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FREE/OPEN SOURCE SOFTWARE IN E-EDUCATION

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ABSTRACT

Today in the age of computer and internet most of teaching is still performed in classical way. In last time we speak a lot about new method of teaching and e-learning, which are connected with large investment. The expense for software we can reduce with use of free/open source software. That we don't use it often is because we don't know it and we fear from new things where we need to put some effort. In this paper free/open source software and movements in the world will be presented. The benefits of using this software from primary school to university will be shown.

Key words: education, open source programs, free software, internet

1. INTRODUCTION

In the recent time a lot of attention is spent on the e-education, which includes the use of computer in the passing and checking of the teaching matter. Use of the electronic media first emerged in the institutions using distance-teaching. Recently this media found its way also into the regular education.

When performing e-education, appropriate ratio has to be found among [1]:

- functioning software

Professional use of software introduces additional didactic value into the education; it is, however, not a basis and starting-point for its planning. Software should serve to the users as far as possible to reach the education goals, and should therefore be simple for use.

- education contents, prepared for e-education

During the preparation of e-educational substance we should not just follow the school textbooks, since the e-contents have to, apart from teaching substance also use the explanations using multimedia techniques. Additionally to an expert in the presented area, also experts for the preparation of the e-materials is needed, who should know how to animate and motivate, and thereby improve the concentration of students.

- trained teachers

The task of a teacher is to direct and lead the students through the educational process. He/she also has to be able to establish and maintain the motivation. Additionally, he/she should also provide the help with the teaching and use of software, but also to grade the students.

A lot of additional work is required in order to change the way of thinking about the e-education. It is, however, evident that new methods bring new qualities; therefore this process should be accelerated. In the paper we will focus on the first point, where appropriate solutions are available on the technological level. The applied systems are quite complex, which results in many excuses concerning the price, availability, use of Slovenian language, etc. Lucky for us, royalty-free and open source software is available and well-established. The large global corporations (SUN, Novell, IBM, NASA, ...) already recognized their potential and are successfully using them. Also the European Union supports the projects using open source software equipment, like in the Project INES [2] from the 5th Framework Programme, which was executed on the Institute of Robotics. Additionally, Slovenian Ministry of education, science and sport in the year 2003 recognized that alternative software, based on the open source software standards, should be made available to educational institutions. Thus in cooperation with educational institutions, The National Education Institute of the Republic of Slovenia, Universities of Ljubljana, Maribor and Koper, Government Centre for Informatics, Ministry of Information Society, Lugos group and independent scientific researchers, the project OKO (Introduction of open source software and free software into the educational institutions) was started.

The goal of the OKO project is to introduce the information environments, based on the open standards, open source software and royalty free software into the educational institutions. Thus the possibility of selection of software and didactic applications, which can be used by teachers and students in the teaching process, has increased. The OKO project directly supports the use and further development of the open and free code in the educational processes. The

basic task of the OKO project is to educate the teachers to use the open source software and didactic applications, based on them.

The goals of the project are:

- To obtain the quality, free or cheap didactic software for the teaching needs of the educational institutions. All subjects are supported with the appropriate didactic applications and software tools in both, teaching and learning. Teachers and students use this software free of charge in school and at home.
- To offer the open source software and free software, based on the open standards and not bound to a single producer, to the institutions.
- To support the use of open source software and its further development.
- To support the use and development of didactic applications, which are independent from the operation systems and are transferable.
- To educate and teach the teachers to know and wish to use the didactic software, independent from the programming environment.
- To teach the students to be able to use applications and software tools, independent from the programming environment.

The OKO project is following the recommendations of the government document [4]. The basic characteristic of the software, based on the open source software and royalty free software is that the basic software, from which functionally operating software products can be created, is available to everybody. From this basic property – the availability of code – many specialties arise, which put the open source software into the special focus, making it thus attractive.

Free/Open Source Software (FOSS) is a recent phenomenon that has the potential to revolutionize the software industry. It has already gained a strong foothold in the server software segment, with a leading market share worldwide in some software categories. It is also gaining ground in desktop applications and it has been predicted that its use on the desktop will become significant in the near future.

Interest in FOSS is growing globally, particularly in developing countries. Governments are considering policies to promote its use, businesses are recognizing its potential and various other sectors are giving increasing attention to the opportunity for localization that it presents.

The impact of FOSS will be felt in many areas. In this paper we focus on FOSS in education and the role it can play in schools, colleges and universities. Information and communication technologies (ICTs) have the potential to improve the quality of education. However, educational institutions are often faced with financial constraints. Competing demands for resources and the high costs of ICTs can be a major obstacle to providing ICT facilities in educational institutions. FOSS has the potential to help lower the cost barrier by reducing the cost of software, which is an important component of ICT facilities. Besides the cost benefits, there are numerous other advantages in using FOSS in education, including pedagogical benefits.

Beside of using FOSS there are ongoing initiatives for available course materials. So MIT - massachusetts institute of technology announced the OpenCourseWare (OCW) project through which it will make available course material used in 2,000 courses taught at MIT. These will be available online (ocw.mit.edu), more as 700 are already, and educators, students and self-learners from anywhere in the world can access the material without any restrictions. Educators from all over the world can use the course material as a basis for curriculum development in their own institutions. Students can use it for self-study or as supplementary material for their courses. The availability of such a repository of educational materials can stimulate innovations in teaching and can lead to other collaborative efforts.

Similar project, how to use internet in teaching is PHARE project on Institute for robotics, FOCUS-SIAT (www.focus-siat.org), where for deliver of materials a brokerage platform EducaNext (www.educanext.org) is used. EducaNext is a service supporting the creation and sharing of knowledge for Higher Education. It is open to any member of the academic or research community worldwide.

Very interesting is also Wikipedia (www.wikipedia.org). It is a free Web-based encyclopedia that is available under the GNU Free Documentation License. The encyclopedia's contents are written collaboratively by readers and are not subjected to any formal peer review. Readers can also edit the articles written by someone else and is available in over 90 languages also in Slovene (sl.wikipedia.org).

2. FREE/OPEN SOURCE SOFTWARE IN EDUCATION

As first appear the question “Why we should use FOSS in education?”. Further will be presented results from the research [5], made by Tan Wooi Tonga for United Nation Development Programme and is published under Creative Commons licenses (creativecommons.org). These results correspond with our findings.

One of the main issues that policy-makers have to contend with in making decisions on the use of ICTs in education is the cost. FOSS can lower the barriers to the access of ICTs by reducing the cost of software. The initial acquisition cost of FOSS is negligible. Indeed, it is usually possible to download FOSS without any cost. Even more, there is no licensing fee for each user or computer, as by acquiring proprietary software, and it can be freely distributed once a copy is downloaded or made available on a CD-ROM. Upgrades of FOSS can usually be obtained in a similar way, making the upgrade costs negligible as well. In contrast, proprietary software upgrades normally have to be paid for even though the upgrade costs may be lower than the initial cost, and must be also considered by migration [6,7]. By migration we must take into account the existing use of proprietary software and the need to maintain the use of some proprietary applications for academic requirements. A gradual approach can be taken, for example, by first introducing and supporting FOSS applications that run on Windows, followed by the introduction of GNU/Linux as part of a dual boot system.

Lower cost is not the only reason why the use the FOSS. FOSS is considered to have better reliability, performance and security. The development methodology of FOSS tends to assure high quality of the software. Bugs are rapidly removed with the help of large numbers of developers, and the resulting software is more reliable. This is especially true of the more mature FOSS applications. For example, in a quantitative analysis of database software carried out by Reasoning Inc., it was found that the FOSS database MySQL has six times fewer defects than proprietary databases. Similar result was found also for other applications. One of the reasons for better security is the availability of the source software, which allows vulnerabilities to be identified and resolved by third parties. An independent audit of code is possible only with FOSS and not with proprietary software.

There are clear indications that the use of FOSS in government, industry and other institutions is growing and that there will be a need for graduates familiar with FOSS. It is important that students are not only exposed to the predominant proprietary software but also have the opportunity to use a wider array of software, including FOSS. Companies recognize the importance of the education market because the students of today are tomorrow’s employees in the ICT sector. Hence, if they are exposed to certain products during their education, they will tend to continue to use them in the future, so they give hefty discounts, to capture the education market, but there product are still closed.

The open philosophy of FOSS is consistent with academic freedom and the open dissemination of knowledge and information common in academia. The advances in all of the arts and sciences, indeed the sum total of human knowledge, is the result of the open sharing of ideas, theories, studies and research. Yet throughout many school systems, the software in use on computers is closed and locked, and indirectly force students to use illegal copies of the proprietary software.

The use of FOSS also discourages piracy by students, many of whom can ill-afford the purchase of licensed copies of proprietary software. If proprietary software was used for teaching, students would have no choice but to use illegal copies of the software to do homework and assignments at home or on their laptop computers. In contrast, there is no restriction against making copies of FOSS for use outside institutions.

The open nature of FOSS is such that it can be localized, because we have access to source code. With proprietary products, localization is constrained by commercial interests. When the size of the market is too small, there is no incentive for localizing proprietary products for that market. Next advantage of FOSS is to examine and to modify the programs. This gives students the opportunity to learn from studying high quality real-life programmes. In contrast, proprietary software is normally provided in binary form and the source code is seldom released for users to study. In this way we enhance the quality of education.

3. INFRASTRUCTURE REQUIREMENTS OF EDUCATIONAL INSTITUTIONS

Different educational institutions have different ICT infrastructure requirements, depending on the level of education, the nature of the courses they offer and the available funding. Irrespective, however, there is a need for computer laboratories in educational institutions for conducting basic computer classes, allowing students to complete their

assignments, conducting specialized ICT classes, providing access to the library system, making available learning management systems and facilitating email communications, so we need good network and ability to connect to the internet is a basic requirement that educational institutions should strive to provide the access the numerous digital resources available on the Web. For educational institutions, the internet is a service that facilitates effective administration of the institution and provides a channel of communication between educators and students that can lead to more effective learning. It is also necessary for the implementation of e-learning and distance learning. Because we are on the internet, we need secure user authentication, to ensure that only authorized users can access the network.

In last time increase requirements for publishing information and providing access to materials via the Web. These include online course materials, information on the intranet, as also the institution public website. All these require appropriate Web server hardware and software.

3.1. Server Software

A main component of the ICT infrastructure of an organization are the servers that provide various services such as email, file and print services, etc. Appropriate software is required to provide these services. FOSS have been found to be appropriate for this purpose and in certain cases they have a higher market share as proprietary competitors. As an example several robust FOSS email servers such as Sendmail (www.sendmail.org) and Postfix (www.postfix.org) are available and are being deployed successfully in many organizations, including educational institutions for email services. They compare favourably with proprietary email servers such as Microsoft Exchange, are simpler to deploy and require fewer computing resources.

One characteristic of ICT usage in an educational institution is the “nomadic - mobile” user, that is, students who use the network services from different computers. This requires a file server that would allow them to save their work and configurations in a central server instead of in the local workstations. Samba (www.samba.org) is a FOSS file, print server that runs on GNU/Linux and works seamlessly with workstations running Windows at the same time. For accessing a network computer need an IP address. This can be done manually but it is most common to have the IP address assigned dynamically by a DHCP (Dynamic Host Configuration Protocol) server which is included in most GNU/Linux distributions. For security GNU/Linux has a utility called Iptables that can be used to implement firewalls to protect against security intrusion. Some ready-made FOSS firewalls are also available, such as Shorewall (www.shorewall.net). Intrusion detection tools are used to detect any security breach and one such FOSS is Snort (www.snort.org). We can download it from www.apachefriends.org and it is easy to install and use.

The most popular Web server is Apache (www.apache.org), which is also FOSS. It is reputed to have near 70% share of the total Web server market worldwide. It can be used to host public and to intranet sites. It is often used with GNU/Linux as the operating system, MySQL (www.mysql.com) as the database server and PHP as the scripting language. Their combination is often referred to as LAMPP (or XAMPP) – Linux(MS Windows), Apache, MySQL and PHP (alternatively Perl or Python language). We can get the package on www.apachefriends.org, and it is easy to install and use.

A Content Management System (CMS) facilitates the creation, publishing and management of Web content by providing a platform that can be used by individuals without their having to be skilled in the underlying technologies. Examples of FOSS Content Management Systems are PostNuke (www.postnuke.com), mambo (www.mamboportal.com) and Plone (plone.org). PostNuke and mambo are based on PHP and MySQL, while Plone is based on the Zope application server, used also by NASA, which is written using the Python programming language.

These FOSS server applications make the development of a collaborative environment in educational institutions at minimal cost possible. They allow academic staff, students, parents and administrators to interact in a way that was not possible in the past.

3.2. Workstation Software

Although there has been increasing adoption of FOSS for desktops, its penetration is still relatively low. Microsoft Windows still dominates the desktop environment, with an estimated 90% market share. However, it is believed that the desktop based on GNU/Linux suits many users. The increasing availability of applications on the GNU/Linux desktop with features comparable to proprietary software will only encourage more widespread adoption. A long list of FOSS desktop applications that are equivalent to proprietary applications running on Windows is available at

linuxshop.ru/linuxbegin/win-lin-soften/table.shtml. However, it should be noted that in order to use FOSS on the desktop it is not necessary to discard the proprietary desktop operating systems. For example, programs such as OpenOffice.org, Mozilla, and GIMP are available for the Windows platform. Hence, FOSS programs can be easily downloaded, installed and experimented with, without having to replace the existing proprietary operating system. You can try out GNU/Linux, with CDs (www.knoppix.org), without to install it to your hard disk.

In educational institutions, both staff (administrative and academic) and students require a suite of office productivity software consisting of a word processor, spreadsheet and presentation software. Microsoft Office is currently the most widely used productivity suite. However, the FOSS productivity suite, OpenOffice.org (www.openoffice.org), is gaining popularity as its features are becoming comparable to the proprietary Office suite. As noted earlier, OpenOffice.org can run on various platforms and a complete migration to Linux before it can be used is not necessary. In fact, it can be run on Windows side-by-side with Microsoft Office. A prominent feature of the latest version of OpenOffice.org is the ability to export documents directly to pdf format. This feature is not available in its proprietary counterpart.

There are a number of Open Source browsers available such as Mozilla (Netscape) (www.mozilla.org), firefox (www.mozilla.org), Galeon (galeon.sourceforge.net) and Konqueror (www.kde.org). Apart from a browser Mozilla also contains an email client and Web authoring tool. It is cross-platform and a version for Windows is available that can be downloaded and installed without affecting existing Internet Explorer installation. Unlike Mozilla other are purely a Web browsers and Galeon and Konqueror run only on Linux.

A wide range of multimedia FOSS is available, including graphics editors and video players that can serve as tools for enhancing educational content and its delivery.

GIMP (GNU Image Manipulation Programme—www.gimp.org) is the most well-known FOSS for image editing and graphic design. It is available for GNU/Linux, Unix variants and Windows. As it supports various image file formats, interoperability with other programs should not be an issue. GIMP is considered to be the FOSS equivalent of the proprietary Photoshop software.

A programme that allows the drawing of diagrams will find good use in an educational institution. There are some good proprietary software that serve this purpose, such as Visio and Smartdraw. A FOSS equivalent called Dia (www.lysator.liu.se/~alla/dia) has been designed to provide similar functions. It can be used to draw many different kinds of diagrams and has special objects to facilitate the drawing of flowcharts, network diagrams and simple circuits. The programme is available for the Windows platform in addition to FOSS operating systems.

Audacity (audacity.sourceforge.net) is a FOSS audio editor through which you can record sounds, play sounds, and import and export files in various formats. It can be used to edit your audio, mix tracks together, or apply effects to your recordings. This software will be useful when there is a need to digitize audio or make recordings for incorporation into multimedia educational content. It runs also on Windows.

A media player for many video and audio formats for workstations is necessary for playback of videos and other multimedia content. On FOSS platforms we can play multimedia files with Mplayer (www.mplayerhq.hu) like well known bsplayer (www.bsplayer.org) for Microsoft Windows, with xine (www.xinehq.de) and others. For playing audio files is very known xmms (www.xmms.org).

Aside from FOSS desktop applications for general use, there are a lot of FOSS educational software that can be used for teaching specific subjects or courses in schools, colleges and universities. These range from drawing programs for young students (e.g., Tux Paint - www.newbreedsoftware.com/tuxpaint) to programs for learning geometry (e.g., Kig – edu.kde.org/kig, Z.u.L (Slovene C.a.R – www.gimptuj.net/mobid/car/doc_slo/index.html)), chemistry (e.g., Ghemical - bioinformatics.org/ghemical) and physics (e.g., Open-Source Physics Education project - www.opensourcephysics.org). For higher education, there is QCAD (www.ribbonsoft.com/qcad.html), a programme for Computer-Aided Drafting that may be used in technical drawing classes. Scilab (scilabsoft.inria.fr) and octave (www.octave.org) are full-featured scientific software packages that may be used in numerical analysis or engineering courses at the university level.

For implementing of e-learning a good Learning Management System is necessary.

4. LEARNING MANAGEMENT SYSTEMS

A Learning Management System is a software application or a Web-based system that provides an instructor with tools to create and deliver online content, monitor student participation and assess student performance. A Learning Management System may also support collaboration and provide features such as chat facilities and discussion forums. Learning Management Systems are sometimes referred to as Course Management Systems.

The availability of such a system in a school or university will help to achieve the pedagogical improvements that ICTs are envisaged to bring to education. However, the existing proprietary systems such as WebCT and Blackboard are too expensive and beyond the reach of many academic institutions. Fortunately, several FOSS Learning Management Systems are now available.

Moodle (moodle.org) is an acronym for Modular Object-Oriented Dynamic Learning Environment. It has been released under the terms of the GNU General Public License and currently has a very active group of developers working on it. At the moment over 2600 installations in over 100 countries are reported. Developed using PHP, Moodle is cross-platform software: it runs without modification on Linux, Windows, Mac OS X and any other system that supports PHP. It supports the FOSS databases MySQL and PostgreSQL and can also be used with other databases. Moodle is multilingual and is currently available in over 40 languages, including Slovene.

Moodle has numerous features for site management, user management and course management. It has modules for assignment, quiz, discussion forum and chat. Instructors can put up assignments with due dates and maximum grades, allow students to upload completed assignments, and provide feedback to students on their assignments. Various types of quiz questions can be created using Moodle - multiple choice, short answers, true/false and fill-in-blanks. The quiz can be graded automatically and feedback can be given to explain the answers. The questions can be shuffled to make it more difficult for students to cheat, and the maximum number of times students can take the quiz can be specified. All grades for assignments and quizzes can be viewed and downloaded for further processing if necessary.

Another LMS is ATutor (www.atutor.ca) that has a variety of tools to allow the instructor to manage the online content, such as a built-in content editor, a resources database, a forum manager, course statistics and assessment support. It has good standalone modules for collaboration and chatting. However, the user interface may not be very intuitive. ATutor supports IMS/SCORM specifications, allowing content to be imported from and exported to other Learning Management Systems that also conform to IMS/SCORM specifications. However, it is relatively new and does not have a large installed base. ATutor has been released under the GNU General Public License.

At this place I would like to mention LMS Inšola (insola.uni-mb.si), that is developed at University of Maribor. It is a powerful tool, that can be used on all level of education. It is not yet known, at what licence it will be published.

Among the other requirements for the administration of educational institutions is a Student Information System for the management of student records and subject offerings, timetabling, registration, management of academic and financial records, and so on. As Student Information Systems are often customized to the needs of particular institutions, there are not many proprietary systems available, one is AIPS (aips.uni-mb.si, chp.uni-mb.si) system from University of Maribor. So far, there is no production quality Open Source student information system available. However, there are some initiatives for developing such a system. The SchoolTool (www.schooltool.org) project is one such initiative. The objective of SchoolTool is to develop a system for school administration that can be used globally and which is suitable both for schools and for higher educational institutions. The system will be made available under an Open Source license but it is still in the early stages of development and the software is not yet available for use.

5. CONCLUSIONS

If we want to use e-education, we must be familiar with using of computers. There are two problems with this method of teaching computer literacy. First, the skill in the use of a particular version of proprietary software is usually short lived. Even though it will be easier to learn how to use a new version of the software from the same vendor (relative to learning an entirely new software), re-training will still be necessary unless the user has the ability to self-learn. A different approach to teaching computer literacy should be used in order to equip students with the ability to learn, unlearn and relearn. The emphasis should be on generic skills that should not be dependent on software from a specific vendor.

The second problem with using specific proprietary software in the computer literacy curriculum is that it encourages illegal copying of software. Students need to use the same software which is available in their schools or universities for doing their homework and assignments, leading many of them to use illegal copies on computers at home.

In teaching computer literacy it is not important which operating system, word processor, email client, Web browser and spreadsheet are used. GNU/Linux, together with appropriate Graphical User Interface such as GNOME or KDE, is a FOSS operating system predominant to teach the basics of operating system features. When we use it, we found out, that it is a powerful tool, that we can use on every day work. OpenOffice.org has word processor, spreadsheet, presentation and drawing programs that can replace the proprietary equivalents. If necessary, other FOSS such as the Abiword word processor or the Gnumeric spreadsheet can also be used. To teach students how to access the Web or to use email, the FOSS application Mozilla can be used. Again, the features of Mozilla are comparable to the browser and email client that come together with Windows.

Michael Surran, a Computer Science teacher in the US, states the following [8]: *People sometimes ask me, "Is teaching our students Linux preparing them for the workplace?" This question is based on the fact that Microsoft is the current dominating presence in operating systems and office software. It is a question I have thought over a long time, and the answer I always come up with is, "Yes, most definitely." The basic principles of any type of operating system, office application or other similarly grouped software are the same. A student who becomes proficient in Linux will not find themselves (sic) lost in a Windows environment. I have found Linux to be the more advanced of the two operating systems, yet our students are very quickly and easily learning it.*

Consequently, using FOSS software as the basis of the computer literacy curriculum and other also results in cost savings for the school or university. It obviates the need to ensure that sufficient licenses are purchased as FOSS software can be legally installed in as many computers as necessary. Students can also install the FOSS software in their own computers without restrictions, and illegal copying of proprietary software is not necessary for their academic work outside the school or university's premises. However, it may be necessary to train teachers and lecturers in the use of Linux and FOSS before they can be competent to conduct classes using these software. Modification of the curriculum is necessary and some effort will have to be put into developing suitable teaching materials. It is on us, if we will profit of our own potential.

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