ICTs programmes in school education

PPP models vs. integrated approach

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Abbreviations and acronyms

BOOT	Build Own Operate Transfer (a popular PPP model)
BRC	Block Resource Centres
CRC	Cluster Resource Centres
DIET	District Institute of Education and Training
FOSS	Free and Open Source Software
IPSE	ICT programmes in School Education
MHRD	Ministry of Human Resource Development, New Delhi
PPP	Public Private Partnership
TLM	Teaching learning material

Abstract

New Information and Communication Technologies (ICTs) have a close association with spread of globalisation and neo-liberal ideologies. The ICTD (ICTs for 'Development') domain is one where traditional development thinking been largely supplanted by neo-liberal techno-centric prescriptions relating to financial sustainability, business models, techno-centric solutions, critical role for business sector, irrelevance of investment in social change processes etc. It is not surprising that "ICT programmes in schools" are thought best implemented with private sector leadership, through "BOOT[1]" models, where the state pays annuities to technology vendors for such implementation. The regular teachers of the school and the teacher educators in the education system have little role to play in the curricular or pedagogical aspects of computer learning and computer aided learning.

Against this backdrop, the study of two large 'ICTs programmes in School Education' (IPSE) programmes of neighbouring Indian states reveals some interesting insights. The integrated model followed in Kerala's IT@Schools programme, which focused on developing systemic in-house capabilities anchored around school teachers, has shown considerable success; in terms of higher teacher engagement, integration of computer learning with the regular learning processes, significant cost efficiencies, greater per-learner computer availability, and development of teacher networks and collaborative content creation processes, which support teacher professional development. The alternative 'outsourcing' or 'BOOT model, employed by Karnataka's Mahiti Sindhu programme, does not show such significant outcomes. Funds were spent on vendor payments instead of building in-house capacities. The system itself did not benefit from this expenditure, and is unable to meaningfully sustain the programme beyond BOOT period. Such outsourcing also builds dependencies of public education system on private players that can significantly distort pedagogical structures in inimical ways.

The Kerala model has some important learnings for governments seeking to implement computer education in schools, from both policy and programme perspectives. Some of these are: integration of computer education into the regular systems of school education, the decentralisation of teacher training as well as hardware/software support, and finally the free availability and local customisability of educational software, 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 into an integrated approach to 'ICTs in education' and replacing the dominant BOOT model may be essential for such programmes to be meaningful and effective.

While elementary education is now a legal right, MHRD's note[2] on PPP uncritically promotes privatisation of school education. The study suggests that PPP models in the education domain have some inherent flaws which lead to failures in the attainment of educational aims and clear evidence in favour of these models is required before these are encouraged across the school system.

A caveat to the arguments presented in this paper - this paper's focus is primarily on programmematic design and implementation. Though it discusses pedagogical implications of some of these design aspects, it does not get into details of computer aided learning from pedagogical perspectives.

1. Scope of the Study

1.1. Background

It is accepted that we are living in an increasingly digital world and the role of new ICTs is becoming critical in our lives. Whether it is in using search engines, accessing public services over the Internet at home or at tele-centres, communicating with colleagues and friends, participating in virtual professional and social networks, banking, use of the net for by political parties and NGOs for campaigns; computers and the Internet have become critical part of our lives. Manuel Castells, says "Social networks which process and manage information and are using micro-electronic based technologies have become the basic units of modern society"[3]. Software is the basic building block of our increasingly digital world and its nature has important implications for public interest. 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 as well as learning it to use it as a method/media for further learning (also called "computer aided learning"), can thus be considered an increasingly important component of school 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 are still 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'[4]. Since 'catching them young' helps develop an abiding captive market through early shaping of people's digital habits, the school system is very strong attraction for business[5]. Public education systems in many states, responding to these different pressures, have started implementing computer programmes in schools, in very rare 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 popular office applications).

1.2. Scope

The paper basically aims to analyse the planning and implementation processes of the IPSE in the India public education system[6]. An analysis of the different components of the design of the 'rollout' (implementation) of IPSE in the two states of Kerala and Karantaka, and the lessons that may be learnt from them, precedes suggestions that future IPSE projects can consider.

This paper does not get into the debate on 'should computers be introduced in schools at all, and if yes, then at what stage?' Nor does it explore in any depth issues like 'what are specific factors that need to be considered in designing the curriculum of IPSE as well as their integration with the overall curriculum', 'what pedagogical issues and processes are relevant to IPSE', etc. While those issues are indeed critical to any meaningful design and implementation of a IPSE, they are not the principal subject matter of this paper. Secondly, computers have also been used in

education administration, for purposes of programme planning and monitoring, processing large volumes of data for decision support (DISE[7]), 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 cover other sites of the education system.

1.3. Objectives

The research aimed to study the ICSE model in Karnataka which is based on the popular BOOT model, and to compare this with the alternate 'integrated' model adopted in the neighbouring state of Kerala. The study covers the following aspects within both models

1.aims of the programme

2.structures of the programme design and implementation

3.curricular design and development models

4.pedagogy models

5.implications for educational processes

1.4. Research scope and methodology

The Mahiti Sindhu programme was implemented from 2001 and covers 1000 high schools across the state of Karnataka. The programme was managed by NIIT, APTECH and EDUCOMP initial BOOT period of five years, after which the programme was handed over to KEONICS, which is a government company and part of the Department of IT.

The study of the Mahiti Sindhu programme in Karnataka was conducted between January and September 2009 through the following:

1. Visits by the study team to ten schools in Bangalore and Yadgir districts using a combination of structured interviews, focus group discussions with teachers, head teachers, vendor faculty and parents
2. Questionnaires were administered to 35 schools in Haveri, Dharwad, Shimoga, Chitradurga, Bellary, Gadag and Mysore districts
3. Discussions with DIET faculty across the state, from the Educational Technology wing, who are expected to monitor and support the programme in schools
4. Discussions with officials in the education department of Karnataka
5. Desk research on media reports on the programme and on BOOT model programmes in other states

The study of the Kerala IT@Schools was conducted between March and August 2009 and covered the following:

1. Visits by the study team to fifteen schools in Kozhikode, Kollam and Trivandrum districts using a combination of structured interviews and focus group discussions with teachers and head teachers,
2. Visits to District Resource Centres in Kozhikode, Kollam and Trivandrum districts and

discussions with the DRC teams

3. Desk research on media reports on the programme

4. Discussions with officials in the education department of Kerala

The district selection in both states covered both rural and urban districts. Schools were randomly selected in these districts.

2. 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 IPSE 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[8].
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[9].

BOOT in India

States that have opted for such a BOOT model include Karnataka (with Aptech, NIIT, and Educomp), Assam (Educomp and NIIT), Gujarat (with NIIT and Educomp), Tripura (Educomp and NIIT), Delhi (Educomp), Orissa (Educomp), Andhra Pradesh (NIIT), West Bengal (Educomp and NIIT), Himachal Pradesh (EDUSATand NIIT), Chattisgarh (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) and Bihar (NIIT).

This indicates the popularity of the BOOT model as well as the pervasiveness of the IPSE in India. The National Policy on ICTs in School Education (NPISE) recommends PPP models for IPSE[10].

2.1. Key findings on the BOOT model

The study of the Mahiti Sindhu programme indicated that

1. In most schools, the faculty worked directly with the students and the teachers in the schools did not participate in the computer learning process. The teachers and the head teachers felt that the programme was not directly connected with their own work in the school. Vendor faculty also felt isolated from the school activities.
2. The faculty is paid poorly, especially compared to the regular teachers. Faculty are paid between 3.5 to 4.5 thousand while teachers are paid at least thrice that amount.
3. The vendor focused on basic computer learning – teaching of Windows and Microsoft Office. There was almost no attempt to integrate computers into the teaching learning of the regular subjects of the school, computer aided learning was almost completely absent
4. In most schools, Internet connectivity was not available. This meant that access to information available on the world wide web was not available to support computer aided learning in the schools
5. Hardware failure is common. Given the high rate of obsolescence of computer hardware, maintenance, support costs tend to be significant. Lack of investment in maintenance and replacement means that over a period of time, out of the initial 15 computers made available, in most cases, at least half of them were not operational.
6. Since the teachers were not involved in the programme, they did not feel the need to use computers in their own teaching.
7. Apart from the payment of the vendor faculty, hardware maintenance and electricity and phone expenses, neither the vendor (nor the department) provided support for additional learning resources
8. The programme thus had a minimalistic focus in terms of educational materials, given its focus on Windows operating system and Microsoft Office, neither of which are particularly relevant to schools. The programme did not incorporate any of the large number of educational tools available, nor did it access digital educational resources available on the Internet.
9. The number of computers provided was too few for meaningful learning experiences to students, since the time available to each student for hands-on was quite limited
10. The software taught was entirely in English[11]. The programme did not attempt to customize the software into the local languages
11. Students learning is restricted to acquiring some basic understanding of word processor and of presentation software.

Discussions with the teachers,head teachers and vendor faculty in the schools, and with the education department officials at district and state levels provided some explanations for the programme status.

2.2. Low cost, low investment

Typically the bids for the programme tend to be highly competitive. The winner is usually the company which has offered to implement the programme 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[12] thousands, far below what the teacher gets and what a a competent computer trainer would get elsewhere[13]. Thus the breadth and depth of understanding as well as skills in computers of the trainer is usually inadequate (along with low motivation and job satisfaction) which defeats the rationale provided, of having an 'external expert'. The vendor faculty is neither able to source educational resources that would be relevant to students in different classes/levels and pertaining to different subjects, nor is able to install and use educational tools that students could work on, to create learning resources.

2.3. IPSE STAND-ALONE

The teachers and the school treat the programme 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[14]. Thus the programme 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 IPSE is not even a part of the academic programmes of the department, and is instead part of the MIS (Management Information System) programme of the department, which suggests the IPSE 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[15]. Programs which require long term sustained involvement16 of the school teachers are often 'implemented' in schools in a standalone manner in a 'mission' / '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 programme activities also end, or at best, limps along. Thus computer learning programmes 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 programme. The lack of sustainability is such a common phenomenon that it has created what have often been called "computer museums"[17] in in schools across the country. This issue is acute in the computer learning field, given the high rate of technological advance and consequently obsolescence of both hardware and software/learning tools. The effort required to 'keep pace' is high and needs to be continuous, and the absence of ownership and involvement by the teachers is a significant drawback.

The stated goal of Mahiti Sindhu includes “Enrichment of existing curriculum and pedagogy by employing ICT tools for teaching and learning"[18]. However, the programme keeps IPSE distinct from the regular teaching-learning activities of the school, which has resulted in little impact of the programmes on the existing curriculum and pedagogy.

2.4. TEACHER PREPARATION MISSING

Another critical issue with the BOOT model is that it does not take into consideration teacher preparedness or school readiness. The programme typically begins with the installation of the

computers in the school and the 'teaching of computers' by the vendor faculty follows immediately, without any plan or design for developing teacher preparation and school readiness. The programme also has no provision for the capacity building of the teacher educators in the DIETs (District Institutes of Education and Training), BRCs (Block Resource Centres) and CRCs (Cluster Resource Centres) who have the responsibility of facilitating pre-service and in-service teacher training for teachers in the government school system.

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 programme is critical for its success and when the programme does not have such ownership the failure rate is extremely high. A study conducted to review the programme found that the programme was not at all functional in more than 50% of the schools where it had been implemented. Also in one earlier version of the programme, 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 IPSE on the learning processes or outcomes[19]. Thus from a model of extensive implementation of the CALP[20] across thousands of schools, the Foundation has made a significant shift in the programmematic design of CALP, of implementing the programme in a much smaller set of schools, engaging with the teachers in an intensive manner[21].

2.5. Vendor

Since the programme is entirely managed by the vendor, the school is dependent on them for all aspects of the programme, whether it is in hardware maintenance or provision of digital materials, etc. Whenever there is hardware failure, or non availability of the Internet or software failure (virus), the school is not able in most cases to directly address it. The school needs to have the 'vendor faculty' approach the vendor officials for the rectification which is often delayed and beyond the scope of influence of the school as well as the vendor faculty. Thus, Internet availability, though a part of the programme was not available in many schools, either partly or wholly, depriving students of an important information resource. There was no support from the vendor in making additional educational software tools and resources available to the school which limited the programme largely to learning office applications. On the other hand the availability of vendor faculty who took responsibility of the entire infrastructure did enable the hardware to be secured/protected.

Feedback from the schools, both teachers and vendor faculty suggests that the situation has worsened with KEONICS taking over the programme. The ability of the schools to address issues has become even lesser, even on basic hardware issues. KEONICS being an IT company has no resources to offer on pedagogical aspects. Since the programme is largely ignored by the teachers, the responsibility of interacting with the vendor is largely that of the head teacher and of the vendor faculty. Since the DIET faculty, who are supposed to monitor and support the programme, have themselves not been trained, they are unable to negotiate with the vendor in any effective manner.

2.6. Vendor faculty

The vendor faculty are typically young people who have studied computer courses, most of them do not have any qualification in education. They are employed on contract basis, and their compensation is 1/3rd or less than that of the teachers in the schools they work in. Even though their enthusiasm levels are high in the beginning, over the programme period, the lack of support from the school and teachers as well as inadequate support from the vendor, creates frustration. They are not able to see any connect between their work in training children on office applications with the schools regular teaching learning processes.

Given their terms of contract, vendor faculty in Mahiti Sindhu have protested and also formed unions. They demanded permanent employment as regular teachers and protested against non payment of salaries and Provident Fund. Right from a year after the programme began in 2001, till date, there have been regular protests by vendor faculty. Handing over the programme to the government IT company KEONICS has not resulted in the situation getting any better[22]. There are media reports on poor treatment of vendor faculty by vendors. "The committee had drawn the Government's attention with documentary proof to the violation of norms by the companies in the implementation of provident fund, training allowances, failure to sanction maternity leave and offering incentives"[23]. These kind of issues are also seen amongst para teachers in other states. The logic of 'saving on salary' and on 'long term employment contract benefits' which is one of the aims of the the para teacher model thus proves counter-productive when the para teachers claim parity with the other regular teachers in the school, notwithstanding their own differential qualifications.

2.7. Inferences from NGO programmes

The experiments of other NGOs like American India Foundation (AIF) also 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 honour 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 programme. 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 issue of the impact on the available learning time of students.

2.8. Objectives / assumptions in outsourcing

The BOOT model appears to be based on the following assumptions.

1. 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.
2. School teachers do not have the capacities or motivation to learn computers well, and quickly, enough to teach their students.
3. 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.

4. Schools also would not like to take responsibility for the infrastructure, which is both expensive and fragile. Hence computer learning should not be a part of the regular teacher training systems.
5. It takes a considerable time for the computer learning processes to stabilise, and the BOOT model leverages private expertise of the IT vendor in making a smooth transition.
6. 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 programme 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 mean much.

These assumptions have been disregarded in the Kerala IT@Schools programme, which has played a role in its successful implementation.

3. Integrated Model in Kerala

The IPSE in Kerala, called 'IT@Schools'[24] makes some significant departures from the popular PPP model. The programme is integrated into the regular school education, by making it a part of the responsibility of the teacher educators and the teachers. There is no vendor presence in the school.

3.1. Moving from BOOT to integrated model

The Kerala IT@school programme 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 programme 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' programmeme, and this programmeme's course material, which was wholly based on Microsoft software, was used for the training[25]. 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 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 realised that their model would not help in the goal of integrating ICTs into the public education system in the state, nor in scaling the programme for universal access, and decided to re-look at the programme design assumptions and make some basic changes to the roll-out design on that basis.

3.2. Computer literacy seen as trivial

The assumption that "'computer learning' is difficult and hence external experts are needed" was questioned. 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, where such learning is seen to be of value to the learner. The 'hole in the wall'[26] 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 the goal of learning is best served by focusing on different applications that have value for the learner, which in the context of the school, would be applications that relate to the school curricula.

The Kerala model questioned the assumption that "'computer learning' is difficult and hence external experts are needed".

Hence the programme decided to make the school teachers acquire basic computer literacy and then have them use computers to teach students, on both computer literacy as well as computer aided learning in their own regular subjects. The first teacher programme covered operating system, office application, web browser, email and was adequate to build basic computer literacy. Since the teachers themselves taught computers in the schools, their classroom training was further supplemented with this on the job usage of computers and made them comfortable in using computers. Subsequent trainings focused on software installation as well as hardware maintenance, making teachers comfortable in using computers. Our discussions with teachers in all the fifteen schools clearly showed that teachers were confident in using computers, going far beyond operating system and office applications, to email and Internet use, as well as in executing annual software upgrades and basic hardware maintenance/trouble shooting.

3.3. IPSE AS A PROGRAMME OF THE TEACHERS AND THE SCHOOLS

Secondly, any 'expertise' requiring to be developed was taken care of by having well-qualified external experts[27] train an initial set of master trainers, who then trained their colleagues. This obviated any need for the external 'experts' to be continuously required to train the entire teacher community. Since the initial training of master trainers was a small part of the entire training effort, it was adequately invested in, in intensive and high quality preparation of 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 IPSE 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 programme.

Thus the teacher training structures which are fully responsible for the pre-service and in-service training of teachers were also responsible for training teachers on computers. Since the training faculty is in-house, it helped 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.

IPSE Teacher Training structure

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 programme. 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).

Significantly, this shift has also changed the nature of the IPSE from being a 'centrally designed and implemented' programme, with external resource persons, to a decentralised programme of the school, supported by the school system.

3.4. Computers as a method of learning and not a separate 'subject'

Secondly, the real benefit of using in-house trainers to train teachers is the integration and internalisation of computer learning to the context and needs of the teachers. Since the teacher trainers are part of the education support system, have studied education and have taught in schools themselves, and train teachers on a variety of subjects and areas; their abilities to contextualise the computer learning within the larger learning arena was much higher.

In fact, a recent programme to develop educational leadership and management capacities in the education officials in Karnataka[28], 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 contextualisation 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 and more effective.

This process of contextualised ICT education by teacher support system allowed for teachers to integrate computers into their own regular subjects, converting the computer from being a 'subject of learning' to 'process or tool of learning' which took the programme to much superior level of quality. This is seen from the continuous enrichment of the learning processes through the relevant use of additional tools. For instance, the 'school wiki'[29]

A contextualised ICT education by teacher support system allowed for teachers to integrate computers into their own regular subjects, the computer being a 'process or tool of learning', rather than a 'subject of learning'.

programme has trained teachers in publishing digital content on the web to allow each school to have its own wiki page for sharing its work and ideas.

It is significant, that the SCERT is in the process of integrating the computer based learning component into the regular subject text books and avoiding making separate computer text books. For the upper primary section, where computer based learning is being introduced, there is no separate computer text book, instead existing science and mathematics text books have sections dealing with use of educational digital tools.

3.5. Role of the teacher in teaching-learning

Where we see the teacher as a 'transmitter of content' then ICTs are easily seen as 'additional work load' which needs to be passed on to vendor faculty/ para teachers. On the other hand, if we see computer as a method of learning, then it is possible that its appropriate use by teachers would actually help in better/more effective teaching learning, hence instead of computer being an additional load, computer aided learning would help in better management of the transaction.

Prof. Poonam Batra, in a recent workshop on 'public software and public education', speaking about ICTs and Teacher Education suggests that "The constructivist position articulated in the NCF, 2005... promotes the idea that education is about the 'appropriate use' of information which is possible only when information is engaged with in order to construct meaning, perspective and understanding. This can be achieved by a teacher who has learnt to regard textbook knowledge not as an exclusive given. Such a teacher engages learners with subject content rather than focus exclusively on 'how' to communicate the 'given'. ... One of the most important uses of ICTs would be to build and sustain a professional cadre of teachers. ICT can be imaginatively drawn upon for the professional development and academic support of pre-service and in-service teachers. If we want teachers to become co-constructors of knowledge and reflective practitioners, we will need to re-examine our understanding of constructivist pedagogy. For the teacher and learner this would mean rejecting the idea of subject-matter as a 'given' and bringing into the classroom ideas, experiences and perspectives of the learners in a manner that prompts enquiry and dialogue rather than mere 'acquisition' of information"[30].Thus computer need to be tools that teacher engage with.

If we want teachers to become co-constructors of knowledge and reflective practitioners, we will need to re-examine our understanding of constructivist pedagogy.

– Prof. Poonam Batra

3.6. Teacher work load

At the school level, it is a concern that the current work loads on teachers itself is high[31] and hence adding IPSE may be an unacceptable additional load. However this view basically sees 'computer learning' as an additional subject. Whereas if IPSE is recognized as a part of educational process, handled by the teachers as all other essential curriculum components, it

would not necessarily be an additional load, since it would be one of the resources available to teachers along with text books and other materials to chose from, in curricular design and transaction. Computers as another 'method' in teaching learning can provide opportunities for teachers to engage with digital resources, as considered appropriate/relevant in different contexts, for reflection and co-construction of knowledge.

Where current teacher pupil ratios are poor, 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 or 'School IT@School Coordinator' in the school.

3.7. Systemic capacities for teacher education

The 'Education Technology' (ET) wing'[32] 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 specialisation. The 'generic' nature of the job responsibilities of the government employee (which may be hugely helpful in moving people across positions easily to fulfil 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 specialisation is required. But this process often ends up making each role shallow and indistinguishable from others, thereby defeating the rationale of the entire structure[33].

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, rigour, excellence in keeping with its role as an apex academic institution in the district[34]. Thus making the ET (Education Technology) faculty responsible for IPSE, 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 develop in other master trainers (at block or cluster levels) or directly in teachers will strengthen IPSE 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 also 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 programmes need to prioritise 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 IPSE in schools.

There is a challenge here though, research suggests that there is a linkage between age and ability/willingness to pick up new technical skills. This is clearly seen in ICTs, where younger teachers and students are able to pick up new technologies or applications much faster than older people[35]. Most of the DIET faculty tend to be older people and may not be necessarily comfortable taking on roles envisaged here. In the Kerala model, though the teacher trainers are from the department, they are more likely to be younger teachers taken on deputation to the role of 'CAL teachers' than DIET or BRC faculty.

3.8. Free and customisable software

The Kerala programme while perhaps not going so far as to having the IT curricular design explicitly proceed from the cardinal question 'how computer education can help fulfil educational aims' has still made a significant effort in aligning it to the learning contexts of the schools. Firstly, the department realised that Office automation software[36] (while important to learn) was not really the 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[37], 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 realisation 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. Moreover, the pay per license model of proprietary software would make computer education enormously expensive, and unjustifiable in the context of a country like India.

Kerala's education department thus wanted to begin with a customised software distribution[38] 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

A FOSS based approach could allow the department to take an existing software set and customise it in two ways – make the software interface available in the local language, and bundle in hundreds of educational applications available on a free and open source model along with the basic operating system.

– make the software interface completely available in the language spoken in the state (Malayalam)[39], and to also bundle in hundreds of educational applications all available on a free and open source model along with the basic operating system.

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. According to a recent study40, 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 and have taken the software used in schools to their homes, without having to either pirate proprietary software or pay license fees. This model also helps prevent complete dependence on technology vendors as well as resist marketing pressures.

3.9. Educational and local language software

Adoption of a customised software distribution in local language thus 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, this has enabled the department to customise 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

Educational software used in Kerala IPSE

Subject Area	Educational Software
• Mathematics	DR Geo, KIG, Geogebra, Carmetal, Geometria , Kbruch
• Geography	Kgeography , Marble , Sunclock , Xrmap , GCompris[41]
• Chemistry	G ChemPaint , GDIS, G periodicals, Kalzium, Chem Tool
• Assessment tool for teachers	Keduka
• Astronomy	Sun Clock
• Geometrical Drawing	KIG
• Paint	TUX Paint and X Paint
• Programming language	BLASIK
• Image editing	GIMP
• Word processing, spreadsheet calculations and presentations	Open Office Suite
• Internet browsing	Firefox

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. See Table below for some of the educational applications that are provided to each school.

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 hundreds of educational applications inbuilt.

The issue of license fees / free sharing is not restricted to the operating system or office applications, but extends to 'educational resources'. 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 little, and a fraction of replicating physical resources like text books, which can enable creating very rich environment of digital learning resources consisting of articles from the Internet, educational software tools as well as audio-visuals.

Proprietary software and content systems are therefore especially inappropriate for public education system which use common content and processes on a very large scale. The Kerala SIET has created more than a thousand films on different subjects and provided them to schools for the 'digital libraries'. These can be freely copied and shared as required at marginal costs equaling just the cost of media.

3.10. Software upgrades and additional educational tools

While in the BOOT Model, there is no planned upgrade of the software or addition of new software tools and there is no incentive for the vendor, nor is there any clause in the contract asking the vendor to do so, in the Kerala model, software is upgraded every year. The installation as well as the periodic[42] upgrades of the software in each school are done by the teachers. The upgrade not only makes the software used, more secure and robust, but also adds to its features and functionalities. New educational software tools are incorporated into the upgrade every year and given the nature of the FOSS, all these applications can be freely bundled into the upgrade for a single installation, while proprietary software would require a distinct installation process for each tool. This makes installation/upgrade process far simpler[43].

3.11. Hardware procurement and maintenance

The procurement of hardware, its installation and maintenance, is also managed within the system. This allows significant cost advantages arising due to large quantities of hardware purchased. The programme has created 'mobile hardware clinic' teams, which regularly visit schools for inspection, checking hardware and doing most of the required maintenance and repair work. A policy of cannibalising computers that cannot be repaired has two benefits; it substantially lowers costs of maintenance[44] while ensuring higher uptime. Teachers are trained to install software and also do routine software upgrades, which they have been doing without any significant issues or problems. The programme disproves a commonly held belief that school

teachers in India's public education system are not capable of, and/or are unlikely to be interested in, engaging with ICTs beyond being passive users of closed applications.

3.12. Assessment

While the students in high school who are part of the Mahiti Sindhu programme do not have any formal assessment which could help identify their learning (both in computers and through computers), in Kerala, it is part of the regular board examination in class X. Without getting into the debate on board examinations and their advantages and limitations, the feedback from the teachers, students and programme administration is that this has made the programme transaction a matter that is taken seriously by all. From the examination results, which is publicly available, it is clear that students overwhelmingly fare well in the examination. On the other hand, in Mahiti Sindhu, our discussions with students suggest that the actual transaction in many cases covers much less than the syllabus, which itself is restricted largely to learning about operating system and office applications. In the absence of formal assessment processes, it is difficult to confirm or negate this assertion.

3.13. Some factors that favoured 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 worth exploring specific factors in Kerala that could have helped such a model to succeed. One important factor was the involvement and support of teachers unions, who were consulted in the design and roll-out of the programme. This helped get a greater support and buy-in of the teachers in implementing the programme and putting in additional efforts required from the teachers for learning computers and implementing IPSE 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 IPSE to use proprietary software.

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 programmes and have one teacher designed as a coordinator in each school.

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 urbanisation (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' programme 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]. 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].

3.14. Challenges faced by Kerala programme

Notwithstanding the successes of the Kerala model in achieving higher ownership of teachers, experimenting with academic possibilities through FOSS tools and universal ICT literacy and CAL competencies, the programme does face many challenges.

While the programme has managed to work with all the teachers in the high schools, the teacher educators in the SCERT-DIET-BRC-CRC still need to be fully bought on board. Secondly, the programme still runs on the 'computer lab' model in which students need to be taken to a separate room where computers are kept, this takes away time and can be difficult to manage where number of computers is inadequate (and in many schools, the number of computers is not sufficient to support 2:1 student – computer ratios). The alternative of 'smart classrooms' (where the computer is brought into the classroom and used with a LCD projector) has its own limitations of not allowing students hands-on and also in the initial phase, the digital tools can become a distraction from the actual transaction. The government has identified the need to provide electrical connection to all classrooms for the 'smart class' facilities and this is being now planned across the state. Also using ICTs to link schools and teachers is an activity that is yet to take off, though this has begun with projects relating to school wikis, content management systems, etc.

4. Overall inferences

4.1. Curriculum – a critical factor

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

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.

In Kerala however, the SCERT creates the curricular content for the IPSE programmes through workshops with the regular teachers and educationists are clearly in charge of the process.

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 fulfil these goals. This means that the IPSE 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 minimised, 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[48] 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 privatisation 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 privatisation' within the public schooling system itself, of which IPSE is a prime example, with the curriculum being determined by technology vendors and with the computer education teachers being private company employees / 'para teachers', 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 outsourcing to non experts, what it otherwise seems to believe to be an increasingly critical part of education.

4.2. Exploring new possibilities for learning

Education through computers in schools has enormous possibilities[49]. 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[50] 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 discriminate and identify authentic from spurious sources of information, which would be a component of critical pedagogy, 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 IPSE approach is largely irrelevant to mainstream processes of education, and therefore educationists including teachers and teacher educators need not engage with the programme at all. Such a view is perhaps premised on both the area of IPSE being under developed as well as there being several more important priorities that need to privilege attention and resources over IPSE. However, this view is perhaps 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

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.

would create a space for vendors and technology experts to 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 programmes, 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 critical pedagogy and its converse of 'manufacturing consent'[51]. 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...[52]. In addition, young people are embracing this medium with much higher levels of enthusiasm than the adults around them often recognise them to be[53]! 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.

The role of new ICTS in the education process has also been discussed by Henry A. Giroux in his conception of ''public pedagogy', where the role of mass media (leveraging the digital media) in the socialisation of the child has become far more powerful than what the child learns within the formal schooling system. His discourse on Public Pedagogy suggests that educationists need to look beyond “ICTs for learning” to “ICTs as learning” and what this implies for the formal school system, in terms of both opportunities for newer ways and means of learning and dangers in terms of subverting the primary purpose of education in our society, to build a responsible citizen of a democratic state.

4.3. 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 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[54]. 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 IPSE.

Video making has been significantly democratised, with the technology becoming both much simpler for laypersons to adopt as well as much less expensive. Video and audio editing FOSS tools have matured for large scale use. 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 IPSE.

While digital cameras (still and movie) have been given to schools as a part of IPSE, once again the programme has limited itself to hardware distribution and in most cases, these equipment are hardly used. Investment in building systemic capacities in video learning and video aided learning can create new opportunities for decentralisation of curricular processes, in ways that can make learning more meaningful and powerful.

4.4. Integration of ICT into core activities – a prerequisite for success

The learnings from the current models for IPSE in schools in India mirror those of the business sector as well. Initially, computerisation was driven by technology officers in the organisation while the line managers responsible for the basic functions of the organisation 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 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 computerisation 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" cycle in managing inventory cycles were developed. Concepts of Just in time; ABC[55], VED[56] 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 extended the notion of resources beyond materials, and covers other aspects including people (HR), Marketing, Finance as well. In this phase, the CTOs did not drive the "conceptualisation-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 scale and reach and still

remain flexible and responsive, together providing much higher overall business effectiveness and efficiencies.

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 IPSE interventions, we have a technological and not pedagogical orientation in introducing computers in schools. For e.g., 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 IPSE programmes 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 centralised model, is sufficient for impacting the learning processes. This is perhaps the largest cause of the widespread failure of IPSE in India and elsewhere. While efforts to implement large scale programmes at a school level without teacher preparation or involving the support structures of teacher educators is not unique to IPSE, the extent of such externalisation is perhaps unprecedented in IPSE.

In order to be effective and sustainable, IPSE design 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 programme design and the school levels.

Professor Krishna terms this process as 'fascination with the end point[57]'. 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. IPSE 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 - 'How can computers further educational aims?

For IPSE 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 programme design level and the school levels. Such a systemic design and preparation is essential for programme effectiveness as well as sustainability. 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 have chosen 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. These faculty are in the nature of para teachers – poorly paid, on short term contract basis with no promise of tenure, little or no investment in their professional development, etc.

4.5. Role of technology vendors

Both in IPSE 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 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[58], 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' models that favour their businesses. This crisis is endemic to the ICTs sector, for e.g. 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 IPSE designs by the vested interests of technology vendors.

4.6. ICTD and the development discourse

The role of technology vendors in the IPSE space is in keeping with the general 'ICTD' (ICTs for Development') discourse. While ICTD is supposed to be the cutting edge application of new ICTs to address age old developmental challenges, it has unfortunately led to the introduction of concepts and practices that have distorted fundamental developmental ideals of equity and social justice. As Gurumurthy and Singh say in ICTD – Is it a new species of development[59], "The ICTD field is shaped predominantly by a two-fold discourse. Firstly, the utopian preoccupation with technology and an ahistoric conception of the world. It is as if new ICTs and their intrinsic push for free and open communication have suddenly rendered all known conceptions about social structures irrelevant. The struggle for social power now is ostensibly only about the individual pitted against usurping systems and institutions. Structural inequities among people and groups are not admissible in this schema wherein an individual's very access to these powerful technologies is seen as, somehow magically, bestowing equality.... In fact, such techno-fascination dislodges two concerns central to development – equity and institutional transformation. Secondly, as discussed earlier, ICTD is constructed within the neo-liberal shadows development. It is the engine that propels the marketisation of development. Blatant in its method, ICTD uses every trick in the newest version of the neo-liberalism bag, 'inclusive neo-liberalism', the key ingredient of which is the material incentives to disempowered masses to

promote the market colonisation of the lifeworld. Telecentres in their mainstream avatar are based on the commodification of information, packaging development as a set of over-the-counter services, and promoting a formulaic entrepreneurship based model as the unassailable anti-poverty pill.."

This nature of the larger ICTD discourse is not surprising, ICTs themselves have been the primary vehicles of the processes of economic globalisation and hence have tended to carry many of the elements. Christian Fuchs says, "Computer networks are the technological foundation that has allowed the emergence of global network capitalism, that is, regimes of accumulation, regulation, and discipline that are helping to increasingly base the accumulation of economic, political, and cultural capital on transnational network organizations that make use of new technologies for global coordination and communication60".

The ICT sector typically supports the emergence of large transnational monopolies/ near monopolies with business models based on proprietisation of knowledge (expanding the role and scope of 'intellectual property'). On the other hand, school education is seen as a 'commons' requiring collaborative efforts and public investment and management . The intersection of private sector driven ICTs and school education has seen the emergence of PPP models , where the overall framework and funding is from the government , but the actual curricular transaction by private sector. PPPs are seen as the 'preferred model61' for implementing ICT education and outsourcing to technology vendors seen most 'viable' solution.

4.7. Failures inherent in the PPP model

The study of the Mahiti Sindhu programme suggests that PPPs are no panacea. 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 programme management expertise) is not one that should drive the programme, blindly embracing PPP can end up as a failure. In a nutshell, the following are the limitations inherent in a PPP model like BOOT:

1. Like any other educational activity, computer aided learning requires enormous resource investment for a longer period of time; teacher preparation is essential, supporting creation of digital resources, especially locally relevant/contextual resources, hardware maintenance and support, variety of educational software tools provision are all essential and given that this is a very new area of learning, there would be several pilots required to explore different possibilities. This means that privatized models are created through competitive bidding processes are bound to fail, since the low bids that would help win the contracts, would simply not permit the required investments. Whereas the integrated model in Kerala allows for significant investments in resources and capacities as required to make the programme effective.
2. BOOT model keeps the programme stand-alone. The vendor faculty, who is basically a para teacher – not qualified for teaching in a school, poorly paid and demotivated is not able to command the respect of the teachers or offer any educational experiences through computers that can serve as value for the schools. Basic computer literacy offered is neither the most relevant item, nor is it worthy of being the sole curricular item for the programme. Computer

aided learning is inherently not possible in the BOOT model. The teachers do not own the programme, given their being uninvolved in both the curricular (computer literacy is not relevant and computer aided learning is absent) as well as the pedagogical (teachers are not taught, nor do they have any role in the programme, in teaching students) aspects. The impact of poor teacher ownership on their enthusiasm and commitment is palpable. The programme is thus not able to implant into the school and sustain. Inherently BOOT fails to sustain in the school and a paradoxical perennial dependence on vendors is created.

3. There is very little academic monitoring of the programme. Unlike other areas, where the academic support system comprising of the DIET-BRC-CRC is able to train as well as provide on-site support, there is no such possibilities in BOOT model. The programme focuses directly on students being taught by the vendor faculty and no resources are invested in building capacities of teacher educators. DIET faculty have expressed their frustration at being asked to provide academic support and monitoring without any preparation for that task. The visits of DIET faculty to 'monitor' the programme is invariably restricted to checking basic physical infrastructure. The quality of instruction or the scope of the curriculum are issues that they are unable to engage with, due to which the programme is unable to rise over extremely limited curricular scope and poor quality of instruction.

4. Public vs private model of ownership - Another advantage of the 'public ownership' model in Kerala, is that the school makes efforts to acquire hardware from alternate sources. Parents Associations, MLA fund, MP fund etc are all sources for procuring computers for many schools. This is possible due to the feeling of ownership of the school over the programme, whereas in a BOOT model, the infrastructure is under the custody of the private player who has no incentive to increase the scope of work beyond what is committed. Thus the PPP model given its stress on private ownership comes in the way of public support enhancing the programme.

Though as this paper indicates, PPP models have significant inherent limitations, they are still seen as role model, the MHRD document on 'PPP models for schools' cites ICT PPP models as exemplar. Instead of PPP models, what is needed is well-thought out integrated models of introducing ICTs in schools, which best take forward our educational priorities. While this of course a difficult process, one also prone to inefficiencies, lack of accountabilities, etc., substituting private ownership over educational processes is a remedy that appears to be worse than the disease.

Though ICTs have supported forces of competition, they can support forces of collaboration as well . The reach of civil society networks to influence larger set of actors and policy makers has been seen in many cases, the role of community informatics and community media has been increasingly a counter to the privatised, top-down models of ICT programmes. The increasing popularity of FOSS, Wikipedia points to new collaborative 'non-market' models of knowledge creation, which are now being extended to newer areas of knowledge construction such as drug research[62].

4.8. Conclusion

The currently dominant BOOT Models may have been the way most public education systems got 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 activities in the schools. Such engagement itself requires that we accord centrality to the role of the teacher in IPSE 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 IPSE 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 address these issues' through appropriate teacher support systems[63]. Thus bringing the teacher to the centre stage is an essential requirement for any meaningful outcomes through IPSE.

Endnotes

1 Build Own Operate Transfer – this is a popular Public Private Partnership model, in which the private party builds the infrastructure, operates it for a period and then transfers to the public authorities

2 http://education.nic.in/secedu/from%20stakeholders%20and%20the%20public%20on%20concept%20note%20on%20possible%20models%20of%20Public%20Private%20Partnership%20in%20school%20education.pdf

3 http://globetrotter.berkeley.edu/people/Castells/castells-con4.html

4 For instance, participants in ICT in education workshops and seminars organized by vendors or 'ICTD' NGOs are typically government officials and technology vendors and educationists are conspicuous by their absence (rather omission). The content of these workshops is limited to a display of technology products and solutions and rarely engages critically with the real issues and contexts of education system.

5 Microsoft's "Project Shiksha" aims to have school teachers exclusively trained on their proprietary software products offering the training centre and faculty free of cost to governments. The 'Project Shiksha' MOUs also represent a kind of PPP model, where public funds are used to support training on one vendors products and perpetuate their monopoly. See http://itforchange.net/dis/edu-ict/232-govtofmah.html

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

7 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

8 http://www.dise.in/dise.html

9 The companies that mostly have been bidding for these IPSE bids are NIIT, Educomp, Everron, Aptech

10 E.g. the total outlay of Karnataka education department under the Mahiti Sindhu programme over a period of five years (2001-2006) amounts to Rs. 210 Crores.

11 See http://itforchange.net/dis/edu-ict/223-lettermhrd.html

12 in some schools, Nudi, the Kannada word processor software, which works only on MS Windows, was taught

13 Usually anywhere between 2 – 5 thousand rupees per month

14 The low margins also mean that vendors tend to cut corners wherever possible, including on hardware and connectivity. 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. In another IPSE 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 be able to listen

15 We also see this happening in some places where the implementation of the mid day meal (MMM) programme 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.

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

17 Any programme 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

18 Another term that is used is 'computer graveyards'

19 ICT@SCHOOLS programme goals

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 programme, on learning

20 The programme was 'implemented' in more than 14000 schools in 12 states across the country.

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

22 Deccan Herald August 20, 2009. “Mahiti Sindhu teachers to get pending salary”

23 http://www.hindu.com/2005/12/29/stories/2005122918570300.htm The committee refered to is “Mahiti Sindhu Instructors Struggle Committee”. Other media stories on the programme available in reference section

24 http://itschool.gov.in/index.php

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

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

27 From the FOSS communities in Kerala, which also had teachers as members

28 Management Development Programme in education department of Karnataka. Reference – Kasinathan Gurumurthy 'A Monograph on Management Development Programme in Karnataka'' (unpublished)

29 See http://www.schoolwiki.in

30 See http://public-software.in/node/730

31 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. This is required by the Right to Education Act (RTE) and will result in requiring recruitment of additional teachers.

32 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.

33 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 see http://ageconsearch.umn.edu/bitstream/12847/1/er040055.pdf , or the "DIETs- Potential and Possibilities" by the DQEP, Chamarajanagar, see http://www.nias.res.in/site/html/docs/2-DIETs%20Potential%20and%20Possibilities-Eng.pdf

34 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

35 Marc Prensky uses the term 'digital natives' to refer to younger people who have grown up in the midst of new digital technologies and 'digital immigrants' to older people who need to figure an entry method, in a reversal of usual age roles, where the younger need to enter spaces where the adults are already comfortable. See http://en.wikipedia.org/wiki/Digital_native

36 An umbrella term that covers software applications such as word processor, spreadsheet, presentation software, database etc bundled into a single application – for e.g. Microsoft Office or Open 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.

37 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

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

39 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

40 Economic Impact of Free and Open Source Software – A Study in India, Professor Rahul De', Indian Institute Of Management Bangalore. See http://www.iimb.ernet.in/□rahulde/RD_FOSSRep2009.pdf

41 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

42 At least once a year

43 This is one of the features of the programme, 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.

44 The programme estimates to have saved 90% of the costs in making computers functional through repairs, which would otherwise have required new computers to be purchased

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

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 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.

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

50 Enabling constructivistic approaches

51 Manufacturing Consent: The Political Economy of the Mass Media (1988), by Edward S. Herman and Noam Chomsky., explains the power of the media industry today. For some disturbing aspects of the process of manufacturing consent using ICTs as 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

52 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.

53 Mark Prensky's concept of digital natives and immigrants mentioned earlier,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

54 Again, the experience of IT for Change in the community radio programme 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.

55 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.

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

57 See NCERT Director's opening remarks in the 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.

58 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.

59 See http://itforchange.net/images/ICTD_Species_of_Devlp_Ed.pdf

60 Christian Fuchs (2008) Internet and Society: Social Theory in the Information Age. New York: Routledge

61 National Policy on ICTs in School Education, MHRD. See http://itforchange.net/media/Concept_note_on_possible_models_of_Public_Private_Partnership_in_schooleducation-2.pdf

62 India is a pioneer in collaborative research for discovering TB drugs, see http://en.wikipedia.org/wiki/Open_research

63 Such systems themselves can be in the form of virtual communities (networks) of teachers and teacher educators, read about the USRN project, see www.eledu.net

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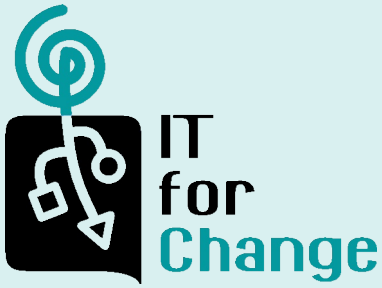

IT for Change (ITfC) is a non-profit organisation located in Bengaluru (India) that works for an innovative and effective use of ICTs to promote socio-economic change in the global South. IT for Change's research and advocacy work in gender, education and governance aims to influence the information society discourse and policy spaces at global, national and local levels, seeking to build cutting edge theoretical concepts and policy responses from a pro-South standpoint.

www.ITforChange.net

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