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Role of ICT in Improving the Quality of School Education in Bihar

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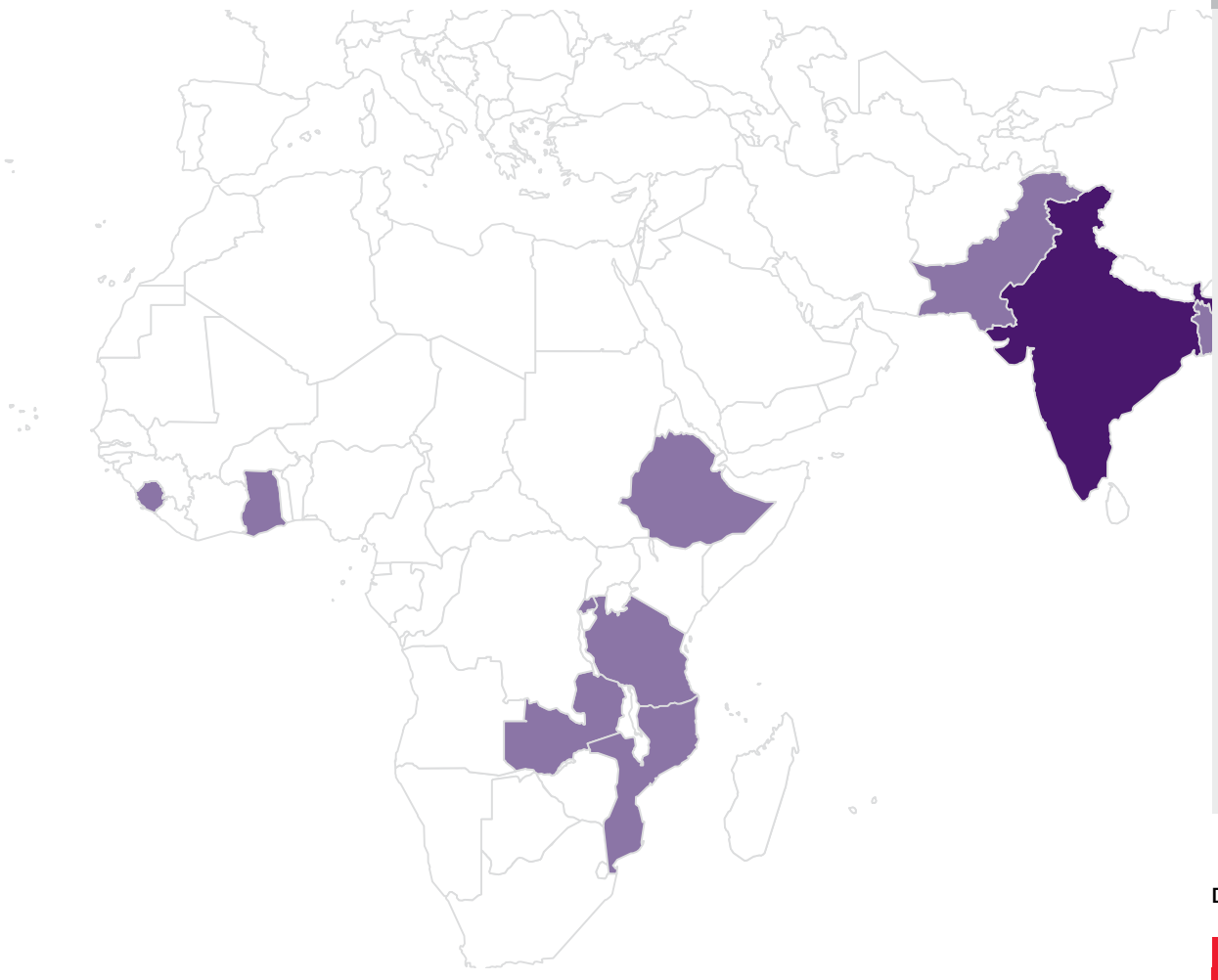

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Chirashree Das Gupta and Haridas KPN[1]

Government of Bihar has taken an initiative in the implementation of Computer Aided Learning (CAL) in school and has been recognised for these efforts through the Manthan South Asia award for e-governance for the year 2010 under the e-education category for its project "Implementation of computer aided learning in 244 schools in Bihar under the BEP-India". The literature on use of ICT for pedagogy has set out certain benchmarks for integration of ICT into the learning process as a way to improve the quality of school education in specific social contexts. The objective of this study is to bring out the role of ICT in improving the quality of school education integrated within pedagogical approaches taking on board the social constraints of schooling in Bihar and comparing it with the documented results of similar initiatives, experiences and impact in other parts of India. Government of Bihar has also announced a shift in the focus of its current IT policy to Information and Communication Technology (ICT). This study will provide inputs to the education component of ICT policy and school education policy of Government of Bihar on possible ways to create and improve the learning environment in schools in Bihar.

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I Background

Barret's (2009) review of the international experience of using ICT to improve the learning environment in schools has been demonstrative in identifying the conditions in which ICT can be effectively used to enhance the quality of learning and create social payoffs which would be conducive to sustainable growth and equitable development. It is largely agreed in the literature that infrastructure, trained teachers, e-literacy or stand-alone computer lessons though necessary are not sufficient. Integrating ICT tools into the curriculum and tailoring pedagogy according to the social environment are necessary for achieving qualitative improvements in learning (Kremer and Holla 2008; Sreekumar and Sanchez 2008; Barret (2009); Gurumurthy 2009). Kremer and Holla argue that pedagogical innovations that work around the distortions in educational systems can improve student achievement at low cost. Technology-assisted learning or standardized lessons can mitigate weaknesses in teaching and substantially improve test scores.

In this process of integration of ICT into curriculum and pedagogy, the role of teachers has been argued to be crucial as the 'agents' of change (OECD 2001; Semenov 2005). Manchin et al examined the relationship in ICT investment and changes in educational outcomes in the UK. They found that a change in the rules governing ICT funding led to changes in ICT investment and subsequently changed educational outcomes. They found a positive causal impact of ICT investment on educational performance in primary schools primarily in English and to a lesser extent in science. But they could not find any improvement in mathematics. They also observed that the effect of computer aided learning is more effective in primary schools than in secondary schools. It was the joint effect of large increases in ICT funding and a fertile background for making an efficient use of it, that led to positive effects of ICT expenditure on educational performance. Thus increase in ICT funding in itself is not enough to ensure the improvement in quality of education.

A case study of ICT-enriched school environment in Rishon Le-zion, Israel (OECD 2001) which analysed the impact of innovation in teaching – learning methods implemented in a school supports the argument that successful implementation of ICT depends mainly on staff capability to assimilate ICT in teaching and learning processes. The amount and variety of teachers' training assured competency of staff regarding ICT implementation in pedagogy. In addition, the wide range usage of ICT in all subject matters, all grades and at all times made ICT a vital and essential means of learning. Students were led by their teachers in an effort to improve their ICT skills and fostering appropriate usage of technology in pedagogical practices. The study concluded that the sustainability of the innovation depended on two factors: 1. staff and school atmosphere and 2. political support from the community and the state institutions.

Synthesis from this literature shows that the effective uses of ICT to improve the learning environment in schools catering to students from underprivileged social backgrounds depends on cost-effective scalable delivery systems to meet challenges of: 1. Provision of basic infrastructure and teachers 2. Overall and sustained enhancement of ICT skill-levels of teachers 3. Motivation of teachers, curriculum designers and other stakeholders to integrate ICT into curriculum and pedagogy.

While the first two listed above are necessary conditions, it is the third which has been found to make the critical difference in improvements in learning. These factors have been studied within the different delivery processes of CAL in schools in various states of India and a contested literature exists on the efficacy of delivery systems (public delivery / PPP (Build-Operate-Own-Transfer or BOOT)/ private delivery models). The most important lessons emerge in the experiences of Kerala and Karnataka, in terms of experiences and subsequent willingness to make changes to policy, programme design and delivery based on those experiences (Vidya Bhawan Society and Azim Premji Foundation 2008; Gurumurthy and Vishwanath 2010).

For example, Banerjee et al's (2003) evaluation of a computer assisted learning and remedial education programme to improve the quality of education in Vadodara showed that computers were used effectively only in very few schools in 2002. Pratham's intervention with the help of local volunteers ran the programme with an emphasis on learning Mathematics through computer games consisted of two hour classes per week for children in the fourth standard with two students sharing one computer. The design of the programme allowed children to learn as independently as possible and the interactions between instructors and children were driven by the child's experience with computer games. The results showed that the intervention led to an increase in math scores by 0.37 standard deviations. Average scores on a 50-point math test rose from 14.9 to 29.0 in the treatment group but only from 15.5 to 25.0 in the control group. At the same time the programme did not have any visible changes in the language competencies. It also suggested that the more interactive, computer-based approach to learning might not have created a greater enthusiasm for learning overall.

Another significant study on Computer Assisted Learning is the one done by Vidya Bhawan Society and Azim Premji Foundation in 2008. This initiative began in 2001 in rural Karnataka and was subsequently taken up in other states like Tamil Nadu, Andhra Pradesh and Uttarakhand. The objectives of this study were 1. To study the effectiveness of the implementation mechanisms and training strategies in the programme 2. To study the process of delivery in CAL classes and its impact in the classroom. 3. To study the impact of CAL on children, teachers, community and other stakeholders 4. To study the role of other stake-holders like the state government, teachers, schools etc.

The study cited above found that in all the states and almost all the categories, more than half the programmes were not functioning and among those that were functioning majority turned out to be under the categories 'average' or 'poor'. The programme

seemed to function best in schools in Karnataka compared to other states. Most of the centres are located in the school or within 2 kilometers of the school. The infrastructure of almost all CAL centres was in place with all the safety measures needed. Each CAL centre had 2 to 5 computers. Teachers from all states felt that computers and technology are essential in today's classrooms and that technology is not just meant for private schools. At the same time, teachers across all states felt that computers do not decrease the role of teachers in classroom process, classroom teaching does not get diluted due to CAL and neither are learning opportunities reduced due to CAL. Also, teachers felt that children get an opportunity for self learning through CDs. The general feeling was that children are interested in learning subject matter through CDs and are actually learning and understanding through the CDs. Teachers across all states feel that CDs not only increase a child's concentration but also their creativity and imagination. Most teachers felt that the achievement levels of children have improved due to CDs. Teachers in all states felt that CALP has increased regular attendance. Peer Group Learning was observed in all states with children taking help from their friends to understand content. A positive relationship was also seen between the teacher and students during CAL sessions. In all the states children did not hesitate in asking teachers questions.

However, these perceptions did not actually translate into effective practice. Teachers had not actually used the CDs as an active tool or aid while teaching. All teachers who stated that they have made changes in their teaching methods due to CAL, could not say what these changes were. Children in all the states reached conclusions through trial and error when it came to solving problem. Most teachers said that they had received training for CAL but they felt that it was insufficient. One of the most important conclusions was that effectively CAL was an add-on and not an integral part of the teaching-learning process. The programme had not been able to engage with the teachers at a deeper level. There was an indication in interaction with the team of a feeling of very rapid expansion and a lot of expectations from the government. This

expectation and the underlying assumptions had not somehow worked and this had resulted in a large number of centres being dysfunctional.

Gurumurthy's (2009) study based on policy reviews, theoretical explorations and empirical evidence of delivery systems of CAL in Kerala and Karnataka points out that the digital medium has the capacity to allow local knowledge construction and also supports all the modes (text, audio, video). Hence its potential for revolutionising teaching learning needs to be explored. However this exploration needs to be firmly grounded in both educational aims/philosophies as well as educational contexts and anchored by educationists to be successful.

Gurumurthy's (ibid) study identifies the reasons for the failure of the BOOT model:

> *Typically the bids for the program tend to be highly competitive. The winner is usually the organization who has offered to implement the program at the 'least' cost. The very low margins also mean that the computer instructor who is deputed to the school is a very poorly paid person. The primary cause for the poorly qualified trainer is that the monthly payment to the instructor is in the range of a few thousands, far below what the teacher gets and what a competent computer trainer would get elsewhere. 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 purpose of having an 'external expert'. More importantly, the teachers and the school treat the program as an 'external' activity that is not a part of the schools primary purpose nor of its mainstream work flows. The responsibility of 'computer learning' is assumed to be entirely that of the external trainer with the teachers having no role or responsibility. Thus the program largely remains a standalone or 'special'*

> *venture, not integrated into the regular activities of the school... Thus computer learning programs that bypass the processes of building the active support of the teachers, both at a micro (school) and macro (the teaching community) levels have all faced uncertain future, not being able to figure out sustainability beyond the program.*

While the stated goal of CLPS in Karnataka includes "*Enrichment of existing curriculum and pedagogy by employing ICT tools for teaching and learning*", the State's Mahiti Sindhu and ICT@Schools programmes follow the BOOT model in keeping CLPS distinct from the regular teaching-learning activities of the school, which has resulted in little impact of the programs on the existing curriculum and pedagogy (Gurumurthy 2009).

Based on the failure of the BOOT model in Karnataka and the success of public delivery of CAL in Kerala, the policy outline for ICTs and learning according to Gurumurthy (ibid) are 1. focus on teachers and teachers' training and not on direct student learning using ICTs (ICTs are complex and need to be interpreted to young minds and hence teachers need to build their own capacities before they can do such interpretation). The successful models have all focused on teachers 2. focus on computer / ICT aided learning and not on computer literacy 3. focus on systemic improvement rather than on specific topics/subjects 4. focus on keeping 'public ownership' over knowledge resources instead of privatising knowledge.

Two contrasting conclusions and policy prescriptions emerge from Banerjee and Duflo (2011) and Gurumurthy (op.cit) based on differences in the interpretation of 'failure' in different contexts of the effective use of digital media in learning and the factors defining cost-effectiveness of delivery. While Banerjee and Duflo concentrate on exploring the failure of pedagogical practices and ways to improve the state of pedagogy in a given institutional context, Gurumurthy focuses on the institutional

factors which shape the status of pedagogy in the public delivery system and specifies ways for institutional improvement.

II Aim

Government of Bihar's CAL (e-samarth) programme in learning centres and middle schools has been experimenting with multiple delivery systems. A public delivery model had been in place earlier under SSA which covers 234 middle schools (Model 1). Since 2005-06 a decentralised BOOT model has been covering 141 schools (Model 2). The current initiative based on PPP implemented by a consortium of partner organizations with IL&FS as the implementing partner has been introduced in 244 schools spread over all 38 districts of Bihar (Model 3). In total, 175000 students and 2100 teachers in 619 centres spread over 375 blocks in all districts of Bihar are officially covered under the programme. There are also private delivery initiatives by education, skill and software providers. Thus Bihar presents a unique opportunity to study the relative efficacy of the different delivery models in the same social environment in how far these have succeeded in improving the quality of learning in elementary schools. In our discussions with the Director, BEP, it emerged that the government is particularly interested to know the 1) extent of improvement of learning in schools specially understanding the hard spots in Language, Mathematics and EVS 2) impact of e-contents on motivational level of learners in understanding technical skills, self-learning and self-evaluation. 3) role of private partners and NGOs in delivering improvements in learning.

In this research, we had set out to do the following:

1. Design a set of simple indicators to measure the actual success and potential of the current initiatives to provide scalable cost-effective and equitable delivery solutions to schools catering to students coming from underprivileged backgrounds to overcome the challenges of the digital divide in 1. Provision of basic infrastructure 2. overall and sustained enhancement of ICT skill-levels of teachers 3. incentives of teachers and

curriculum designers and the other agents to integrate ICT into curriculum and pedagogy .

2. Conduct a field survey using multiple field methods (coded questionnaire based interviews , participant-observer methods, participatory focus group discussions) of --- schools and learning centres in ----districts of Bihar to collect data for documentation and data for calculation of the indicators for Bihar.

3. Analyse the data based on qualitative and quantitative techniques

4. Outline and compare the documented results from the field survey in Bihar with other states and particularly those in Kerala and Karnataka.

5. Cull out the significant and relevant policy inputs from the findings of the study for Government of Bihar's current initiatives around e-samarth.

III Method

What constitutes Learning Effectiveness?

There are no standard systems to measure learning effectiveness. A mix of three distinct approaches to measure improvements in quality of learning - behavioural, cognitive and technical, defines the indices of quality of learning used for the international monitoring of what is now referred to as the Millennium Learning Goals (MLG). This mix is a refinement in response to the critique that the Millennium Development Goals for Education had not addressed the inequities arising due to differences in quality of learning (Barrett 2009). The EFA Global Monitoring Reports (Various Years) cover teacher supply and quality, finance, learning time, learning environments, school resources as well as learning outcomes as measured by assessment of cognitive skills (ibid). According to Barret (2009) of Edqual, a research programme consortium on implementing quality education in low income countries, while the main emphasis has to be on the measurement of cognitive learning outcomes, international monitoring

agencies working on quality of basic education also report on measurable inputs like supply and quality of teachers (e.g. academic and professional qualifications and absenteeism). This framework has been extended by many researchers to study effectiveness of CAL (for an example, see Taylor and Ku 2011).

While this debate has led to a technical framework combining qualitative and quantitative parameters, in which quality of learning is measured through either self-assessment (Banerjee and Duflo 2011; Vidya Bhawan Society and Azim Premji Foundation 2008) or assessment by others through standardized 'one size fits all' tests (e.g. Pratham's test questions for ASER reports). Both approaches have limitations, and a combination of the two have often been used to design frameworks e.g. World Bank 2007. However, these techno-managerial frameworks do not throw any light on: i) the relationship between learning outcomes and socio-economic status of individuals ii) implications of the relationship between learning outcomes and economic wealth iii) the links between learning outcomes and the process of learning iv. links between process of delivery and learning outcomes (Bowles and Gintis 1976; Goldstein 2004; Barret 2009; Tikley 2010).

This process centric debate of the last three decades has led to research initiatives designed for a particular socio-economic context to estimate the impact of quality of learning within a specific programme. These designs are based on four factors: knowledge, skills, attitudes and process (Moody et al 2002). SACMEQ, a cross-country survey of 42000 primary school teachers and pupils in Sub-Saharan Africa, which is one of the largest studies on quality of education done so far, shows that programme effectiveness (measured by programme context, design and delivery process) in improving the four areas mentioned above is highly contingent on pupil background (e.g. gender, age, socio-economic status), school context (e.g. school location, size, average pupil socio-economic status), school process (e.g. facilities, procedures and teacher characteristics). So 'process' has to be studied at multiple levels. Combining

these two approaches, we designed a 'learning effectiveness survey' for CAL in Bihar based on the following:

a. Defining the Learning Goals: The effectiveness of any particular educational programme can only be assessed in the context of its learning goals defined as "particular knowledge, skills or attitudes that participants should have at the end of the learning episode" (Moody et al op.cit).

b. Designing Variables: A combination of latent, observable, and measurable variables to measure Learning Effectiveness (Short Term Learning) to assess the overall effect of the intervention on students enrolled in CAL for languages, mathematics and environmental science to indicate:

1. Knowledge (K Variables): what was the effect of the intervention on increasing knowledge in those particular subjects (e.g. did the student show any improvement in acquisition, retention and reproduction of knowledge after enrolment in CAL; did the teacher acquire and retain the knowledge disseminated through the training program)?

2. Skills (S Variables): what was the effect of the intervention on improving skills (e.g. is there any demonstrable skill acquired by the student in ICT for course-work in the subject areas under CAL – e.g. use of multimedia to improve vocabulary, or use of ICT for EVS project work; has the teacher been able to use ICT tools for doing lesson plans, designing assignments etc)?

3. Attitude (A Variables): what was the effect of the intervention on changing attitudes (e.g. was any topic covered in the Mathematics curriculum perceived as easier to understand by the student after introduction of CAL; does the teacher now aspire for more time on computer, use of OHP facility for her/his teaching work)?

4. Long Term Learning (L Variables): what was the effect of the intervention beyond the scope of the course itself (e.g. on choice of future courses for students, on future design of courses/curriculum and approach to pedagogy)?

5. Process Variables (P variables): what would be the modifications necessary to the existing process to strengthen the integration of the CAL programme in the existing

curriculum and pedagogy (this will cover student background, school process, school context, programme delivery context and delivery process).

The underlying assumptions are:

I) Learning Effectiveness in the short term (measured across cohorts at a point of time) will be indicated by relative gains in knowledge, skill and attitude because learning effectiveness is dependent on how well the learning goals set by the programme were achieved and how much of these were attributable to the programme itself and how much to other process variables.

II) Long Term Learning gain will be determined by Learning Effectiveness (Short Term Learning) because how effectively students and teachers learn and utilise their skills acquired during the programme will determine the usefulness of the learning beyond the scope of the programme.

IV Design

1. Framing The Survey Questions: The survey used three different sets of schedules (respectively for students, teachers and school management) covering coded responses to questions for each of the five areas outlined above for design of variables. It also included a few open ended questions to increase diagnostic power.

2. Correcting Perception Bias: This design may be prone to 'perception bias' as the schedules are intended to capture mainly student and teacher response. However, it is established in the literature that perceptions of respondents in learning programmes have a high correlation with their performance in the programme (Feldman 1976; Cashin 1995). Thus, perception bias if any can be captured through tests of correlation of perception and achievement/performance. For this, data has been collected on the respondent

students' scores in examination and assessment exercises in languages, mathematics and environmental sciences (involving use of computer aid) and also on assessment of respondent teachers' training performance in CAL. However, this exercise has largely revealed that record keeping has been one of the key weaknesses of the CAL programme in Bihar with inadequate documentation of performance at various stages.

3. Validity and Reliability of Design: Inter-item correlation analysis and Cronbach's alpha reliability test have been carried out on the survey design outlined above to test for construct validity and reliability for assessing learning effectiveness in CAL. The results are summarized in Appendix I. In two different test designs, testing major item correlations from the survey, the survey design is validated and found to be reliable.

4. Sample design for survey: Sample design needed to ensure coverage of all constituents of population to capture links between quality of learning and factors like socio-economic status and regional economic wealth as well as ensure fulfillment of randomness criterion necessary for statistical analysis. It also had to be such as to enable comparison of the specific implications of multiple delivery systems. To ensure these, a two-stage sampling technique was used. Using the principal investigator's earlier results of mapping of social demography of districts to strength of public delivery systems (Das Gupta 2010), out of the districts where all three models of delivery are operational, three comparable districts (Bhojpur, Samastipur and Saran) were selected through purposive sampling based on an index combining district level GDP, poverty, sex ratio, female literacy and work-participation rates, maternal mortality, vulnerability to poverty, share of dalit, adivasi and minority population, and ranking of the district by public service delivery for six major interventions. On this index, these are three comparable representative districts of Bihar but

geographically spread over South West, North West and North Bihar respectively. Two comparable districts on the index were selected as control – Gaya to examine any variations due to a higher concentration of marginalized castes and Muzaffarpur for its historical legacy of having a more developed system of school education compared to other parts of Bihar . In each of these 5 districts, 5 schools/learning centres were selected based on simple random sampling. It was estimated that around 25 schools/learning centres with an average of 6785 students and 81 teachers would be covered through this sample design based on enrolment records. The final survey covered 3960 students and 54 teachers which is an indication of percentage of attendance.

5. Results/output: The analysis of the survey data will lead to final results on quantitative and qualitative indicators for each set of factors outlined (in the sub-section 'Designing Variables') calculated for cohorts defined by gender and social background to arrive at overall learning achievement for students. It will also outline a similar set of indicators for the contribution of each of factors listed under process variables for measuring effectiveness of teachers in equipping them to integrate CAL in the curriculum and pedagogy. These results have been analysed for all three models of delivery enabling comparison between the models and across districts.

V Results

VA – School Level Analysis

1. Identification of hard spots in learning: One of the crucial aims of the survey was to identify the subjects which students find difficult. This has been based on a perception index along with a verification of inconsistent responses through a matching of performance (examination scores).

Table 5.1: Subject wise hard spots

Subjects	Number of Students having Difficulty in	Percentage of Sample	Percentage of Students having difficulty only in	Percentage of students having difficulty in one other subject or more along with	Percentage of Boys among those who have difficulties in	Percentage of Girls Among those who have difficulties in
1-Hindi	92	2	54	46	54	46
2-Urdu	150	4	82	18	54	46
3-Eng	1026	**26**	75	25	**42**	**58**
4-Sans	2070	**52**	88	12	46	54
5-Mathematics	388	10	76	24	**35**	**65**
6-Science	149	4	63	37	49	51
7- Other	77	2	…	…	55	45

More than 82 percent students have a significant difficulty in one subject and in most cases it is either English or Sanskrit which together account for 78 percent of hard spots. Also, in English and Sanskrit, the gender gap in learning is significant (Table 5.1 above and Table 2.1 in Appendix II). Thus by middle school itself, the gender disparities within pedagogical approaches in school are leading to gender gaps in knowledge acquisition and learning achievements (these have been noted in the literature for a discussion, see Aslam and Kingdon 2011). The gendered pattern in mathematics accessibility in middle school can be argued to be a clear predictor of gender-biased specializations in later life (majority of boys will take up science and commerce as specializations at high school and college while majority of girls will take up arts and humanities). Studies based on NCERT data does not show any significant gap at Standard V though it does show overall

low levels of achievement in both languages and mathematics at the primary school level (World Bank 2009), but we find that in the next three years of middle school (Standard VI-VIII), the gender gap turns significant in the case of Bihar.

2. Role of *e-samarth* in addressing the hard spots:

Table 5.2: Information and Perception gaps on Role of *e-samarth*

Perception/ Performance	School Authority	Teachers	District level authorities	State BEP officials	ILFS
Increased Interest in learning	88	76	No information	Presumed	No information
Increase in attention span	76	65	No information	No information	No information
Increase in classroom participation	88	48	No information	Presumed	No information
Increase in classroom interaction	68	63	No information	No information	No information
Correct answers/response	72	46	No information	No information	No information
More clarity on topics taught through CDS	60	39	Presumed	Presumed	Presumed
Improved examination performance	64	44	No information	No information	No information
Improved understanding of the subject	56	41	Presumed	Presumed	Presumed
Increase in enrolment (students changing schools)		15	No information	No information	Presumed

Table 5.3: Status of Trained Teachers in *e-samarth*

	Trained under CAL	Trained Outside/ self trained
Trained Teachers	85	15
Training Hours		
Not sure	7	
15 hours	7	
25 hours	4	
30 hours	54	
35 hours	13	
40 hours	2	
50 hours	11	
126 hours	2	
Usage of Computer (Days in a week)		
7	11	
6	20	
5	9	
4	13	
3	4	
2	9	
1	2	
Sometimes	22	
Never	11	
Usage of Computer/Kyan (computer aid) for Teaching		
Yes	43	
No	**57**	

Note: All figures are in percentages

While school authorities held a very optimistic view on the perceived impact of *e-samarth*, teachers' perception was significantly different (Table 5.2). The perception of district and state level officials and the personnel of the private partner were largely presumptions with little or no information on the qualitative indicators of effectiveness of the programme in positively intervening in the learning process. After the

completion of the training, 57 percent of trained teachers were not using computer aids for teaching (Table 5.3).

3. Perception-Performance Matching

Parallel analysis of examination scores of last two years have not been possible for most schools due to unavailability of records of scores for the same batch. Based on the comparable individual scores of students in five schools, Table 5.4 below shows that subject-wise significant changes in exam performance vary from school to school. We identify statistically significant change in exam performance using ANOVA techniques on subject-wise exam scores distributions for same group of students in two consecutive years before and after the implementation of *e-samarth*. This is in keeping with the patterns reported in other studies (Manchin et al op.cit).

Table 5.4 Changes in Performance in Examination in 2011 compared to 2010

	English	Hindi	Sanskrit	Mathematics	Science
School 1	Significant Change	Significant Change	Significant Change	Significant Change	Significant Change
School 2	No significant change	Significant Change	Significant Change	No significant change	No significant change
School 3	No significant change	Significant Change	No significant change	Significant Change	Significant Change
School 4	No significant change	No significant change	No significant change	No significant change	No significant change
School 5	Significant Change	Significant Change	Significant Change	Significant Change	Significant Change

Note: Based on results of Paired T test of examination scores of students in 2009-10 and 2010-11

Here we present two extreme results from the analysis of scores from the exam score records of five schools. In school 4, in which the paired T test showed no change in performance in all subjects, the distribution of exam scores for the batch in the school presented below shows that the top percentile show similar patterns of improved

grades in English, Mathematics and Hindi while the bottom percentiles show similar patterns of worsening. Thus unimodal distributions of scores in English, Mathematics and Hindi have turned bimodal within a year which could be a dangerous trend if left unchecked.

A similar pattern can be seen for the scores pooled across schools in Hindi for both male and female students (Appendix III).

School 4

Fig 5.1A

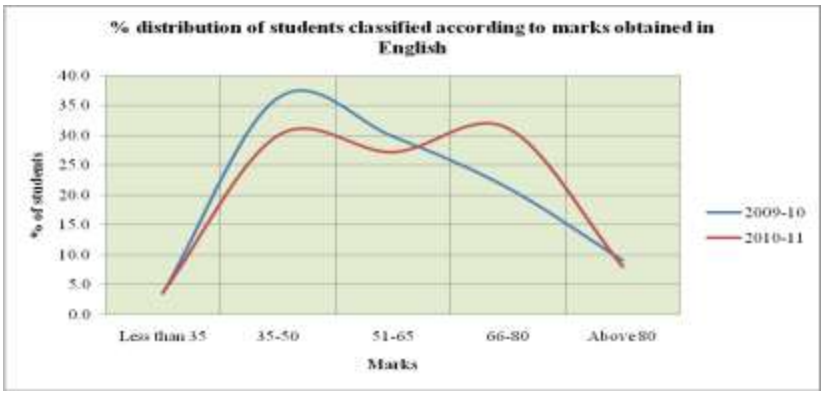


Fig 5.1B

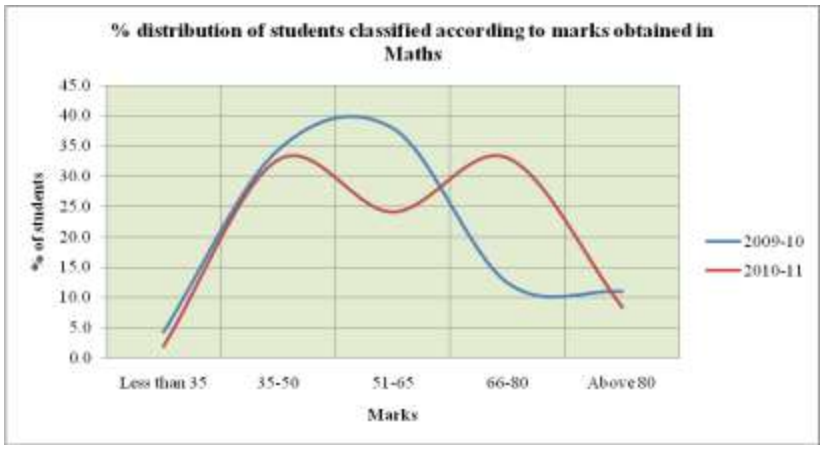
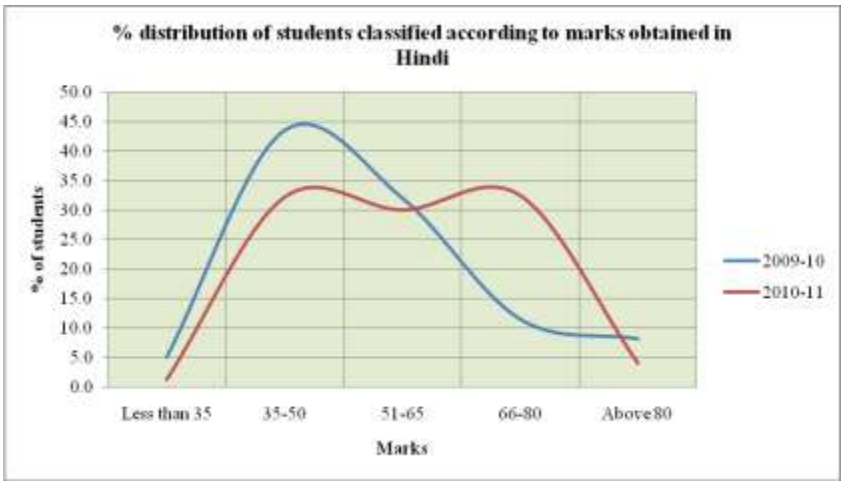


Fig 5.1C



The impact of CAL on performance cannot be isolated out from these patterns as factors like change of teacher teaching the subject as students move up from one grade to another, difference in syllabi etc could also be causal factors as the before/after CAL period coincides with two different years of schooling in different grades/classes. However, the uniform patterns in all three subjects suggest something systemic in the school environment which we have investigated further. Sixty percent of responses in the students' questionnaire based interviews revealed that teachers running the CAL programme in the school offer private lessons (tuition/coaching) outside school hours. Students who avail these tuitions constitute 80 percent of the top half in the class while those who do not are crowded into the bottom half. 90 percent students in the bottom half cannot afford the private lessons. Those who are availing the private lessons are favoured inside the school in terms of learning access. In the case of CAL, it is only this group of students who have access to the computer aided lessons in terms of access

time and teacher supervision. This is the source of the systemic bias in the school environment. This systemic bias has an underlying caste-bias evident from Table 5.5 below. In 2009-10, 11.1 percent of SC students in this school were part of the top half of the class. In 2011-12, all SC students were in the bottom half of the bimodal distribution. A similar pattern for 22.2 percent EBC students can be observed. It must be noted that caste-discrimination in this case is not explicit but plays out in the caste-class correspondence with respect to access to private tuitions and thus linked to issues of access to the market for private tuitions in a context in which the market agents are also the key delivery personnel (teachers) in the government school system.

Table 5.5: Caste-wise Percentage Distribution of Students According to Examination Performance

Row No	Caste	Year	35-50	51-65	66-80	>80
1	General	2009-10	28.1	28.1	25.0	18.8
2	Backward	2009-10	26.7	33.3	33.3	6.7
3	Extremely Backward	2009-10	55.6	22.2	0.0	22.2
4	Scheduled Caste	2009-10	66.7	22.2	7.4	3.7
5	General	2010-11	23.8	33.3	23.8	19.0
6	Backward	2010-11	23.8	33.3	23.8	19.0
7	Extremely Backward	2010-11	66.7	33.3	0.0	0.0
8	Scheduled Caste	2010-11	100.0	0.0	0.0	0.0

Note: The identical figures in Rows 5 and 6 are due to small sample size. Small variations are there in the third decimal which is not evident here due to rounding off.

Performance and perception of students in school 4 were highly correlated. While the top 30 percent of students felt that CAL had helped them to understand lessons better and thus helped in examination performance the rest of the students complained that they did not get access to computer aided lessons in English, Mathematics and Hindi. Very large proportion of students who scored below 65 percent felt that the CAL sessions were useful for them. Students' performance in the examinations and their perception about the benefits of CAL is highly correlated confirming one of the initial premises of our exercise (Table 5.6).

Table 5.6: Perception- Performance Matching of Students in School 4

	English	Mathematics	Hindi
Rank Correlation coefficient (Usefulness of CAL (perception), Examination Score (performance)	0.81	0.79	0.91
Rank Correlation coefficient (Usefulness of CAL (perception – negative), Examination Score (performance <65)	0.87	0. 82	0.94
Rank Correlation coefficient (Usefulness of CAL (perception – positive), Examination Score (performance >65)	0. 78	0.71	0.86

Table 5.7: School 5: Computer Aided Learning Access

Student Attendance (%)	Teacher attendance (%)	Average actual Class size	Student Computer aid Ratio	Student Access to ICT outside school (%)	Student Access to e-samarth tools in school (%)
59.2	88.9	108	108: 1	4.3	21

On the other extreme, we have school 5 in our sample in which the significant change in all subjects reported in Table 5.4 above has been uniformly negative for both male and female students illustrated in Figures 5.2A to 5.2 J, once again suggesting a systemic problem in the school. Also, only three subjects English, Hindi and Mathematics are being taught with computer aids. However, there is no difference in the outcomes on performance among the subjects being taught with computer aids and those without (Sanskrit and Science). This systemic problem was not evident from the student responses. But the interviews with the teachers revealed tensions and conflicts among the teachers in the school. In particular, one teacher whose computer skills are minimal has dominated not only the running of the *e-samarth* programme but also ensured that the more skilled and trained teachers cannot and do not have any access to the use of the programme. The teacher's role in creating an obstructive power structure in the school has not been confined to *e-samarth* but also overall delivery of the different subjects taught in the school. Two of the other teachers who divulged this information requested anonymity for fear of retaliation. The interview with the teacher concerned revealed a very contemptuous assessment of the other teachers and the principal of the school. In particular, the teacher expressed doubts about the teaching abilities of colleagues in the school. The headmaster denied any conflict but admitted that there are 'tensions' between teachers. This finding is also similar to patterns observed in the

literature which attributes such findings to causal connections to specificities in the school environment (see Section 1).

But in Bihar, School 5 would rank as one of the best schools in terms of overall school functioning using standard parameters like average attendance, and more relevant to our study – regular functioning of *e-samarth*. However, there have been long periods in which there have been no classes. Students could not explain why classes were irregular. But the teachers attributed it to 'problems' arising from conflicts over class schedules and distribution of workload. Both district level functionaries and ILFS personnel, separately interviewed, when asked to name a school which in their perception has operationalised CAL very well chose School 5. This also matched with the field team's observations that computer aided teaching being delivered in the school in three subjects.

However, even in this school where delivery has been obstructed due to conflicts among teachers, student perceptions matched with student computer ratios suggests that it is students' access to the computer aided learning tools which is vital to effective learning.

81 percent of student respondents surveyed across schools in response to the open ended question on their observations on *e-samarth* stated that more computers are needed in the school. The infrastructure design for the programme has been conceived on the basis of conceptualizing *e-samarth* as a computer aided teaching programme as opposed to computer-aided learning. For a computer-aided learning programme, resource planning has to take on board social and physical outreach to students and ensure their access to e-learning tools. This is a very basic lacuna in the current design of *e-samarth*.

School 5

Fig 5.2 A

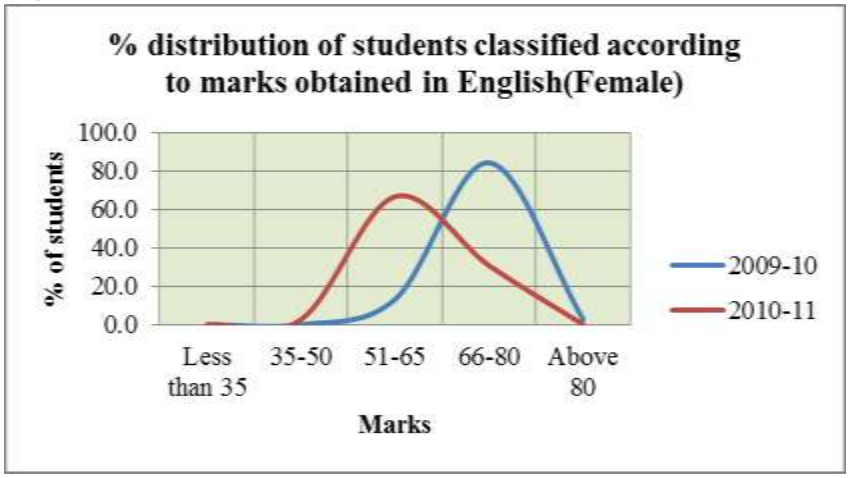


Fig 5.2 B

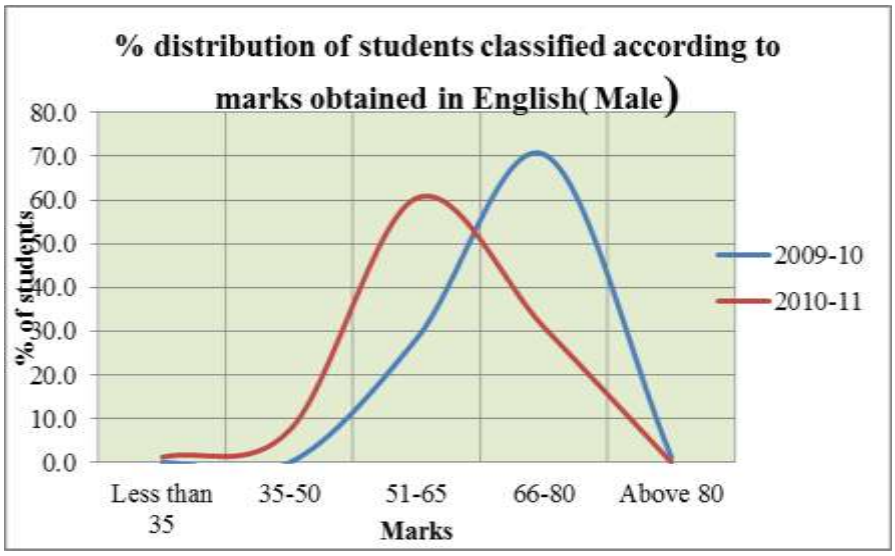


Fig 5.2 C

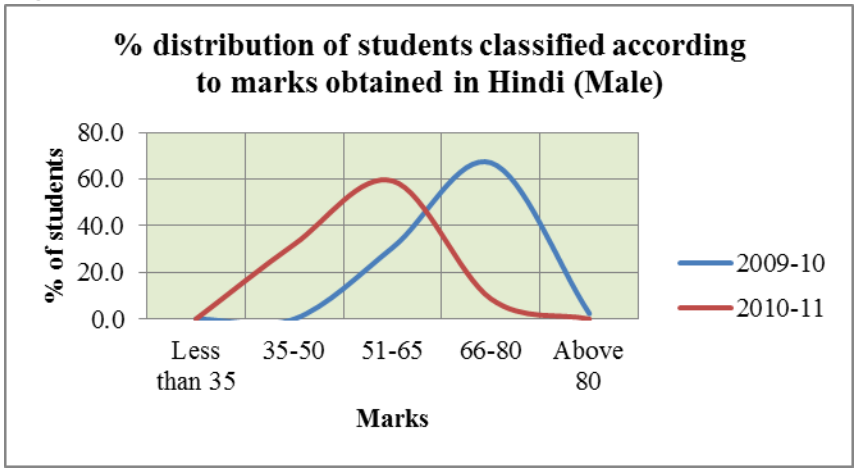


Fig 5.2 D

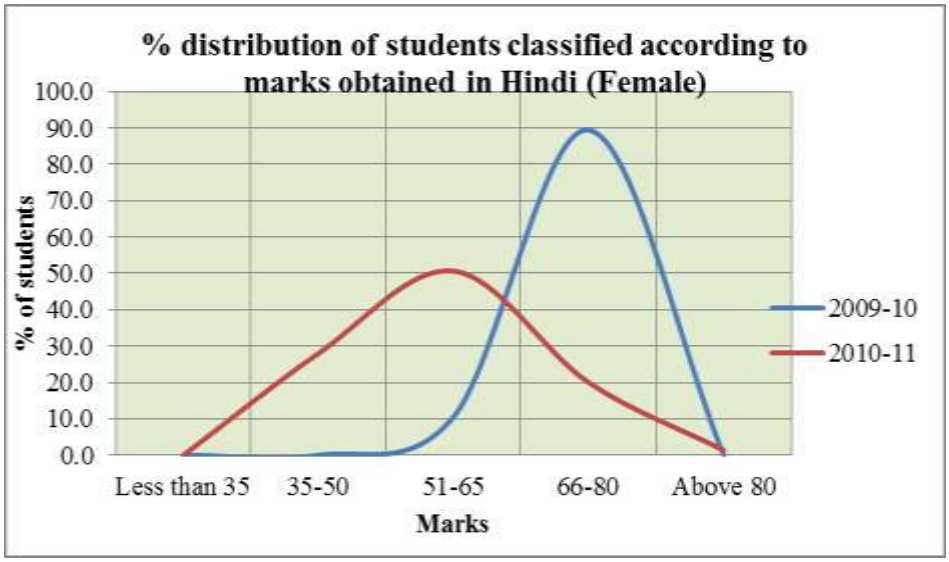

% distribution of students classified according to marks obtained in Hindi (Female)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% of students
Less than 35
35-50
51-65
66-80
Above 80
Marks
2009-10
2010-11

Fig 5.2 E

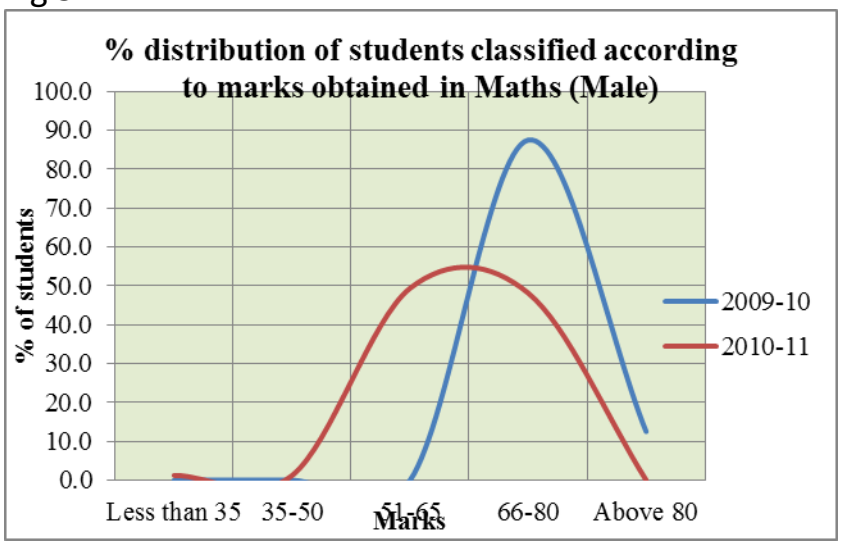

% distribution of students classified according to marks obtained in Maths (Male)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% of students
Less than 35
35-50
51-65
66-80
Above 80
Marks
2009-10
2010-11

Fig 5.2 F

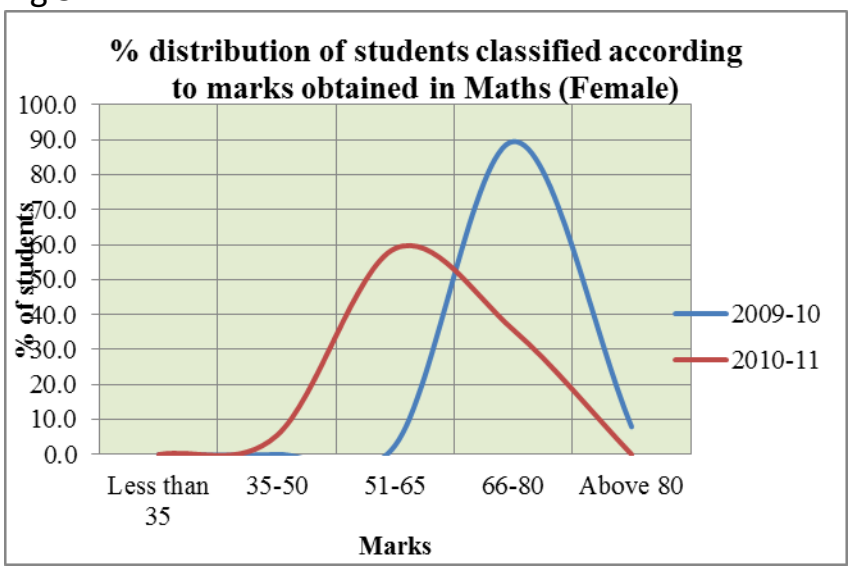


Fig 5.2 G

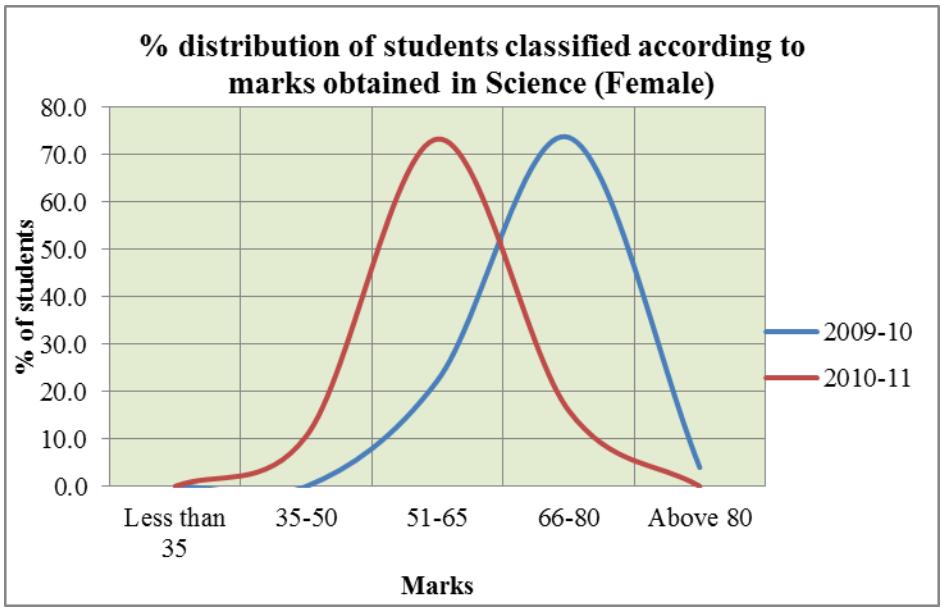

% distribution of students classified according to marks obtained in Science (Female)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% of students
Less than 35
35-50
51-65
66-80
Above 80
Marks
2009-10
2010-11

Fig 5.2 H

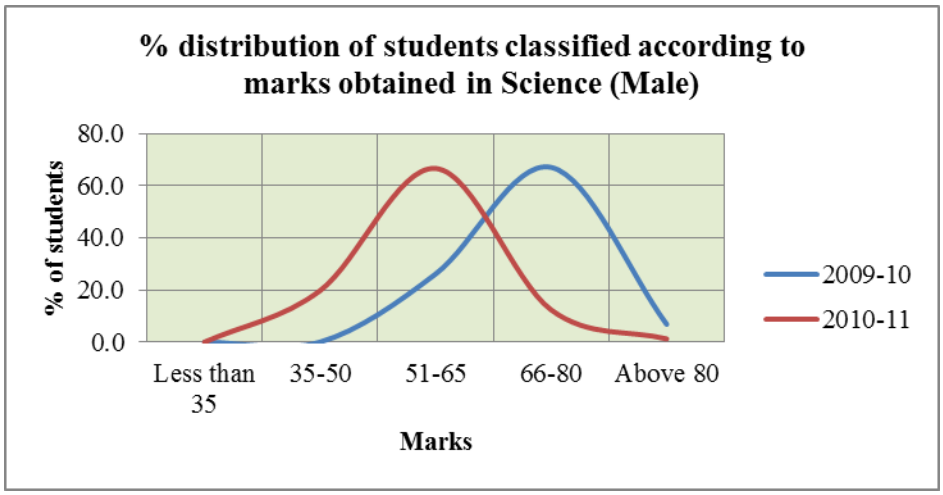

% distribution of students classified according to marks obtained in Science (Male)
80.0
60.0
40.0
20.0
0.0
% of students
Less than 35
35-50
51-65
66-80
Above 80
Marks
2009-10
2010-11

Fig 5.2 I

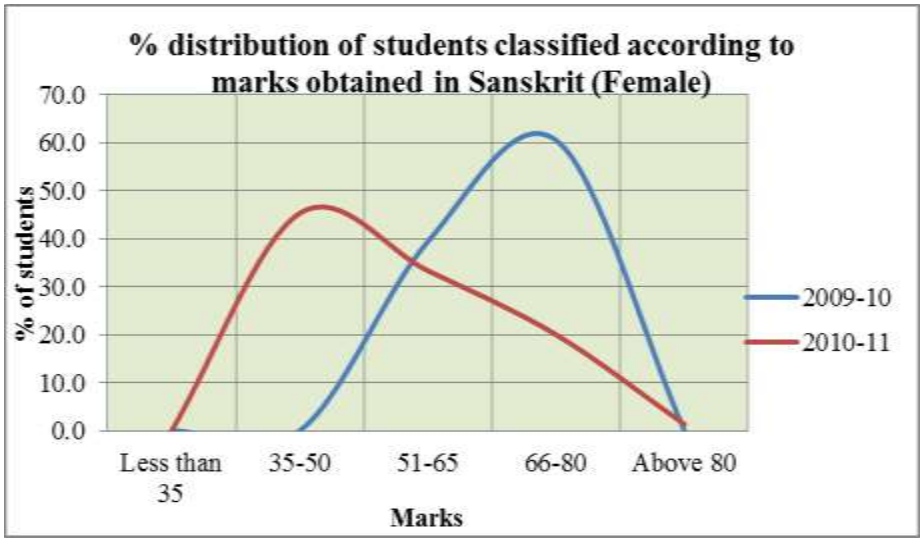
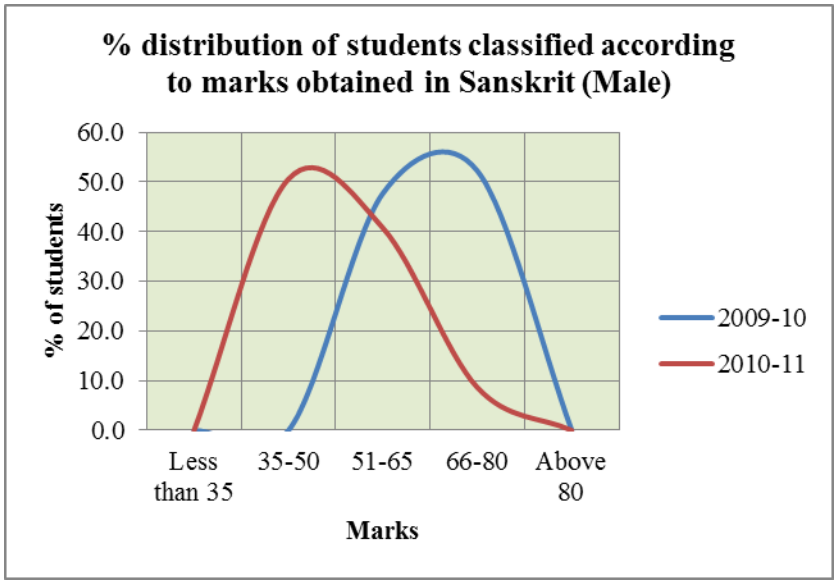


Fig 5.2 J



VB: Comparing outcomes across districts and delivery models

Having explored the physical and social specificity of quality issues at the school level in the earlier section, this concluding section presents an analysis of outcomes on knowledge (K), skills (S) and attitudes (A) of students. Each of these has been measured on a scale of 1-5 where:

1 – Much Below Average

2 – Below Average

3 – Average

4 – Above Average

5 – Much above Average

In this design, the variables K, S and A are a mix of performance and perception variables. K has been measured on the basis of examination scores stated by students in the survey after cross verification with the sample scores collected from school authorities wherever it has been available. S has been measured with pooling of two indicators: to what extent the student can use computer aids for self or group learning; and the number of 'difficult' subjects stated by students (indicator of learning skills). A has been measured by pooling two indicators: whether the student likes classes taught with computer aids and to what extent the student perceives computer aids as necessary to the learning process.

The sample under consideration consists of students who are in schools in which CAL is operational (Appendix II, Tables 2.2A and 2.2B).

Table 5.8 and 5.9 present the results of the mapping exercise of knowledge, skills and attitude of students across districts and delivery models

Table 5.8 : District level variations in percentage distribution of students classified by outcome variables

Variables	Scale	Saran (% of Students)	Samastipur (% of Students)	Bhojpur (% of Students)	Muzaffarpur (% of Students)	Gaya (% of Students)	Analysis of Variance Between Districts (F test at 5% significance level)
Knowledge	1	20	22	23	10	28	There is significant variation in distribution of students on the knowledge scale across districts
	2	16	21	25	24	21	
	3	40	35	28	25	33	
	4	10	14	16	25	12	
	5	14	8	8	17	6	
Skills	1	22	8	23	23	40	There is significant variation in distribution of students on the Skills scale across
	2	46	14	56	49	8	
	3	1	14	7	4	5	
	4	46	42	3	9	35	
	5	28	22	11	16	13	
Attitude	1	4	1	1	1	3	There is **no** significant variation in distribution of students on the attitude scale across districts
	2	2	1	1	1	3	
	3	1	1	1	1	1	
	4	2	1	1	1	3	
	5	91	96	96	96	90	

The distribution of students on the knowledge and skills scale significantly varies from district to district but attitudes of students to CAL is uniform across districts. The qualitative findings of our survey corroborate this result. More than 95 percent of students were very positive towards CAL and the prime reason for their liking for computer aided lessons was that they liked studying with the use of images (computer graphics/animation). They felt that they enjoy and remember the lessons better when taught through images. However, knowledge and skill levels showed much more variations across districts. Also, there are no significant patterns of variation between the students in Saran, Samastipur and Bhojpur and those in our control districts Muzaffarpur and Gaya with respect to knowledge and skills (Appendix IV). Thus the historical legacy of developed educational institutions in Muzaffarpur or the higher

demographic concentration of oppressed castes in Gaya has no correlation with students' knowledge and skill levels.

The difference in outreach of the delivery models is significant. Model 3 (ILFS) has been able to ensure that around 66 percent of regularly attending students are able to attend lessons taught through computer aids. The corresponding figure for Model 1 (BEP) is 3 percent while for Model 2 (BOOT), it is 17 percent. Thus the ILFS model has been successful in increasing the spread of students attending computer aided teaching sessions in school. However, examination of the variations in distribution of knowledge and skills across delivery models reveal that there are no differences in distribution of knowledge and skill patterns of students across the three models of delivery namely, BEP, BOOT and ILFS (Table 5.9). So while Model 3 has been successful in increase outreach of computer aided teaching sessions session, it has not made any significant difference to quality of learning compared to the other to models.

Table 5.9 : Delivery model wise percentage distribution of students classified by outcome variables

Outcome Variables	Models	1 BEP	2 BOOT	3 ILFS	Analysis of Variance Between Delivery models (F test at 5% significance level)
Knowledge	1	1.0	3.6	0.2	There is **no** significant difference in distribution of students on the knowledge scale across delivery models
	2	6.5	3.4	1.1	
	3	66.1	84.3	88.2	
	4	19.8	6.4	8.2	
	5	6.7	2.3	2.3	
Skills	1	83.6	69.4	75.5	There is **no**

	2	9.3	18.5	14.7	significant difference in distribution of students on the skills scale across delivery models
	3	4.0	8.0	5.8	
	4	1.3	2.1	2.1	
	5	1.7	1.9	1.9	
Outreach	Percentage share of students covered by the delivery model who are attending Computer Aided Teaching classes in school	2.9	17.4	65.8	

Table 5.10: Correlation Matrix of Outcome and Process Variables in Learning Effectiveness

Process / Outcome	Access to Computer aided in Schools	Project Work using Computers in School	Access to Computers Outside School	Attendance of Computer Aided Lessons in school	Ability to run the *e-samarth* CDs containing lessons
Skill level	0.91	0.90	0.60	-0.03	-0.16
Knowledge level	0.63	0.81	0.23	-0.24	0.01

Analysis of the relation between outcome and process variables reveal that skill level is highly correlated with students' access to computer and project work done on computers in school. Knowledge is also significantly correlated with project work done with computer aids. Access to computers outside school, attendance of computer aided

teaching lessons and ability to run the *e-samarth* CDs have no significant relationship with knowledge and skill levels (Table 5.10).

Thus students' access to computer aids and project work with computer aids are crucial to levels of skill and knowledge acquired by the student. These two factors have been of least importance in the existing programme design of *e-samarth,* while the conceptualisation of the programme as a computer aided teaching delivery system has led to emphasis on the teaching (through CDs in the current phase of the programme) which have not made any significant impact on either skill or knowledge levels given the larger constraints of the social impediments to learning effectiveness in schools in Bihar.

Based on these survey results in Bihar, we present the results of our comparative review of CAL delivery systems in Bihar, Karnataka and Kerala focusing on design, process and implementation issues in a policy brief for Government of Bihar which is annexed to this paper. The policy brief provides inputs for possible and feasible changes to the institutional structure of public delivery of *e-samarth* in Bihar to address the outcomes reported in this paper.

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