Open Source Movement and Education: Opportunities and Implications

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1. Background

Over the last few years, the concept of openness has been spreading its wings far and wide, in many guises. Much of it started with the popularity of open source software (FOSS, henceforth) movement, which, though dates back to Richard Stallman's days at MIT, gathered popularity only on the arrival of the Linux kernel from Linus Torvalds, in the early 90s. Since then, the movement has never looked back. Almost every large corporation is involved in the movement in one way or another, with IBM, Sun, Intel, HP, etc leading the way. The movement has got into the legislative bodies of many countries, creating pressure at the level of policies, standards, guidelines, etc to support and adopt open source wherever possible. Many countries have taken explicit steps to nurture a FOSS eco-system, by training programs, certifications, resource centres, and so on. Today, FOSS is a familiar term across the world spanning academia, industry, government, and SMEs. The FOSS activities have a number of dimensions, stretching well beyond the availability of software with source code. It has led to sibling movements in content, standards, hardware, systems, etc. Each of these has attained a fair degree of maturity today.

Academia has always related to this thread of thought quite easily, thanks to having a common underlying philosophy based on sharing. However, there have been proprietary pressures often, derailing the curriculum in many cases, and disrupting the balance between conceptual foundations and commercial aspects. An example is the issues of vendor neutral syllabus in India which has been in the air for long. In this paper, we look at the role the various 'open movements' – I will use this term to denote the set of movements consisting of open source software, open standards, open content, open hardware, etc — can play in academia and how academia should use this effectively to nurture these movements in return, for a win-win relationship.

We will discuss the basic driving force of a common mindset, and associated implications first. Then we look at specific aspects such as content, standards, software/hardware,

etc. Though licensing is a major issue in this regard, we will ignore the license discussion in this paper; it is more appropriate for someone with legal background to talk about this. Similarly, we also do not discuss issues relating to e-learning here, since that is a vast field by itself and is discussed in detail in [4].

2. Philosophical Match

Academia is about sharing knowledge, to enrich the giver and the receiver. One builds on the knowledge created by others, and shares the enriched knowledge with others to let it grow further. In a broad sense, software and content can be seen as embodiments of knowledge, differing, perhaps, in the way the knowledge is captured and represented. And hence, the notion that software come with their full source code, is something natural to the academic community. The hiding of the source behind a compilation process was introduced by commercial companies, to 'protect' their intellectual property, in turn to ensure that copies (and even more any modifications) are not done by the customers. The mindset match has multiple implications for both the academia and the open movement.

The popularity of open source is the highest among academia. The pricing issue is certainly a major factor here, since academia often has the severest budget constraints in acquiring resources such as software and equipments. The ability for academia to understand the philosophy behind open movement, in the sense of sharing knowledge freely, also plays a major role. Their contribution in pushing the quality and quantity of open source higher has been significant. Researchers, even earlier, used to contribute the software developed for their research work – often in cutting areas of development – to public use. A number of high quality software which are in wide use has come from academic departments. The Moodle learning management system, Latex document processing system, etc. are good examples of high quality systems coming out this way.

Another implication of this link is the growth of open standards. FOSS is strongly based on the community metaphor – the bazaar development model described by Eric Raymond [3] – which brings together a number of people around the world to work on a common

system. The roles for each are open, and how much they contribute to the final system is also open. There are only internal deadlines set by oneself. This necessarily demands explicit efforts to reduce the learning curve for others, and transparency in shared data structures. Open standards, where the complete description is freely accessible to everyone, and where the standards evolve from collective contributions, becomes natural choice. And not surprisingly, most of the open source programs use open standards wherever available. And formats and conventions invented for one system are reused for another if relevant.

This brings to the idea of building on what is existing, another typically academic mindset. As Newton remarked, “if I have seen farther, it is by standing on the shoulders of giants”. Research literature building on earlier results and acknowledging them by citation, and new software programs reusing and extending existing software programs are clearly echoing the same mindset. Starting from scratch every time, does not take you very far, in trying out new ideas in an already rich landscape. Starting from something that provides a close approximation to what you are looking for, and extending it as appropriate is more productive. As Raymond remarked “a good programmer knows what code to write; a great programmer knows what to rewrite”. This kind of reuse and extension necessitates the openness associated with the open movements.

All these characteristics are fundamental to the growth and sustenance of open movements. And the outcome of these movements, in turn, contributes substantially to the growth and effectiveness of academia. Of course, the fact that almost all open source software are freely downloadable from the web, available in multiple languages and a wide range of platforms, and well supported by a lot of documentation, makes open source appropriate for educational environments, from a practical perspective too.

3. Open Content

The last few years have seen tremendous growth in open content, where the content is declared free for use, just as was done for software by FOSS. Comparable to FOSS licenses like GPL, LGPL, etc, a group of licenses also evolved to provide legal sanctity to this move. These are known as “creative commons” and offer a family of licenses

embodying the core idea of openness, and providing options for permission to modify, retaining attribution, and so on.

Perhaps, the most classic example of open content today is wikipedia, which takes the openness to the extreme allowing anyone with an account – freely obtainable – to modify any of the pages. However, the quality of the content on wikipedia is generally very good, and some formal studies have also shown this empirically. Though, there are spots involving strong controversies, where this is hard to ensure, and where one often sees a series of continuous modifications by the different sides to support their stand for most academic content, the wikipedia offers excellent reference/learning material with additional links, images, and so on. Lacking even a core group for filtering modifications – as is done with open source software – the high quality of content indeed shows the feasibility of the approach. The European Union (EU) funded SELF project exploits such resources, to even form course material for university courses dynamically. Other examples of open content are the million book project Gutenberg, the audio book collection at librivox, the number of video repositories of Google video, YouTube, and so on. The movement got its momentum from the MIT initiative of open course ware, which has in turn led to the wider open knowledge initiative (OKI) involving a number of partner institutions for sharing such resources.

It may be noted that these different setups follow different norms as far as their policy of use and modifications are concerned. A lot of open source software documentation and learning material are also available in such free content – these include, machine learning with Weka (full book available online), OReilly publications, NL toolkit (full book on this available with the tool kit), Linux documentation project, and so on.

Open Source Software for Education

It is in the area of software resources, that open movement has contributed most to education sector. The software relevance to education is from three different angles, and these are described briefly in the following subsections.

FOSS Learning Resources

E-learning is another buzzword that is popular among all academic communities, though its meaning and adoption varies widely from group to group. One major concern in e-

learning is the quality of content. Traditional content has been largely text and static pictures/images, limited by the medium of textbooks. Much of e-learning content is still restricted to these two. Animations, simulations and interactive problem solving environments (IPSE) can significantly enhance the teaching learning process. It provides an opportunity to use the multiple senses in absorbing a concept, and also to try out the concept in, perhaps restricted environments, through simulation and IPSEs.

These are generally hard to develop, as they involve a significant amount of software development for each topic. The system need to have fairly sophisticated model of the domain of the content, and be able to recognise and react to the events with respect to the domain. For example, a program illustrating the concept of projectile motion, need to be able to compute the path of the projectile based on relevant parameters – the initial velocity, the angle of throw and gravity usually. As these parameters are varied by the student, the system need to revise the computation accordingly. However, these tools make e-learning much richer than what is possible in a traditional environment, and ought to be part of e-learning. One reason for the ineffectiveness of e-learning in academic settings is the lack of such quality content, which would deepen the learning and encourage students to use these.

A lot of high quality programs of this type are available in open source over the net. Unfortunately, there are no reliable comprehensive repositories for these kinds of programs, as they are scattered efforts from people around the world. The UNESCO portal for FOSS, and repositories like Edubuntu package list provide some starting places. OSCAR project of IITB also makes an attempt to collect animation programs – IPSEs are not included here, since these are often fairly large programs. The table below provides a (very small) sample of resources one can find on the net.

Euler	Complex numbers and matrices
Kstars etc.	Astronomy with over 130000 stars, all planets,
Chemlab	Chemistry lab
Sage	algebra, geometry, etc
Units	Unit conversion

Earth3D	real time 3D view of earth
Kalzium	periodic table and properties of elements
Atomix	puzzle game for physics
Kig	high precision geometric constructions
Xaos	fractal geometry
R	Statistical and numeric computations with plotting

One major challenge in using these resources for education is linking them explicitly into the curriculum. Except the highly motivated students, most students would be lost when exposed to these tools as a collection for them to explore on their own. For purposeful use of these systems, activities – assignments, experiments, etc – need to be formulated to be carried out using these tools.

FOSS for Basic Utilities

This is the most obvious part that most people can see. Open source solutions of good quality are today available for you to set up a basic computer system working, without investing in any proprietary software. All the software components, including the basic operating system, office suite (for documents, presentation, drawing, equations, etc), browser, media players/editors, drawing utilities, network management, and so on are available in open source today. In most of these cases, one also has a decent number of alternatives to choose from. The table in the next subsection includes some of these tools also. Installation and management of these are quite comparable in complexity with alternative proprietary solutions. FOSS based desktops are seen to be generally less vulnerable to security problems such as virus infections; this is a major headache for system administrators in educational establishments, in general.

Full systems specialised to educational sector are also available from some of the popular distributions. Examples are Edubuntu from Ubuntu, Eduknoppix from Knoppix and the proposed EduBoss from BOSS. These include the basic operating system and associated utilities, select tools for educational use (like an equation editor), and some learner resources for specific subjects. This removes the effort of having to pick the

relevant packages from various repositories and integrating them individually.

4.2 FOSS for Learning Management

Under this category, I include software which are specifically for the educational environments. There are software solutions for school/college administration, for faculty to run and coordinate the various activities in a course, for faculty to create and manage content for a course, for students to track the progress and collaborate with other students, and so on. Accordingly, here also, the scope of software is vast, and FOSS does not disappoint us here either. The table below shows a small list of some of these tools.

Web browser	Firefox, Iceweasel
Document creation	Openoffice, Latex
Audio record/edit	audacity
Web page creation	Nvu
Content management	Drupal, Jhoomla, Plone/Zope
Learning management	Moodle, Sakai, Atutor
Question banking, testing	exe2learn, Moodle
School administration	schooltool
Visual programming?	scratch
diagram editing	Dia
scanner	Xsane
3D animation	Blender
image editing	GIMP
page layout like Adobe Illustrator	Scribus
Plotting	Kmplot
creating and running tests	Keduca
video conferencing	Dimdim, Vmukti, Ekiga, openmeetings
Library management	Koha, Dspace

One can see a wide range of systems from learning management and school administration to library management. Mostly, the systems listed are quite popular with good development and user community, and the software is quite stable with rich functionality. Systems like Moodle have a large national and international user base. Many of these are also available in many foreign languages including Indian too.

4. Future Outlook

As the description so far indicates, there is a strong synergy between the open movements and academic education. There is a lot that open movements are bringing and can bring to the benefits of academic programmes. We need to encourage our academia to benefit from this and also contribute back to help the growth of the movements in return. Our own projects – student projects as well as PhD/MS projects – can benefit tremendously from the existing resources, and can be used to drive new developments and significant enhancements. This should happen on a larger scale.

At the same time, there are new challenges coming up on the education side. Content sharing across institutions is relatively less so far. But, with the growth of e-content and increasing presence of institutions on the Web, this is bound to happen more. Inter-institutional collaboration in sharing not only content, but full courses, subjects and faculty is certainly well within the horizon. This will necessitate a lot of change in many of the software requirements, and offers good opportunities for us to contribute and also to adapt existing software to meet these new requirements. New demands will also be made on interoperability as records and resources move across institutional boundaries. Initiatives such as OKI are a step in that direction. Work on distributed learning management system also looks at similar concerns.

The sharing, in turn, also brings into focus a fast-growing concern of plagiarism. With a vast collection of resources freely available, the chances of plagiarism and the difficulty in detecting them are growing fast. Scigen is a relevant case study, which produces ‘scientific’ research papers using some natural language processing techniques. Since the language appears good quality, rich with a high degree of relevant jargon and following the style and conventions of a research paper, it appears genuine, and outputs from this program has been accepted in some refereed international conferences. Tracking copied (with and without distortion) submissions – for assignments to research

papers – is a major challenge in the academic environment.

There are also changes occurring at the academic libraries. Good quality open source solutions are available to handle the functionalities of today's libraries. Even digital libraries are well supported by FOSS solutions such as Dspace. However, with the growth of e-content rich with simulations, and e-learning growing in popularity, the nature of resources that the library needs to deal with is changing. Dealing with IPSEs offers different challenges compared to conventional or even digital books. Already issues of subscription management and sharing for e-resources are a major concern.

We also need to look at removing the linguistic and physical barriers preventing people from using technology. Software localisation and accessibility are two fields concerned with these two aspects – areas which need to see a lot more activity, for countries like India.

In summary, FOSS has enriched the education field in many ways. But the world is moving fast in the education sector as well as other sectors, and new demands and opportunities are constantly on the horizon. FOSS need to be sustained and nurtured through a sustained cycle of human resources and efforts, to help it continue what it has been able to do so far.

References

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