Linux: An Open Source Technology Tool

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Abstract –

The dynamic and responsive nature of 'open source' software and the existence of freely available documentation and online communities offers an opportunity for educators, network administrators and software developers to participate in the development of resources appropriate to local needs while developing their own skills.

In this paper we study the history of open source, learning using open source technology and digitization education tools through various sectors like courseware, smart class, education portals and virtual university. In this paper we can discuss the impact of open source system tools through services and problems on learning management in education as well as Use of various open source management tools to create and manage learning content on the web. In this paper we also move towards student centered learning in creating blogs and other interactive web applications to enhance peer communication in and outside the classroom.

Educational institutions have rushed to put their academic resources and services online, bringing the global community onto a common platform and awakening the interest of investors. Despite continuing technical challenges, online education shows great promise. Open source software offers one approach to addressing the technical problems in providing optimal delivery of online learning.

Keywords- Open Source, Technology, Education, Digitization, Learning Management tools.

I. Introduction

Many features distinguish open source software from closed or proprietary software. The Open Source Initiative (OSI) has set a standard—the "open source definition"—by which software qualifies for an open source license.[1]

The software must meet the following criteria:

- Unrestricted distribution. Users can distribute or sell the software without paying royalties.
- Source code distribution. The source code of the entire open source product must be easily modifiable. In the absence of the source code, the product must cite a low- cost resource where users can obtain it.
- Modifications. The license allows modifications, and its terms remain unchanged for distribution of improved versions.
- Author's source code integrity. If the license allows patch file distribution along with the original source code, a user cannot modify the code and distribute it2 except by giving the new version a new name.
- No personal discrimination. No person or group shall be discriminated against during open source product distribution.
- No restriction on application. Open source software can be used in any field and for any purpose.
- License distribution. The privileges attached to the original program extend to all who receive the program, so recipients do not need to apply for a separate license.
- License must not be product-specific. The rights associated with a license extend to products extracted from larger software aggregate.
- No restriction on other software. No restrictions are allowed on distribution of

open source products bundled with products developed on other software platforms.

- Technology neutrality. Licenses should not be issued on the basis of the specific technology involved

II. History of Open Source

The development of three operating systems— UNIX, GNU, and Linux—formed the foundation of the open source movement.3 From its inception, open source has been closely associated with academia.

UNIX had its roots in the joint venture launched in the late 1960s by Bell Labs and MIT to create a new operating system named Multics. Based on that work, some of the programmers developed a new operating system, which they named UNIX, to provide more flexibility to users. Academic institutions could purchase UNIX source codes at a price considerably lower than that paid by corporations and government agencies. In 1975, Ken Thompson joined the University of California, Berkeley, along with two other graduate students, Bill Joy and Chuck Haley. In 1977 the trio began distributing an open source version of UNIX called BSD. The following year saw the release of a revised edition called 2BSD.

The MIT Artificial Intelligence Lab launched a similar endeavor in which the code was enhanced by passing it among the programmers. The venture lost momentum in face of advances in computer science. The free software movement was launched in 1983. In 1998, a group of individuals advocated that the term free software should be replaced by open source software (OSS) as an expression which is less ambiguous and more comfortable for the corporate world11. Software developers may want to publish their software with an open source license, so that anybody may also develop the same software or understand its internal functioning. Open source software generally allows anyone to create modifications of the software, port it to new operating systems and processor architectures, share it with others or market it.

Programmer Richard Stallman founded the GNU Project in 1984. The GNU General Public License allows users to modify the code and distribute the improved version under the same license. The GNU operating system lacked a kernel, however, until Linus Torvalds developed the Linux kernel. In 1992, the Linux kernel was integrated within the GNU operating system.

Linux become more sophisticated over time with the help of programmers who worked to improve the kernel and create Linux-adapted software. The following years witnessed the introduction of many commercial and enhanced versions of the Linux operating system by vendors such as Red Hat, Mandriva, and Novell. Linux is still available as free open source software.

III. Learning and Digitization

The digitization of education is a relatively new phenomenon that has transformed the education sector. Corporations and academic institutions have joined forces to further explore the potential for digitizing education through

- Virtual universities
- Online courses
- Education portals
- Courseware
- Coursera
- Smartclass

Virtual universities are the best-known form of online education. Accredited virtual universities such as the University of Phoenix offer degrees in mainly professional courses taught largely by part-time faculty members from different universities. Online consortia of academic institutions integrate related courses into programs delivered via a single virtual university.

Online courses are offered in a variety of forms by various sources. Some courses are offered by subsidiaries of renowned traditional universities, although many such courses are not accredited. The parent universities' names act as a powerful draw for online students. Courses are also offered by organizations that create digital collections of study material culled from different academic sources.

Education portals, although not directly connected to the curriculum, have become an integral part of education. Since the late 1990s, some U.S. universities have outsourced e-mail and other Web services, site administrative functions, courseware, and other computer administrative

services to software development and application companies.

Courseware is used in both the academic and corporate sectors, with development often outsourced to companies that provide study material for both online and offline purposes. Many companies use sophisticated computerized courses in their employee training programs.

Coursera is an educational technology company which works with universities to make some of their courses available online. E-learning or computer- based training includes all forms of electronically supported learning and teaching. It also includes educational technology. Online education is a type of distance learning. There is no need to attend the college or university in person. [22]

Smartclass is basically a digital content library of mapped curriculum, multimedia and 3D content. It also facilitates lecturers to speedily judge how much of a certain lesson students have been able to adapt during the class. There is improved notebook need for students and educational institutions. Digital programme platforms in schools, colleges and universities are some of the new trends. Educomp Solutions' Take Smartclass is one of the first Indian companies in this space. [22]

Following a period of intense competition, the higher education software domain is dominated by a few major vendors,4 with the risk of monopolization in the future.[5] This leaves academic institutions with one obvious option: to develop in-house systems to fulfill their IT requirements. Unfortunately, such projects often are isolated endeavors riddled with flaws or prohibitively expensive—or both.

Another option is to adopt the collaborative model of open source software development, which enables educational institution s to pool their financial and technical resources. In addition, a huge user community provides a variety of testing environments for the new software.

Open source software products tend to be more reliable and benefit from continuous development. This is one reason to invest liberally in developing open source application software—to work out a more cost-effective way of meeting e-learning software challenges.

IV.Open Source and Its Impact on Learning

As college administrators strive to strike a balance between resources and requirements, open source e-learning software has emerged as a viable solution. Many universities have opted for open source learning management systems, in particular. [18]

Advantages that have tipped the balance toward open source include the following: [17]

1. Stability: If you have used other operating systems, once you have made the switch to Linux, you will notice that Linux has an edge over Windows here. I can remember rebooting Windows many times over the years, because an application crashed, and I couldn't continue working. Linux can crash also, but it is much harder to do. If an application crashes in Linux, it will usually not harm the kernel or other processes.
2. Free Software: Most software can be obtained without cost for Linux. Linux was one of the first open-source technologies, but many programmers have contributed and added software that's completely open-source for any user. This means that you can download the source code and change it any way you like. Some developers have restrictions on how you can distribute the code. For instance, some developers allow you to change the code, but you cannot distribute it for money.
3. Runs on old hardware: If you have an old 386 or 486 lying around collecting dust, you can use this to run Linux. I remember running Linux just fine on a Pentium 100 with a 1 GB disk drive, and 16 MB of memory. One use of an old machine like that could be a file server. Just go to your computer store, buy a large hard disk (as long as your old stuff can support it), and you can make a great storage server. With all the digital pictures and movies around today, this could be a great use for Linux. Look into using Samba, a server application for Linux that allows you to make your machine share the disk as a Windows share.
4. Security: Linux has the advantage of the code being in the public domain. This can be a double- edged sword; while you can look at the

code, and developers can fix holes rapidly, it also means hackers can find bad code. I have been very impressed with the security of Linux, and the programs that run on it. I think having the code out in the open, and the ability to fix things yourself if necessary is a big plus. Who likes to work blind? With some distributions, on installation the computer will ask you what levels of security you would like for your system. You can be very trusting, or you can be paranoid. Linux gives you this flexibility.

5. Flexibility: So many people have access to the code. This means that there are a large number of sources for support. Trying to find support for an "out of the box" piece of software means contacting the software company looking for support, however open source developers are everywhere and theoretically any number of them could offer support.

Possibly the biggest advantage of open source software is the fact that everybody has the right to modify and tweak the source code. This means the code can be implemented in other pieces of software and adapted to changing environments.

6.Tax benefits: Governments of many countries have implemented tax exemption policies to boost open source projects, although the governmental role in promoting open source software is controversial.6

The main potential drawback of open source projects for education becomes evident during their implementation. Using the software to its full potential may prove challenging for beginners, and the availability of the source code is irrelevant for end users if they do not find the product useful. Also, open source products are not always compatible with existing software components.

Open source development has other potential disadvantages. [22] There are no guarantees that a project will reach completion and deliver the desired results, for example. Progress depends on the interest and time of the collaborative workforce, and lack of resources or funding can derail a project. Most commercial open source products, however, are self-sufficient.[7]

Disadvantage

1. **Learning curve :**
   I won't lie to you; Linux is going to take some time to learn. I know that our society likes to be instantly gratified. Learning Linux is definitely worth your time, but to really master it, you will need to spend some good time in front of your machine tinkering with things. Don't expect to be an expert after reading something like "Linux for Dummies". If you are contemplating this for your company, you will need to budget some money for training and learning time.
2. **Equivalent programs:**
   While I gave the example before of an office suite of programs that is working well, there are still applications that do not exist in Linux. Thankfully, this list has become much narrower in recent months. You will want to think carefully when you switch to Linux about what programs you currently use, and if they have Linux support for them. It may not make sense for you to switch if you are going to spend tons of time converting databases and application data.
3. **More technical ability needed:**
   You will want to make sure that you train someone in Linux really well. Alternately, you could hire someone who has experience with Linux. A good Linux administrator needs to be on hand as you start to migrate your systems over. This is a disadvantage financially, at least in the beginning. You may find over time, however, that you only need a temporary administrator to handle the routine tasks.
4. **Not all hardware compatible:**
   Some of the latest and greatest hardware that is being produced is not compatible with Linux. At least, not yet. The people that contribute program code and drivers to the Linux kernel are great at including support fairly quickly. Until that time, not everything you buy for hardware in your system may work. I've had to rely on third-party drivers and other means to make hardware like a new Ethernet card work. Eventually, the support will be built in. One thing you can do is before your purchase; ask if the hardware vendor has support for Linux.

Some manufacturers do write their own Linux drivers and distribute them with your purchase, making it very easy to integrate with your existing system.

Open source resources are available from the following initiatives: Curriki, the Global Education and Learning Community, is a nonprofit body dedicated to the creation of free, open source curricula for all users and one of the most popular OSC online resources.9Curriki provides course materials for primary and secondary education, primarily focusing on the creation of complete curricula for courses distributed and used globally.

V.Open Source Learning Management System Tools

Another aspect of the impact of the open source movement on education is the rapid proliferation of open source learning management system (LMS) tools and other learning applications. LMS tools are used mostly to create and manage learning content on the web. Some of the most widely used LMS tools are briefly described in Table 1 and summarized next.14

Moodle. is an open source Learning Management System (LMS), also known as a Course Management System (CMS).The word Moodle was originally an acronym for Modular Object-Oriented Dynamic Learning Environment, which is mostly useful to programmers and education theorists. Moodle integrates pedagogical features missing in many LMS tools, allowing instructors to construct customizable, online courses or a wide range of course modules on a flexible platform. Moodle can be downloaded to any computer and used to support a single instructor site or a system of thousands of students. It is licensed by the Open Source Initiative under a general public license (GPL).

Many plug -ins are available to enhance existing features. MySQL and PostgreSQL databases can be used with Moodle, and developers are working to make the system compatible with Oracle, Microsoft SQL Servers, and other databases. Moodle is free web application that educators can use to create Internet-based courses and web sites for their students. It comes with, Flexible array of course activities - Such as Forums, Quizzes, Glossaries, Resources, Choices, Surveys, Assignments, Chats, Workshops. You can install Moodle on any computer that can run PHP and use MYSQL for database.

Moodle emphasizes making students a contributing factor in learning; its features invite active participation from students. A growing community of over 200,000 registered users in more than 175 countries supports Moodle. In numerous forums and other interactive centers, developers from all over the world contribute to the software's overall development.

Bodington. This Java-based virtual learning environment was developed by the University of Leeds in the United Kingdom. Bodington aims to provide a flexible, durable learning environment for large, complex institutions with numerous departments. It allows quick upload and management of learning content, and the multilayered administrative model effectively meets varied administrative challenges.

Bodington conforms to World Wide Web Consortium (W3C) recommendations. It also complies with the Special Education Needs and Disability Act 2001, 13 allowing people with physical and visual impairments people to take part in digital courses supported by the Bodington VLE. A huge community supports Bodington, continually contributing to the software's sophistication. Some Bodington projects have received JISC funding. Bodington has been implemented at academic institutions including the University of Leeds and the University of Oxford, along with further education colleges. (Further education in the U.K.refers to education received after secondary school, similar to community colleges in the United States.)

Claroline. Built on free technologies such as PHP and MySQL, Claroline addresses the pedagogical needs of teachers and learners, emphasizing training technologies and well-structured online courses. Claroline developers focus on enhancing existing tools to give both instructors and students a refined learning environment.

Claroline is supported by a huge user and contributor community that continuously enriches the software. The nonprofit Claroline con sortium, founded in May 2007, is dedicated to enhancing and promoting the software. It is licensed under the GNU GPL.

eConf .eConf is an open source e-learning software, written in Java. It allows to easily record web sessions and has been used to record multiple computer science courses. eConf is an add-on to an HTTP proxy that is able to capture the web pages shown during the session and the voice of the presenter. The audio and the web pages are then synchronized to allow the students to listen to the recorded course.

ATutor. ATutor is an Open Source Web-based Learning Management System (LMS), designed with accessibility and adaptability in mind. Administrators or web master can easily install or update ATutor in minutes, and develop custom templates to give ATutor a new look.

A Tutor is a first Learning Management System, which complying with the W3C WCAG 1.0 accessibility specifications at the AA+ level and it also adopted the IMS/SCORM Content Packaging specifications ,that allow content developer to create reusable content which easily swapped between different e-learning systems.

OLAT (Online Learning and Training) began in 1999 at the University of Zurich, where a team of developers continues to enhance the software. Much of it is written in Java. OLAT is registered under Apache License 2.0.

Sakai, which its developers call a collaboration and learning environment for education, is built and maintained by the Sakai community. The core software consists of generic collaboration tools, with tools designed for specific applications (such as teaching and portfolio tools) available. The Sakai Project is registered under an Educational Community License.

Open e-LMS. Open e-LMS is the first open source SCORM Learning Management System designed for business by business. Open e-LMS is a very simple to understand and easy to operate, Thanks to its simple and intuitive web interface. Open Elms also provides a Content Management System which enables the creation of professional e-learning content from scratch.

eFront. eFront is an easy to use, visually attractive, SCORM compatible, E-learning and Human Capital Development system. It is suitable for both company and educational usage. It includes a wide variety of components that help you to create your lesson structure and add content, build online-tests, communicate with others, track user's history and progress, conduct surveys, assign projects, and create certifications.

Dokeos. Dokeos is a web-based application developed on free technologies such as PHP and MySQL. Designed to facilitate e-learning and course management, it provides a flexible, user friendly platform to simplify the e-learning process. Dokeos is a open source online learning management system. It provides all the features needed for e-learning and blended learning management: From Authoring to Reporting. Dokeos is a multilingual supported system which offers translations for over 34 languages and helping more than 1.000 organizations worldwide to manage learning and collaboration activities.

Dokeos was developed with the help of global contributions made by universities, organizations, and individual programmers. It integrates open source ideas, especially those highlighted in "The Cathedral and the Bazaar."[10] The Dokeos forum facilitates the exchange of ideas among programmers worldwide, with development details available on the Internet. Contributors may send their revised codes via e- mail, wikis, or forums. Dokeos is licensed under the GNU GPL.

Table 1

Open Source LMS Tools

With Dokeos , user can manage courses, students, documents, forums and exercises, and import SCORM content and PowerPoint presentations directly into your learning paths, making it a wonderful solution in terms of interoperability.

LRN. Pronounced "dot learn," .LRN is a popular tool developed at MIT and based on AOLserver and OpenACS. It supports online learning and other interactive digital systems. Originally designed to meet the needs of universities, it was later implemented in schools, organizations, and corporations. Its flexible framework allows easy customization. LRN is supported by an expanding user community and the .LRN consortium. The consortium institutions help each other deploy and enhance the software. The consortium also provides quality assurance by

certifying software components as .LRN compatible. The software is licensed under the GNU GPL.

LMS Tool	Compatibility	Usage
Moodle http://www.moodle.org	Linux,UNIX, Windows, Mac OS X, FreeBSD, and any other system that supports PHP	**Downloaded about 500 times a day. More than 28,000 registered sites, over a million courses, a learning community of 10 million.**
Bodington http://www.bodington.o rg	Shibboleth, Linux, Microsoft, Mac OS X, or UNIX	**Implemented at University of Leeds,UHI Millennium Institute,and University of Oxford. Provides services to 15,000 users with a single server.**
Claroline http://www.claroline.net	**Microsoft, Linux/GNU,Mac OS X; complies with SCORM and IMS/QTI.**	**Available in 35 languages and has users in more than 80 countries.**
Dokeos http://www.dokeos.com	**Supports SCORM import and LDAP. Data can be imported using CSV or XML files.**	**In 30 languages and more than a thousand organizations. Implemented at Ghent University and Vrije UniversiteitBr ussel. More than 28,000 users and 3,600 courses.**
LRN http://www.dotlrn.com	LORS Central, Curriculum, LORS Management, .LRN Ecommerce, Project Manager,Page Editor, Staff List, Syllabus, Expense Tracking	**Almost half a million users in 18 countries.**
ATutor http://www.atutor.ca	**Complies with W3C WCAG 1.0 and W3C XHTML 1.0; supports content developed in IMS or SCORM.**	**More than 17,000 registered installations worldwide.**
OLAT	**MS Windows, Mac**	**Popular within the**
http://www.olat.org	OS X, Linux, Solaris and UNIX.Conforms to SCORM, IMS QTI and IMS	**European higher education community.**
	Content Packaging.	
Sakai	Complements	Adopted by many
http://www.sakaiproject.org	commercial software like WebCT, Blackboard, ANGEL Learning and Desire2Learn.	reputable universities worldwide.

VI. Moving To Student-Centered Learning

"Teachers all over the world encourage their students to get more involved in creating blogs and other interactive web applications to enhance peer communication in and outside the classroom "

Student-centered instruction [SCI] is an instructional approach in which students influence the content, activities, materials, and pace of learning. This learning model places the student (learner) in the center of the learning process. The instructor provides students with opportunities to learn independently and from one another and coaches those in the skills they need to do so effectively. The SCI approach includes such techniques as substituting active learning experiences for lectures, assigning open-ended problems and problems requiring critical or creative thinking that cannot be solved by following text examples, involving students in simulations and role plays, and using self-paced and/or cooperative (team-based) learning. Properly implemented SCI can lead to increased motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes towards the subject being taught (Collins & O'Brien, 2003).[19]

Student-centered learning can also be viewed from the perspective of an influential report from the National Research Council (1999) that synthesized research on learning and recommended organizing learning environments around four foci: knowledge-centered, learner-centered, assessment-centered, and community-centered. Knowledge-centered learning approaches grow out of the research on novices and experts that has revealed that experts have organized their knowledge very differently than novices. So knowledge-centered learning stresses learners developing their knowledge to facilitate transfer of their learning to new contexts and application of their learning to open-ended challenges such as problem-solving, critical thinking, and design. In a learner-centered learning environment, McCombs and Whistler (1997) state that —learners are treated as co-creators in the learning process, as individuals

with ideas and issues that deserve attention and consideration.‖ Learner-centered learning environments recognize that the prior knowledge of learners powerfully influences future learning and thus attempt to build on prior knowledge.

Assessment-centered learning environments provide opportunities for feedback and improvement throughout the learning process leading to evaluation and judgment at the end of the learning process. Assessment for feedback and improvement is referred to as formative assessment while assessment for conclusive evaluation and judgment is referred to as summative assessment. Nicol and Macfarlane-Dick (2006) indicate that formative assessment can promote the development of capacities and attitudes used in lifelong learning. Assessment-centered learning environments also emphasize congruence between learning goals and what is assessed (National Research Council, 1999). Finally, community-centered environments recognize that individual learners take many cues and insights from learners around them, so that community-centered learning environments facilitate purposeful interactions among learners to promote and sustain learning. For the purposes of this essay, learning environments are student-centered to the degree to which they are concurrently knowledge-centered, learner-centered, assessment-centered, and community-centered. Many different faculty members have developed and used approaches to teaching that fit the criteria for student-centered learning. Many of these developers have created original names for their approaches.

As a result, there is a broad spectrum of named approaches, which include

- Active Learning (Bonwell&Eison, 1991)
- Collaborative Learning (Bruffee, 1984)
- Inquiry-based Learning
- Cooperative Learning (Johnson, Johnson, & Smith, 1991)
- Problem-based Learning
- Peer Led Team Learning (Tien, Roth, &Kampmeier, 2001)
- Team-based Learning (Michaelson, Knight, & Fink, 2004)
- Peer Instruction (Mazur, 1997)
- Inquiry Guided Learning
- Just-in-Time Teaching
- Small Group Learning
- Project-based Learning
- Question-directed Instruction

Faculty members often have many questions about student-centered learning approaches and implications for how they might teach. Several of these questions will be addressed in this document:

- Why would you adopt a student-centered learning approach in your course?
- Can I cover the content in my syllabus using student-centered learning approaches?
- Can I use student-centered learning approaches when teaching large classes?
- Is it possible to move from teacher- centered to student-centered in stages? How?
- How do I respond to student resistance when I start using student-centered learning approaches?
- How do I respond to students who really like being entrusted with their own learning when I start using student- centered learning approaches?

Also, many student-centered learning approaches involve faculty forming students into small groups or teams for learning activities. Prospects of working with student teams raise another set of questions, which are addressed in the last portion of the document.

- How should I form the teams?
- How do I get teams off to a good start?
- How do I grade team assignments?
- How can I help students develop their teamwork capabilities?

With Web 2. 0, the concept of student-centered learning has acquired a new dimension. Previously, the greatest critique of student-centered learning was the lack of resources and the isolation of each student from other learners. Web 2.0 has provided a means through which both collective and individual intelligence can be harnessed, while students bond in stronger, redefined ways.

This dissolution of distinctive parameters is in line with open source or free software, open

access, and Creative Commons licensing. As Ian Davis wrote:

Web 2.0 is an attitude, not a technology. It's about enabling and encouraging participation through open applications and services. By open, we mean technically open with appropriate APIs but also, more importantly, socially open, with rights granted to use the content in new and exciting contexts.1 8

VII.Common Web Tools

The Web 2.0 tools most commonly used in education are blogs and wikis, although podcasting and media-sharing sites are becoming more common. Teachers all over the world encourage their students to get more involved in creating blogs and other interactive web applications to enhance peer communication in and outside the classroom.

Blogs are the most extensively used Web 2.0 tools. Open source blogging platforms such as WordPress, LifeType, and Roller allow the free creation of blogs (as do many commercial services). Open online portals permit keeping content and feedback on the same platform. Teachers and students can collect, create, and share their own online knowledge resources.

Wiki technology allows site visitors to edit the site's content, accelerating content generation. The most common example is Wikipedia, the online free encyclopedia. Both closed and open source LMSs in corporate wikis, and much open source wiki software is available, including XWiki, TWiki, SWik, and Trac.

Podcasting has been adopted by many institutions to make content available to students in audio form. Stanford University, for example, joined forces with Apple to develop the podcast-based iTunes University. Other universities have followed, signing up for iTunes U. Some of the content available is freely available to the public; while others are restricted (to students).Podcasting technologies have encouraged an increase in learner-generated content, enhancing learner participation in digital education. Open source podcasting software such as Audacity and Juice is widely employed by the user community.

Media-sharing sites have emerged as powerful tools for the learning community. Many teachers use still images and video, especially those registered under Creative Commons licenses, for both offline and online courses. Media-sharing sites can also be used to publish student-generated video or photographs, shared with peers and teachers to receive critical feedback. Some photo-sharing sites allow the addition of annotations to an image, facilitating distance learning. Media-sharing and other social networking sites such as Elgg, Slashdot, and AROUNDMe can serve as important interactive learning tools. These social-networking tools were not created exclusively for educational purposes, however, and might contain objectionable materials, raising ethical concerns regarding students' exposure to and use of the sites.

One concern about the extensive use of Web 2.0 applications, especially wikis, 20 is access. Developers can assign content development rights to limited users, and some have done so as Web 2.0 tools slowly gain the sophistication needed to provide much-needed security features. This trend goes against the fundamental Web 2.0 idea of liberating content, however, and rouses objections from many users.

It is highly likely that digital education will depart from current Web 2.0 practices and use Web 2.0 tools in entirely different ways. This movement—making information available to a larger section of the global learning community through the Internet and Web 2.0—has introduced greater democracy in the education system as a whole and is one of the strongest arguments for digitization of education.

VIII.Destructuring Education With Open Source

The use of open source has enabled universities to create courses easily available to the global education community. The concept of open access and the proliferation of academic blogs have broken down many barriers in the education sector. Pundits have propounded various theories of digital education in response to these changes.

Many people believe, for example, that digitization of education has loosened the bureaucratic framework of traditional learning. The administrative body is less involved—in the sense

that teachers and students are more involved—in the direct conduit of e-learning.

Others believe the role of the digital medium in disintermediation is overemphasized. (In economics the term disintermediation refers to the removal of mediators, giving users direct access to products.) The traditional teacher or administrator using digital media now has various roles—as content creator, reviewer, technician, and administrator. These hierarchies can be more confusing and no less stern than those found in traditional education. According to Downes and Mui, "In many sectors intermediaries have proven to be remarkably robust. Long chains are being taken apart, but they are also being put back together in new configurations."[13]

The redefined hierarchy may include components that are not part of the university, such as agents representing corporations with an economic interest in e-learning projects. External agencies could be involved in course development, instructional design, LMS development, LMS hosting, and software support. Outside involvement might not directly affect learners, except in case of course fees. Nevertheless, this cross-linking between various agencies is no less complicated than the traditional educational architecture.

Online learning makes education available to the global community. Students almost everywhere have access to quality education through the Internet. Open access is an initiative to give worldwide access to peer-created and reviewed journal content. The core idea behind such projects is best embodied in the words of the Budapest Open Access Initiative:

Accelerate research, enrich education, share the learning of the rich with the poor and the poor with the rich, make this literature as useful as it can be, and lay the foundation for uniting humanity in a common intellectual conversation and quest for knowledge.[2 2]

A large chunk of digital education is guided by e- commerce goals, however. Some online courses cost as much as on-campus courses, making higher education financially inaccessible to many students. In addition, mass-marketing of education might decrease the brand value of prestigious online courses, undercutting the commercial goals for online education. The university's status is a major factor attracting students and influencing employers in evaluating online degrees.

Nonetheless, the commercial model of education has made education more learner oriented, with courses structured according to what learners need or want. This has led to the decentralization of education. As Chris Werry wrote,

The Internet is allowing entrepreneurial companies and innovative colleges to unbundle learning and credentialing servicesfrom the whole campus- based industry with its high cost of research and residential services and to deliver these services to a growing marketplace. The learning revolution has only just begun to capture the promise of the democratization of knowledge made possible with Internet technologies.2 3

Market demand will foster the emergence of numerous courses and modules not available in the traditional learning framework. This will give rise to a highly flexible learning process, with a greater scope for mass customization.

IX. Conclusion

Open source products have gained considerable currency in the realm of higher education. The question remains, nevertheless: What is the future of open source software in higher education? From a commercial perspective, open source projects are taking their first tentative steps into the marketplace. This might be good news for universities because it would remove the threat of market monopolization, but to measure up to industry standards, open source projects need more sophistication. If collaborative contributions continue at their current pace, this might not be difficult to achieve.

The nature of collaborative contribution could cause some concern. Although the community-based model agrees with the culture and values of higher education, enthusiasm cannot be the sole incentive. Some other form of encouragement is needed to avoid the "forking" of codes,14 which is modifying the technology of the vendor one has been working with and developing a new business model around it by rebranding the technology. Forking is a common problem for open source technology companies. Probably only a few large communities

with considerable commercial backing will survive after a few years.

Moreover, the development of open source software is largely dependent on the requirements of the e-learning industry, which itself has to endure the test of time. Nearly 20 percent of students who enroll for higher study in the United States opt for e-courses, and the e-learning growth rate exceeds that of the traditional education sector, but the emphasis is more on quantity than quality.2

5 Getting qualified instructors could prove difficult, for example. Sometimes existing instructors have to double or even triple their workload to manage online teaching. This can have an adverse effect on the quality of online courses. Also, e-learning has yet to gain the confidence of employers.

A study conducted by internet websites like Vault.com found that around 77 percent of employers prefer online degrees from accredited, established universities.15 The existence of multiple accreditation agencies (regional, national, and specialized) is a bit confusing, however.16 Centralized accreditation might more effectively convince prospective employers of the quality of an online program. Open source and digital education and learning, separately and together, aim to reach everyone. Although both movements have gained considerable maturity, a need for greater coordination exists. A cohesive plan must bring together open source principles and technologies, educational institutions, and economic factors so that each component's role is clearly defined. Both open source and digital education projects are taking their first tentative steps into the consumer world. They have a long way to go before they enter the mainstream, but together they have great potential to change forever the face of education.

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