

The Emergence of Free and Open Source Software (FOSS) for Implementation of ICT in Education in India

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Abstract

IT Education has become a key factor in the socio-economic progress of India. In fact, it has played a crucial role in exploring the potential for technology to redefine the terms of teaching and learning. Imbibing ICT in education is very important to increase the IT literacy rate in India but the conventional educational system as well as the cost of proprietary software puts a big constraint in the implementation. Adoption of FOSS by various Government departments and educational institutions may provide an impeccable solution to address this unprecedented issue because FOSS provides higher degree of independence regarding price, high level of Security and stability and licensing conditions on acquisition of IT. In this paper, we have discussed the implementation of FOSS by Government of India for ICT in education to promote IT literacy in the country.

Keywords

Free and Open Source Software (FOSS), Technology Transfer, FOSS, ICT in Education, India

I. Introduction

IT Education plays a vital role in socio-economic progress of a country and ICT have an immense potential to impact education and provide newer and more effective ways of mitigating some of the challenges being faced by the educational system of India. But cost of proprietary software is one of the foremost hurdles to increase the IT literacy rate in India. The solution lies in the technology transfer from proprietary software to Free and Open Source Software (FOSS) to address the issue. Today, Small and Medium Enterprises (SMEs) and Govt. Departments are moving to Open Source Software. Students with this knowledge will have an edge in the job market. They can also become entrepreneurs and use Open Source Software in their businesses, and save money versus, if they were using commercial software. FOSS is useful in reducing costs, lead to increase in productivity, enhancement in security, and improve standards compliance. FOSS is the lowest threat choice for software systems nowadays [1, 11-13].

The Free Software Definition is published by Richard Stallman's Free Software Foundation. Here is the key text of that definition:

"Free software" is a matter of liberty, not price. To understand the concept, you should think of "free" as in "free speech". Free software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software. More precisely, it refers to four kinds of freedom, for the users of the software:

1. The freedom to run the program, for any purpose (freedom 0).
2. The freedom to study how the program works, and adapt it to your needs (freedom 1). Access to the source code is a precondition for this.
3. The freedom to redistribute copies so you can help your Neighbour (freedom 2)

In this paper, we have discussed the implementation of FOSS by Government of India for ICT in education to promote IT literacy in the country.

II. Free and Open Source Software (FOSS)

Free and Open Source Software (FOSS) refers to the software which is available at zero cost on the web developed by volunteers. For any software to be a FOSS, it has to pass some guidelines or checklists which are as follows:

- Source Code Availability without any cost
- Free to use, modify and to customize
- Free to redistribute
- Free to create derivative work
- Free to join the development and cooperation

FOSS is the most effective solutions for the transfer of technology to economically weaker nations or to developing countries.

III. Aim of FOSS

The main aim of FOSS is to provide open access to the source code and enabling research innovations in software development. The use of FOSS is not only about applying software for free, but also it can offer some benefits like sharing of resources, quicker repairs and high code quality and, empowering users to gain the benefits of using shared software [5].

IV. Criteria for Open Source

Open source software is officially defined by the open source definition:

Open source doesn't just mean access to the source code. The distribution terms of open-source software must comply with the following criteria:

A. Free Redistribution

The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale.

B. Source Code

The program must include source code and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable reproduction cost preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

C. Derived Works

The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

D. Integrity of the Author’s Source Code

The license may restrict source-code from being distributed in modified form only if the license allows the distribution of “patch files” with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

E. No Discrimination Against Persons or Groups

The license must not discriminate against any person or group of persons.

F. No Discrimination Against Fields of Endeavor

The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

G. Distribution of License

The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

H. License Must Not Be Specific to a Product

The rights attached to the program must not depend on the program’s being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program’s license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.

I. The License Must Not Restrict Other Software

The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.

No provision of the license may be predicated on any individual technology or style of interface.

V. FOSS in Education System

There is need to add FOSS as a compulsory subject in technical education. The direct impact of this addition in curriculum will arm our engineers with deep architectural skills in software engineering. FOSS can play an important role in education, especially in developing countries due to following key features:

1. Lower Costs
2. Reliability, Performance
3. Open source philosophy
4. Encourage Research
5. Stop Illegal Copying
6. Learning from Source Code and implementation

These key features will allow students to learn from high quality real-life programs. In contrast, proprietary software is normally provided in binary form and the source code is seldom released for users to study [7]. Almost, every FOSS equivalent is available for the commonly used proprietary software in the commercial market. Table 1 List down the FOSS available equivalent to the respective proprietary software and Table 2 list down the FOSS available specifically for education sector.

Table 1: List of FOSS With its Applications and Commercial Equivalents [2]

FOSS	Applications	Commercial Equivalent
Linux-Ubuntu	Virus free, robust Operating System	Windows
LibreOffice	Basic computer usage Office suite for documents, spreadsheets, presentations, database etc.	MS-Office
Writer	Word Processing, Documentation	Word
Calc	Spreadsheets	Excel
Impress	Presentations	Powerpoint
Base	Managing Databases	Access
Draw	Drawing	Paint
Math	Mathematical Operations	MathType
PHPMySQL	Web development and Database Management	
C/C++, Java, Netbeans and Python	Programming language	
Scilab	Scientific Computation package for numerical computations	Matlab
LaTeX	Document markup language and preparation system for Tex typesetting	MS-Word
OpenFOAM	For Fluid Mechanics to solve and create fluid movies	Fluent
Oscad	EDA tool for circuit design, simulation, analysis and PCB design.	Orcad
Firefox	Web browser	Internet Explorer
GIMP, Q-CAD	Image Editing and Graphic Design	Photoshop
Blender	Animation and Computer graphics	Maya 3 D

Table 2: Software Programs in the Education Category [9]

Sub-category	Software Title
Programming	Scratch, Kturtle
Touch-Type Tutor	Ktouch
Kindergarten	Ktuberling, Gcompris
Math	GeoGebra, Dr. Geo, Kig, KmPlot, Kbruch, Kayali, Kalgebra, Geometria, wxMaxima
Chemistry	Kalziium, Ghemical, Avogadro, GchemPaint, Bkchem, BALLView
Biochemistry	Pymol
Physics	Step, OpticalRayTracer
Astronomy	Kstars, Stellarium, Celestia-gnome
Geography	Kgeography, Marble
Language	KLetter, KwordQuiz, Parley

VI. Initiatives by Government of India

A. Spoken-Tutorial Project by IIT Bombay

Spoken-Tutorial is an initiative of the 'Talk to a Teacher' activity of the National Mission on Education through ICT (NMEICT), launched by Ministry of Human Resource and development (MHRD), Government of India, to promote IT literacy through Open Source Software. The Spoken-Tutorial project offers Audio-Video Tutorials/Lectures designed by faculty members from IIT Bombay on a variety of Open Source Software viz. Basic IT Skills, Blender, C, Firefox, GeoGebra, GIMP, Java, LaTeX, LibreOffice Suite, Linux and Ubuntu, OpenFOAM, ORCA, PHP & MySQL, Python, Scilab, Thunderbird. This Teaching-learning experience is based on Self paced Learning is being implemented in the form of workshops. The training workshops started in July 2011. These have spread across several Institutions across India viz. Degree colleges, Polytechnics, ITIs and even Schools, NGOs, Govt. Offices and some Corporate. To date, mid 2014, around 300,000 students and teachers from all states of India, have taken this Software training. The students particularly from rural areas are being benefited by this project. It is a win-win situation for all and the best part is that all the workshops are conducted free of cost. In fact, this platform can help us to Bridge the Digital Divide in our nation. [2]

B. ICT in Education Curriculum by CIET, NCERT, New Delhi

Based on the goals of the National Policy on ICT in School Education and National Curriculum Framework, the Central Institute of Educational Technology (CIET), NCERT has developed a three-year ICT in Education course for students of Classes VI - XII. The course has been rolled out as pilot on July 1, 2014 in all the 588 Jawahar Navodaya Vidyalayas spread across the country for the academic year 2014-15. [10]

The ICT curriculum is a generic curriculum for teachers and students. Typically spanning two years for teachers and for the student, the course spans three years; it leads to a Diploma in ICT in Education [11]. This endeavour by the Government of India can play a vital role in adoption of FOSS by the public and private sector because introducing FOSS at school level means a huge difference in perception of the next generation about the IT Industry which in turn can stop the drain of huge amount of money that Indian public sector and even private sector pays for proprietary software.

C. National Repository of Open Educational Resources by CIET, NCERT, New Delhi

NROER is a digital repository for Open Educational Resources. The Repository houses a wide range of educational content and resources covering all subjects and all grades for school students, teachers and other stakeholders. In addition to the educational resources which are available in a wide variety of forms, the NROER also provide opportunities to users to enroll in various online courses and participate in online contests [3].

VII. Future Scope

FOSS brings many compelling benefits to a nation, especially a developing nation with limited resources [4]. In the coming future students should be taken as a trainee for software development and encouraged to join FOSS communities in order to learn, share their innovative ideas, and participate in software development [5]. FOSS and commercial software need each other; the competition

between the two keeps the software marketplace in check [6]. Free and open source movement accelerates technology and knowledge expansion in public [8].

VIII. Conclusion

A major technology transfer is required in India to increase the IT Literacy rate by implementing ICT in education at various teaching-learning levels. In the present scenario of technology transfer, FOSS is gaining importance with its numerous features viz. knowledge sharing, professional recognition, group problem solving, challenge proprietary software, project developments, development of new skills and many more. The Free and Open Source Software (FOSS) movement is one such development that is playing out before us today. As a revolution power, the representative of the free and open source software, Linux challenges Windows which represents proprietary software. Free and open source movement accelerates technology and knowledge expansion in public. This paper has addressed the implementation of FOSS by Government of India for ICT in education to promote IT literacy in the country.

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