Computer Masti: Use of FOSS for Teaching Computers in Indian Primary Schools

Malathy Baru, Farida Khan and Sridhar Iyer,

Department of Computer Science and Engineering

Indian Institute of Technology Bombay

malati@it.iitb.ac.in

[farida,sri]@iitb.ac.in

***Abstract*— Inclusion of FOSS based activities in school curriculum is of paramount importance in developing countries. However, FOSS usage for teaching Computers in schools is minimal today. This is mainly due to lack of awareness about FOSS education resources and non-availability of teaching material, trained teachers and maintenance support team. To address this gap, we have formulated a FOSS based computer education syllabus and developed *Computer Masti [CM],* a computer science textbook, to teach it. In this paper, we present details of CM, design goals, its content and FOSS applications used therein. The book, CM has the following differentiators --- higher emphasis on computer science concepts rather than skills, and a constructive pedagogical approach. In addition, we include a brief description of the field experience of implementing it. Preliminary analyses based on actual implementation over two years, reveals that primary school students can easily adapt to the proposed FOSS-based learning model.**

I. Introduction

The need for teaching computers in the Indian primary schools has been well established through government annual reports on current education status [1]. It is a common belief that irrespective of the careers they choose, the basic knowledge about computers will help students in the long run. Most of the programs are focussed on providing some exposure and teaching information technology skills. We postulate that in addition to the above, schools should enable students to understand computer science concepts and develop reasoning skills. These efforts will serve not only to demystify computers, but also prepare students for their future in any career.

Given that benefits of FOSS in elementary education are known [2], it is paradoxical that FOSS usage for teaching Computers in schools is minimal today. This is mainly due to lack of awareness about FOSS education resources and non-availability of teaching material, trained teachers and maintenance support team. Most schools rely on proprietary software, off the shelf textbooks and outsource computer education to a third party provider.

A developing country like India cannot rely on proprietary software for mass information literacy. FOSS for computer education is cost effective and particularly suitable for resource constrained groups. Given the Indian government initiatives to bring computers to schools [1], it is essential that the investment allocated is used economically. This holds implication for educationists to frame a syllabus and provide teaching material based on FOSS. Thus, to ensure FOSS usage in schools, there is a need for systematic thought on curriculum and adoption of FOSS in teaching computers at the Indian Primary schools.

Computer Science is not a compulsory subject in many schools, and does not fall within the main track of the school. Hence, the thought process that decides which books to use, what topics to teach is not rigorous or meticulous. To address this gap, we conducted a study of syllabus and textbooks available for teaching computers and found that most textbooks seem to be skill based [3]. The focus is on teaching minute details, which can be learnt through exploration over a period of time. Thus, the study reinforced the fact that there is very little choice of good textbooks for teaching computer science.

To the best of our knowledge, there is no computer science syllabus that integrates systematic use of FOSS applications and teaching material for FOSS based education. Hence, we developed a syllabus and lesson content using FOSS applications that focus on teaching core concepts of computer science such as step-wise thinking. Moreover the applications included in the book, subtly take the student through other subjects like Maths, Science, English, besides teaching Computers. Hence, we believe that the book helps in augmenting learning in other subjects as well. In addition, every level of the book includes a chapter on exercises to avoid computer related injuries. Besides, the textbook can be instrumental in enhancing thinking clarity, values and team work ability.

Computer Masti books are released under Creative Commons, license, freely downloadable at the website http://www.cse.iitb.ac.in/~sri/ssrvm enabling scalable and affordable dissemination.

In this paper we present an outline of the book *Computer Masti* [4], the rationale behind the content and details of FOSS applications used. Besides, a

brief experience report of field implementation that provides insights and learning is also included.

Section II presents a report on current status of computer education in Indian Primary schools. Section III presents CM details, Section IV presents FOSS usage in CM, Section V presents an experience report and Section VI presents the conclusions and future work.

II. Current status of computer education in Indian primary schools

In India, 87 per cent of schools do not have computers. The spread of computer education is limited to just 6.51 per cent of all primary schools in the country (Fig. 1). Although this number is very intimidating, it has to be looked from the perspective of the enormous work required to increase computer penetration in schools. At present, computer education is mostly concentrated in urban, private schools. Thus, the numbers of schools and students who can benefit from any innovative intervention that brings technology to them is huge.

Government of India has made a beginning with an initiative like Sarva Siksha Abhiyan [5] through which computer infrastructure is set up in schools. This is supplemented by corporate social responsibility initiatives that provide ICT-enabled education e.g., Bharati Foundation of Airtel [6], Azim Premji Foundation of Wipro [7], and many others. These companies support government schools by providing resources for computer aided learning. However, most of the efforts are concentrated on acquiring the infrastructure. An equally important challenge is to provide teaching content that is locally relevant and available in vernacular languages. In addition, the need for technical support and training of the teachers, are important.

School Category	All Areas			
	2003-04	2004-05	2005-06	2006-07
Primary Only	3.95	4.50	5.42	6.51
Primary with Upper Primary	10.12	12.68	15.65	21.31
Primary with Upper Primary & Secondary/ Hr. Secondary	48.73	52.06	46.57	52.33
Upper Primary Only	7.14	7.50	11.05	14.61
Upper Primary & Secondary/ Hr. Secondary	35.70	35.64	41.18	50.36
All Schools	**7.68**	**8.99**	**10.73**	**13.43**
Number of Schools with Computers	71,501	93,249	1,20,591	1,60,749

Fig. 1 Percentage of schools having computers in schools
(Source: www.digitallearning.in: NUEPA report)

Section III presents CM, the content that we created to address many of the above concerns.

III. Computer Masti [CM]

The textbook *Computer Masti* has been written to teach computer science concepts in schools. It is primarily based on FOSS operating system and applications. The design goals for the content and structure of the book are described in the following sub-sections.

3.1 Textbook Content Design Goals

At the outset, it was decided that the content for the textbook should meet the following goals. With reference to a lesson in *Computer Masti* – Book 2 (CM 2) titled *Activities Using a Mouse*, the goals are enumerated.

- *Emphasize on concept:* The concept of Folder is introduced along with mouse skills of double click, single click etc.
- *Use FOSS applications* : Jigsaw puzzle games of Childs Play, Drag and Drop games of GCompris are included in the activity section of the lesson
- *Allow the students to do group activities*: Group activity of writing names of flowers, fruits and categorising items to get across the concept of folders and storing similar files in folders is a part of the lesson.
- *Provide pointers to teachers about teaching methodology*: Under the sub-heading 'further reading' useful URLs of websites to teach mouse skills are listed at the end of the lesson.
- *Supplement learning in other subjects:* A GCompris based Discovery game is included to reinforce mouse skills. This requires application of arithmetic, thereby augmenting learning in Maths.

The entire lesson content has been woven around child characters using a storyboard format so as to make it interesting, absorbing and intriguing. The story format adopts a constructivist pedagogical approach. It encourages the characters to keep asking questions, and to explore on their own. In addition, it subtly teaches values like sharing, team work etc. The CM 2 Cover is shown below in Fig 2

The workflow for content generation involves the following steps:

1. Arriving at topics and scope for a particular grade.
2. Authoring of content.
3. Designing content in storyboard format.
4. Creation of illustrations, worksheets, activities and teacher's manual.
5. Releasing web version of the book.
6. Publishing the book.

Each step has an iterative loop where feedback is taken from a review team. A detailed description of workflow is beyond the scope of this paper.

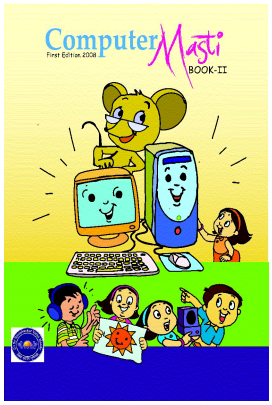

Fig. 2 Cover page of CM Book 2

3.2 Structure *of CM books and Lessons*

The structure of CM books and lessons are discussed in this section.

A. *Book Structure*

- Table of content with pointers to concepts and skills covered, duration needed to cover the topic, breaks required to conduct evaluation and assessment processes.
- Lesson chapters.
- Projects based on topics covered in the book.

B. *Lesson Structure*

The lesson structure has the following components.

- Aim of the lesson
- The actual lesson content in a dialogue format
- The concepts evolving in the lesson
- The skills for a particular topic
- Worksheets
- Activity – individual and group
- Lesson outcome
- Explore beyond the lesson content
- Teacher's corner

Section IV describes how FOSS applications are incorporated in the CM content.

IV FOSS USAGE IN CM

The entire CM content is based on the Ubuntu distribution of the Linux Operating System [8]. The flavour 'edubuntu', which comes pre-packaged with a variety of educational applications, is used extensively throughout the CM content. Although CM is designed for use with the Linux distributions like *Edubuntu,* it can be suitable for other educational distributions as well. The concepts covered hold good even with other operating systems and a subset of the FOSS games and activities used are available across other operating systems. Most of the games can be used for teaching both skills and concepts. For example, in one of the games, students are expected to drag and drop the object in the given pattern. Thus, while teaching mouse skills to drag and drop, the game also builds pattern recognition skills.

The major FOSS applications used while designing activities for the lessons are:

- GCompris [9]
- Childs Play [10]
- Tux Paint [11]
- Tux Math [12]
- KDE Educational Games [13]
- Scratch [14]

These applications are described below.

4.1 GCompris

GCompris is a free educational software suite built for the age group of 2 to 10 years. It consists of more than 100 different activities. The activities are in the areas of functioning of the computer, using the mouse and keyboard, general learning, reading, writing, algebra, as well as various activities such as memory and logic games, scientific experiments etc. The suite is available for Linux; a subset is available for Windows and is presently being ported for MAC OS. As it is available in Indian languages such as Hindi, Tamil, Gujarati, usage of this software can be extended to non-English speaking users. The levels can be changed in all the games to suit the age of the student.

Use of GCompris activities is not limited to what we have suggested in CM.

Fig. 3 Screenshot of GCompris game, Falling Letters

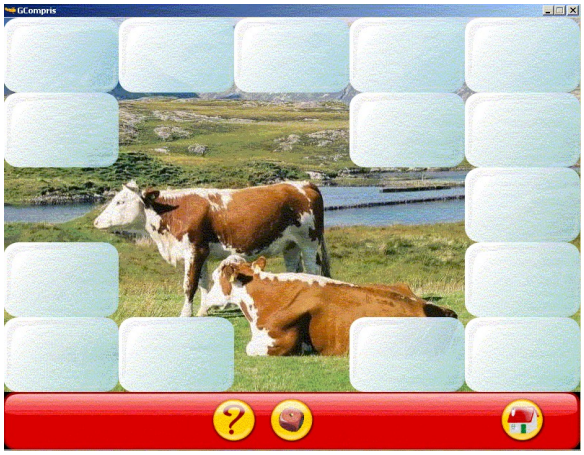

Fig.4 Screenshot of mouse skills game to remove white spaces and discover the picture behind

In CM we have used GCompris activities in the following manner:

1) Discover the Computer Peripherals:

This includes games to increase familiarity with the keyboard and reinforce mouse skills. In addition, these games can be used to teach spellings, and build reasoning capacities of primary school children.

A sample of games from this sub-set are:

- The falling letters game is for recognizing and typing the falling words/letters as shown in Fig.3.
- The mouse movement activities require moving the mouse over white spaces to see the hidden picture, clicking on points to draw a picture, double click points to discover background as shown in Fig 4.

2) Discovery Activities:

This includes colour, sound and memory based activities. These are used to teach names of colours and their pronunciation, sound recognition, improve memory, reinforce logical thinking, reading the clock, etc.

A sample of games from this sub-set are:

- In the colour activity, the name of a colour is read aloud and the student has to click on the correct coloured object.
- The sound activity plays a sound, which has to be remembered and repeated.
- The memory activity has games, which teach differentiating left and right hand, reading time and recognizing the next object in a sequence.

3) Amusement Activities:

This includes word processor, and drawing activities, which can be used to teach typing and drawing.

4) Mathematical Activities:

This sub-set includes calculation, geometry and numeration based activities. These activities have games where numbers are added and the result is typed, arrows on keyboard are used to move a character to multiples of a number. These activities are used to teach number recognition, counting, addition and subtraction.

5) Puzzles:

This sub-set consists of various puzzle-based activities like Tower of Hanoi and finding hidden items. These activities are used to teach mouse movements and logical thinking.

6) Reading Activities:

These are vocabulary-based activities. The games consists of listening to a letter and clicking the letter on the keyboard, recognizing a word from a list of given words. These activities are used for vocabulary building and teaching spellings.

7) Strategy Games:

This sub-set includes games like connect 4 and chess. These activities are used to teach strategy execution and improve planning skills in students.

4.2. Childs Play

This application has interesting games for memory, typing, recognizing different sounds etc. This can be used to teach memory, pattern recognition, keyboard skills, and mouse skills. A sample screenshot of a jig-saw puzzle is given in Fig. 5

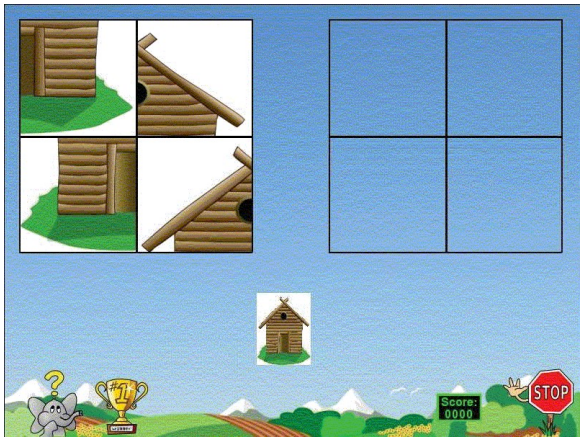

Fig. 5 Sample screenshot of Childs Play

4.3 Tux Paint

Tux Paint has simple and entertaining interfaces, and has sound effects when tools are selected. An animated Tux provides hints, which primary school students find amusing. A sample screenshot of Tux Paint is given in Fig 6.

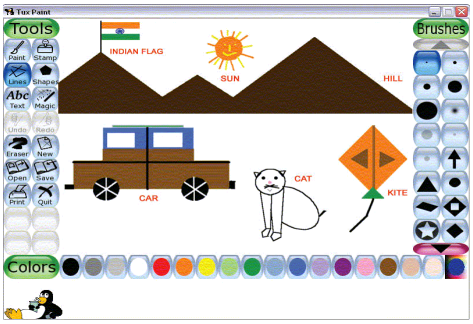

Fig. 6 Sample screenshot of Tux Paint

In addition to standard drawing tools, Tux Paint application has additional tools like magic and stamps to reinforce creativity among students.

4.4. Tux Math

This game has activities for improving maths skills like addition, subtraction, multiplication, and division of positive and negative numbers. The correct answer is entered using the keyboard, thus enchaining familiarity with number keys.

4.5 KDE Educational Games:

Kanagram, KLetters, KTouch are some of the KDE games incorporated in the CM content. Given a word with jumbled letters, Kanagram teaches how to look for correct words. KLetters and KTouch teach alphabets and typing skills.

4.6 Scratch

Even though programming is an intimidating topic in primary school level, graphic user interface (GUI) based programming tools can be used to teach concepts like flow charts, logical thinking, controls, variables and loops.

Scratch is a powerful, intuitive FOSS application developed by MIT, which enables teaching of programming to young students by using graphical interfaces. This application is included in CM: Book 3. By mere drag drop of various blocks like motion, looks, sound, control, sensing, numbers, and variables, the tool gives enormous flexibility to build creative projects. The differentiator of Scratch has been the fun element combined with the learning, which brings out the creativity of the individual student. At present, Scratch is available in only one Indian language (viz. Kannada). Sample screenshots of Scratch program are given in Fig. 7 and Fig. 8.

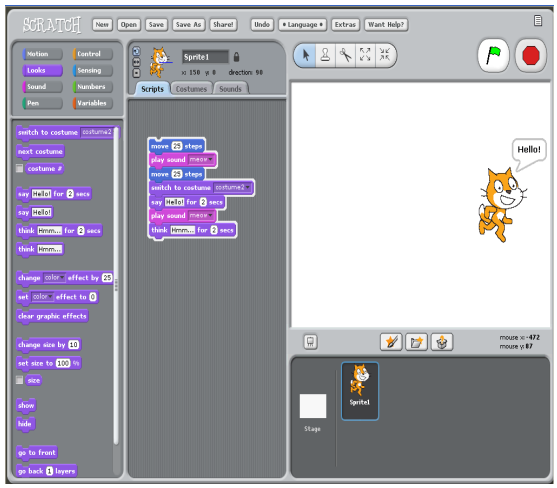

Fig. 7 Screenshot of Scratch Interface

Fig. 8 Screenshot of Scratch control components

V. Experience Report

The textbook content was implemented for class 1 - 5 at Sri Sri Ravi Shankar Vidya Mandir, Mulund, 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 teams of five to eight students and the computer use was monitored. Students were made aware of basic uses of computers, computer skills, ergonomic/safety values, applications such as paint, word processor, media player. Exposure to FOSS applications like GCompris, Childs Play and Scratch was possible through activities in lessons.

It was found that the elementary school students are eager learners and can explore the various computer applications with minimal assistance [15]. This indicates that FOSS learning curve is quite smooth and primary school students can easily adopt it. The study is ongoing for the academic year 2008 -2009.

VI. Conclusions and Future work

The experience of implementing the CM content has shown that the design goal of getting the concept across clearly before getting into skill details is appropriate. The CM content [4] created a lot of enthusiasm among the teaching community both nationally and internationally. The Goggle analytics data for (July 2008 – Feb 2009) shows 2,212 Page views and more than 100 downloads for *Computer Masti* - Book1 and Book 2.

A number of individuals have volunteered to translate the content into Marathi, Kannada and other languages in a collaborative process. We have also received requests from European countries to translate and use the CM content. Translating the book to multiple national and international languages will surely help in dissemination to geographically remote areas.

Training programs for teachers to implement CM content are being carried out. This will create a team of trainers, personnel for infrastructure set up, and maintenance to scale up dissemination of FOSS in education.

We believe that the CM content can also be adapted to rural audience by replacing urban specific examples with locally relevant instances. Adapting the content to adult literacy programs can also be done seamlessly and a pilot is already being conducted to investigate these aspects.

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