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Computer Curriculum in Elementary Schools

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With e-Learning and digital adaptive learning becoming buzzwords in the recent years, the age of integration of ICT in school education seems to have truly arrived. But the moment one looks beyond the urban centers, the rural areas throw up hundreds of thousands of schools just beginning to wake up to the idea.

In the absence of a clearly defined computer science curriculum, computers could just get relegated to entertainment devices. A systematic curriculum can be instrumental in developing algorithmic thinking and organisation skills. This will not only lay a foundation for future programming skills, but develop important life skills.

In this article we share the learnings of a pilot project on implementation of computer sciences curriculum carried out for 10 months from class 1 to 5 at a private school in Mumbai, Maharashtra.

Computer education provides a unique opportunity for boosting natural ways of learning. Integration of ICT into the school curriculum is instrumental in developing a culture of thinking, lifelong learning and social responsibility.

For developing countries, investing in computer education can be instrumental in building indigenous technological capability and autonomy.

Addressing digital divide

Given the support for ICT in schools under government schemes such as Sarva Siksha Abhiyan (SSA), computer education has got a thrust in the past five years [1]. However, compared to developed countries and even developing countries like China, the figures of computers in schools are quite low.

In India, less than 10% of all schools have computers, and even this is also heavily in favour of urban areas (26.41%) while the rural areas (6.66%) are marginalised. Amongst the urban areas, six Indian states of Chandigarh (73.65%), Sikkim (55.56%), Delhi (55.40%), Kerala (48.19%), Andhra Pradesh (43.48%), Nagaland (39.41%) have more than 35% penetration of computers in schools. On the other hand for the rural areas, only three states Delhi (51.18%), Chandigarh (40%) and Kerala (36.87%), have more than 35% penetration of computers in schools [2].

Except for Delhi, there is a wide gap in computer penetration in schools in rural and urban areas of each state indicating the rural-urban digital divide.

Even when computers are available in schools, the emphasis is largely on acquiring the skills for its usage. There is little deliberation on the course content and the methodology best suited to teach it. Private international schools have been the major frontrunners in computer assisted learning and other private and government schools are slowly catching up.

Defining a curriculum

Computer science curriculum of the national and few state boards take the societal approach – computers being pervasive in present times, focus on acquiring basic technical skills – and vocational approach – prepare for a career in computer science, or application of technical skills in different vocations – to the curriculum. Private companies that market educational software to the schools consider the pedagogical approach and focus on computer assisted learning for different subjects.

However, in all the approaches to the curriculum -societal, vocational and pedagogic - only the behavioral aspect is considered and students are groomed to become 'expert users'. On the other hand, the catalytic approach focuses on teaching information handling and problem solving skills. Curriculum based on this approach aims to develop computer fluency amongst the students and mentor them to participate actively in constructing the technology.

To address this issue, a team at Department of Computer Science and Engineering, Indian Institute of Technology Bombay, adopted an eclectic (combination) approach to the computer science curriculum with the goal of developing computer fluency at the end of school education. The computer curriculum for each standard is broadly divided into three groups:

1. Concepts: Learning computer science concepts that are generally useful in many areas as well as some concepts that are specific to computer usage/functioning.
2. Usage Skills: Developing hands-on skill in the use of various hardware/ software and programming packages/languages.
3. Social Aspects: Understanding ethical and security related issues of computer and Internet usage.

The emphasis is on understanding the concepts behind various computer-based

activities, rather than just the usage skills of specific tools. For each standard, the syllabus is defined by giving the topics that should be taught, the reasons for doing so and a schedule. There is a spiral organisation of the curriculum so that students can continually build upon their existing knowledge. This curriculum was reviewed by experts and modified appropriately. The detailed syllabus is available at *http://www.cse.iitb.ac.in/~sri/ssrvm/*

Development of teaching material

At the outset it was decided that the curriculum will be OS independent and eventually provide an exposure to both the platforms – open source (edubuntu) [4] and proprietary (Windows). We begin by focusing on the behavioral aspect and later widen the scope to cognitive aspects, refining mental capacities (through step-wise reasoning and logical thinking exercises) and teaching fundamental computer science concepts. A positive attitude towards computer technology is inculcated in the students through the various computer based activities and teaching methodology. Ergonomic aspects such as posture, exercises are covered at each level to emphasise health values.

After deciding on the content to be taught, teachers' handbooks were written for the first four levels. Each chapter in the handbook included a lesson plan, worksheet and website references for further reading. The course was implemented in a pilot school located in Mumbai. In light of the field experience, the curriculum was modified and the teacher's handbook was upgraded to a textbook.

Each lesson in the textbook includes aim, lesson outcome and the content tied by a loose story with three characters, a mouse (Moz), a boy (Tejas) and a girl (Jyoti). This is supplemented by worksheets, computer based activities (using open source applications), points to explore by the students, a lesson plan for the teacher and suggested web resources for further reading.

At present, teaching material for four levels are available. Levels I and II focus on skill acquisition (e.g. keyboard/ mouse skills) while Levels III and IV concentrate on building algorithmic thinking, reasoning and organizational skills using real-life experiences, computer applications and multimedia programming language (Scratch) [5]. Practice of specific skills is through open source educational games such as Educational suite Gcompris [6], Childsplay [7]. These activities not only provide opportunities for building the computer skills, but also sharpen the cognitive skills such as classification, similarities, differences, speech/audio/ colour/pattern recognition, etc.

The book is available freely for educational use, under the creative commons license, at *http://www.cse.iitb.ac.in/~sri/ssrvm/*

Delivering the curriculum

The teaching methodology adopted in the project followed a four stage model that is outlined as follows:

a) Exploration: At the initial stage there is no direct teaching, but students are asked to explore a particular application by themselves. The teacher's role is to provide positive reinforcement – appreciation, stars, etc for every right move by the student.

It is essential that the students are motivated to learn and they are able to focus attention on the task at hand. In some cases, students are asked to observe the teacher doing a particular task and then explore the application on their own. Dividing the class into groups of four/ five students allows for collaborating and sharing resources amongst peers.

b) Motivation for self learning: At this stage, the learner is actively involved in constructing new ideas/concepts based upon their current/prior knowledge. Computer based activities such as multimedia programming (e.g. Scratch) provide students opportunities for experimental learning. These activities are intrinsically interesting to the students and they discuss alternative strategies with their peers. The teacher's role is to work as a mentor/facilitator and ask probing/open-ended questions instead of 'teaching'. For example, after demonstration of basic features, students wrote programmes in Scratch on their own. They had healthy disagreements wherein different team members tried their way of writing the script.

Reasons for including computers in schools

Rationale	Basis
Social	Computer skills are essential requirements in present information based society, hence school education should equip students with technical skills
Vocational	Prepare for jobs that require computer skills
Pedagogical	Use technology to enrich leaning experience, flexible and efficient course teaching
Catalytic	Computers as tools to change the education process through collaborative learning, relevant curricula and expand learning opportunities

c)Reflection: Students engage in social negotiation (debates/discussions) with peers and teachers to compare their understanding and create revisions to their current structures of knowledge. The teacher's role is to provide individualised support and motivate the students to become active learners. Thus, the emphasis is on inquiry learning wherein students actively make observations, collect, analyse, and synthesise information, and draw conclusions. For example, after students made a picture using paint application, they were asked to construct a story around it. The teacher encouraged students to narrate more than one story for the same picture.

Field insights

The pilot project implemented the curriculum for class 1 - 5 at Sri Sri RaviShankar Vidya Mandir, Mulund, a private school in Mumbai. a private school in Mumbai. The field work was carried out for 10 months (July 07 - April 08) with each class having one computer lecture per week of 30 minutes duration. Maximum strength of a class was 34 students and four laptops were used to provide hands-on experience to the students.

Each class was divided into mixed sex groups of five to eight students and the computer use was monitored. Students were taught basic computer skills, ergonomic/ safety values, applications such as paint, word processor, media player.

Exercises in algorithmic thinking and logical reasoning were provided through computer based and paper pencil activities. For class 3 and 4, Scratch was taught through minimally invasive learning approach.

It was found that the elementary school students are avid learners and explore the various computer applications with minimal assistance. Given the urban setting and familial background, it is likely that 74% students have had an exposure to computer technology.

Computer-based activities interest the students and can be used for developing skills in other subjects. For example, students averse to solving mental math sums enjoyed TuxMath game requiring similar exercise. Thus, computer science can be instrumental in sharpening competencies in other academic areas.

No gender differences are observed in computer proficiency and usage. This may be due to controlled exposure provided in the school setting where every student was provided an equal opportunity to use the technology. It is likely that when girls have to compete with boys for computer usage, differences might show up.

Field observation indicates that while girls preferred paint application, boys were keen on playing strategy games. However, a more elaborate study is required in order to make a conclusive statement on gender difference in application preference. Confidence of teacher with the technology has a positive impact on confidence of students.

This is in line with evidence from other studies that have highlighted the role of a teacher as a model that students emulate and transfer of positive computer attitude of the teacher onto her students.

Hence, teacher training is an essential component of successful implementation of computer science curriculum.

References

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