Also most of these'Akshaya' centres themselves have computers running on FOSS

47 Though the support for FOSS has moved across the political spectrum with the BJP, a party on the right end of the political spectrum, also explicitly supporting FOSS. See http://www.webyantra.net/2009/03/21/bjps-it-vision-document-supports-open-source-unrestricted-voip-broadband-at-cable-tv-prices-etc

48 This also brings to question the complete reliance by the governments on 'PPP' models which bypass traditional developmental processes, in this specific case, of curriculum design and development, teacher professional development etc, under the guise of innovation and efficiency.

their first exposure to ICTs. Such primary exposure may have helped overcome early inhibitions of key educational actors. However, that phase is mostly over now, and schools and teachers do understand the basic need for introducing computers and are also ready to invest themselves in the effort, as shown in Kerala. For computer education to have any meaningful impact, it requires complete engagement and ownership of the teachers who are responsible for the basic functions and activties in the schools. Such engagement itself requires that we accord centrality to the role of the teacher in CLPS as we have accepted in other areas of the teaching and learning activities. This means that the basic preparatory processes of training should be handled in-house through the regular system of teacher training. Secondly the ability to freely share and modify the software as required – both at the macro state level (such as making customised distributions on the state languages) as well as micro levels of district through to school (writing simple extensions and applets, creating educational content) will help in making computer learning deeper and more meaningful. Without such engagement, computer education in schools will continue to be unconnected and irrelevant to the school and its purpose and achieve no major results other than fulfilling financial expenditure targets.

Once we accept that the real challenges in CLPS are pedagogical (how can we integrate computers into the learning processes in the schools and see how that can positively impact learning and how we can avoid the possible negative consequences of such processes) and not technological (installing hardware, software, basic computer training, support), it would but be logical to move towards adopting 'ICT in education' deployment models that actually help teachers engage with these pedagogical issues. The discourse would then shift to 'how can we facilitate teachers to understand and address these issues' through appropriate teacher support systems[49]. Thus bringing the teacher to the centre stage is an essential requirement for any meaningful outcomes through CLPS[50]

Experience also suggests against embracing PPP as a panacea for success of any program. Where the private partner is not able to bring in the real expertise required (contexual understanding of our schools, aims and perspectives of education) and the expertise brought in (perhaps technical expertise or program management expertise) is not one that should drive the program, blindly embracing PPP can end up as a failure. Instead, well-thought out integrated models of introducing ICTs in schools need to be developed, which best take forward our educational priorities.

49 Such systems themselves can be in the form of virtual communities (networks) of teachers and teacher educators

50 For a lucid exposition of the criticality of the agency of the teacher, see also Poonam Batra Poonam Batra (2005), Voice and Agony of Teachers, Missing Link in National Curriculum Framework 2005, EPW, October, 2005.

Annexure A - A tabular comparison of the two models

Particulars	**BOOT Model (used in several states)**	**Integrated Model (as implemented in Kerala)**
Feature		
Overall ownership / management of program	Vendor	Education department – the training of teachers is taken care of by the teacher training institutions and the actual custody and use of computers in the school is directed by the school teacher(s)
Computer Installation	Vendor. The basic operating system is installed. In some cases proprietary office automation application is also loaded. Very few educational software is available.	Installation is done by the teachers. Large number of educational software is available bundled with the computer, which adds to the learning possibilities
Teacher Training	Vendor is primarily responsible for teaching children. Teacher training is less common. All teachers are not covered	Teacher training is handled in the same method regular teacher training is done, through the master resource persons (teacher educators from the department). An initial small set of lead master trainers intensively trained by the vendor and other NGOs
Maintenance and Support	Vendor. Since the vendor is typically located in bigger towns, schools in remote areas face problems in depending on the vendor	This is largely an internal activity, since teacher training covers basic hardware and software maintenance. In case of bigger issues, local authorized centres have been identified.
Software upgrades	Software upgrades are not part of the program and hence needs to be paid for.	Software upgrade costs are nil
Impact of the Models		
Integration of CLPS with regular curricular activity in school	Negligible – the CLPS is seen as a standalone activity of the vendor not connected to regular classroom processes	Higher level of integration – the CLPS is transacted by teachers who also handle regular subjects.
Scope of learning	The program is largely restricted to Computer Learning - operating system, Office automation, internet etc.	The educational software included in the program connects to the regular subjects of the students and the teachers are enabled to use this content as a part of

		their regular curricular transactions
Costs of the program	Vendor is paid for the program on a turnkey basis. The bid amount decides the program costs and this cannot be varied over the program life	The costs are incurred by the department on hardware and capacity building.
Sustainability	Once the BOOT period is over, it has been difficult for the education department to continue the program.	Since the program is conceptualized as an internal program of the department, integrated with regular activities of the schools and support institutions, the program sustainability is much higher
Scalability	Scaling up the program is difficult since it is seen as a standalone program which is the responsibility of the vendor.	Since the program is entirely using FOSS, the costs are lower and pertain to hardware and capacity building. This helps in greater scalability of the program. Also teacher trainers are of better quality and their training efforts have been more effective in helping teachers across the state learn. The also conduct regular refresher programs.

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