Using Free and Open Source Software for E-Learning System (FOSES) in Tanzania

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Abstract
The implementation of e-Learning software in Tanzania's universities as well as other developing countries is still very low even though there are plenty Free and Open Source Software (FOSS) that can cater for this purpose. Among ten universities, only the University of Dar Es Salaam (UDSM) has managed to implement the e-Learning software in Tanzania by using WEBCT and Blackboard are e-Learning proprietary software. This study therefore discusses how the Tanzania Universities can establish and implement the e-learning technology with a case study of the Sokoine University of Agriculture. Specifically, this study describes the early evaluation steps that were observed during the adoption of the e-learning platform at SUA. The extensive literature review, experience gained from other universities, and the analysis of the available open source e-learning software were used for the selection and further improvement of the e-learning platform at SUA. Challenges that are delaying the implementation of e-learning platform at SUA are also discussed, and recommendations are given upon them. It is anticipated that the findings of the study will be used by all stakeholders in planning cost-effective and efficient ICTs implementations for general improvement of education sector from national level up to district level.

Keywords: E-learning, E-learning in Universities, E-learning in Tanzania,

1. Introduction
Information and communications technologies (ICT) hold great promise for learning and teaching because they can enhance interaction among people, information, and systems in ways that never before have been possible. The Proprietary E-Learning Systems (PES) available today have only just begun to scratch the surface by delivering content and connecting people across distance and time. Yet while these PES have begun to show the promise of technology in teaching and learning (LaRocque et al, (2003), they also seem to have hit an early plateau. Free and Open Source Software (FOSS) are standing on that

plateau looking forward. Therefore, if e-Learning is to become a key and effective component in universities then the adoption of FOSS in universities has to be given a higher priority. This would enable the universities to become major players in the provision of global education.

E-learning is defined as instructional content or learning experiences delivered or enabled by electronic technology. In practice, it incorporates a wide variety of learning strategies and technologies (The Commission on Technology and Adult Learning, 2001). E-Learning is an alternative solution, which enlarges accessibility to the training and becomes essential to complement the traditional way of teaching (i.e. face-to-face). With the help of ICT, one teacher can assist many students in many places. This helps to reduce costs and increases the impact of teaching and learning processes. ICT based learning opens many possibilities since the same course materials can be sent to learners via Internet, Email, videoconferencing and multimedia (videocassette, Compact Disk (CD).

A part from facilitating the improvement of teaching and learning processes, the potential of e-learning lies in bringing an overall qualitative improvement in the education system by providing timely and quality information to both trainers and learners. Developing countries like Tanzania have the potential to develop and deploy the e-learning system to conduct distance learning across and outside the country. However, in order for this to be realizes, the following are needed: better infrastructure, human resource base, electricity up to the rural areas etc.

However, the e-learning technology is at infancy stage in Tanzania. Among ten universities, only the University of Dar Es Salaam (UDSM) in Tanzania has managed to implement e-Learning software (Mutagwahywa, 2003). Therefore, so many efforts are needed for the promotion of adoption and implementation of FOSES in Tanzania universities. This study therefore describes the early evaluation steps that were observed during the adoption of the e-learning platform at SUA. It is anticipated that the findings of the study will be used by all stakeholders in planning cost-effective and efficient ICTs implementations for general improvement of education sector from national level up to district level.

2. Why Open source technology should be applied in learning and teaching practices within universities?

It is argued here that open source software is a promising technology for designing and developing the e-learning systems in universities throughout the world. There are two terms that are interchangeably used when referring to free/ open source software (FOSS): "open source software (OSS)" and "free software (FS)". In summary, OSS/FS are programs whose licenses permit users the freedom to run the program for any purpose, to study and modify the program, and to freely redistribute copies of the original or modified program (OSS/FS References, 2005). Such licenses include the GNU Public License (GPL).

The usage of open source in implementing e-learning systems is more emphasized especially in developing world due to the challenges they face when implementing the Proprietary E-Learning Systems (PES). Two characteristics of

PES make it ill-suited to the task as described by (Coppola, 2005): (1) the rapidly escalating cost of proprietary software leaves too little of an institution's IT budget available for creative exploration, once the software has been installed and minimally supported; (2) reduced flexibility to adapt to institutional culture, teaching practices, and disciplinary uniqueness occurs when software development is driven by mass market economics.

Open source software offers the potential to reduce the cost of the software while providing the universities greater control over its destiny. The characteristics in particular make it an attractive solution:

- Elimination or reduction of license and maintenance fees leaves more budgets available to invest in adapting the software, managing organizational change, providing professional development, and responding to end-user requests (Coppola, 2005).
- It offers better reliability, performance and security (Tong, 2004). In the comparison of the security feature of FOSS and that of proprietary software, Wheeler (2003) suggests that FOSS is often superior to proprietary software in terms of security. One of the reasons cited is the availability of the source code, 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.
- Customization of Open source can be done more effectively because there are few barriers to adapting, sharing, and collaboratively developing new applications (Coppola, 2005).

Several FOSS learning management systems (LMSs) are now available. In a report published by the Commonwealth of Learning in June 2003, thirty-five FOSS Learning Management Systems were identified and evaluated. ATutor, ranked the highest (COL LMS Open Source, 2003). While, in his study, Edutools (2005), Moodle software was highly ranked among 36 surveyed open source E-learning systems. These studies provide a foundation on which the universities can use and build upon them when evaluating the open source e-learning software for the implementation in their universities. However, more emphasis should be put on selecting and implementing such a system as according to the user requirements.

3. Application of E-Learning in Africa
Education forms the basis for world wide development including African countries. Previous studies have shown that education, particularly primary education, has a significant positive effect on economic growth, earnings, and productivity (World Bank, 2001). LaRocque and Latham (2003) notes that e-learning is now a viable tool for addressing the significant education challenge in Africa. Adopting e-learning in Africa will increase education access and quality as well as lower the cost of education. The paper elaborated further that while e-learning is not a cure for the entire problem related to education in Africa it is it is clearly a tool that now must be taken into serious consideration by policy makers.

A paper by Uys et all (2004) suggest that in Africa e-learning needs to be

implemented within a strategically developed framework based on a clear and unified vision and a central educational rationale. The paper also highlights the importance technological transformation required to achieve e-leaning and the importance of using a combination of strategies — top-down, bottom-up and inside-out — during the diffusion process to attain coherence, collegiality and ownership.

However, there are number of challenges that face Africa universities when seeking to implement the e-learning systems. This includes poor ICT development, inadequate funding, and poor human resource base which are most critical components in the establishment of e-learning systems etc. AAU (2004) acknowledges that the Africa universities which should be in the forefront of ensuring Africa's participation in the ICT revolution are themselves unable and ill-prepared to play such a leadership role, because the information infrastructure of African universities is poorly developed and inequitably distributed. The development and application of ICT for African universities therefore becomes crucial and urgent if the continent is to be able to increase education access and quality as well as lower the cost of education.

Despite the fact that the Africa universities are faced with many challenges, but e-learning seems to gain its momentum. As Mufeti (2005) notes that although the ICT capacities are still very low in developing countries, particularly in Africa but the African Universities are slowly integrating e-learning technologies in their program offerings.

4. E-learning experience in Tanzania
As it is the case with African countries, the implementation of e-Learning software in Tanzania's universities is still very low despite of the opportunities that are provided by the open source technology. Among ten universities, only the University of Dar Es Salaam (UDSM) has managed to implement the e-Learning software in Tanzania by using WEBCT and Blackboard are e-Learning proprietary software. However, these universities such as Sokoine University of Agriculture and Mzumbe University possess the basic ICT infrastructure that forms the basis for the establishment of e-learning platform.

UDSM implemented the e-Learning system through the financial support from the Flemish University Council. The university established the Technology Enhanced Independent Learning project (TEIL) as an independent section to deal with the provision of e-Learning services to the university community. Blackboard software, the proprietary software was selected by the university to implement the e-learning platform. Blackboard is currently used by all faculties within the university. In partnership with other agencies and universities, UDSM has implemented other e-learning software for distance learning purposes. WEBCT (proprietary software) is among of the e-learning software that is used for distance learning purposes within the university in collaboration with the African Virtual University (AVU). Specifically, WEBCT is used for computer science and business studies degree and diploma programs. UDSM is also a partner in the AVOIR (African Virtual Open Initiatives and Resources) project of

the University of Western Cape in South aiming at developing the KEWL next generation e-learning software. Currently, KEWL is used to offer online postgraduate Diploma course and a master's course in ICT policies and regulations within the university. This is also used by several universities in Southern Africa Including UDSM, Western Cape, University of Zambia and Makerere University. Despite of these achievements, the university still faces some challenges due to the high license cost it incurs to run its widely used program, Blackboard. Instead, this budget could have been used for other purposes such as staff development.

4. Methodology

The extensive literature review, experience gained from other universities, and the analysis of the available open source e-learning software were used for the selection and further improvement of the e-learning platform at SUA. The evaluation of the available open source e-learning management software (LMS) was done between April and August, 2005. The evaluation was done in order to adopt a semi-ready open-source software system (OSS) for further customization, configuration and extension of the functionalities that are at SUA. This type of system analysis was selected because is the most widely recognized suitable solution that can match both low cost investments and fully application customisation (Kaderali and Elhert, 2003). The key goal of this study was to develop a high quality online course to satisfy the needs of students, as well as lecturers.

5. Evaluation and Adoption of E-learning System at the Sokoine University of Agriculture

Sokoine University of Agriculture (SUA) is the second largest public university in Tanzania offering degree programmes in agriculture and allied sciences. SUA developed Information and Communication Technologies (ICT) policy since 2002. The main goal of the policy is to ensure that ICT is fully integrated into planning and implementation of the university mission (teaching, research and consultancy) in order to speed up and improve quality of activities of the university. One way to realize the above-mentioned goal is through the use of appropriate electronic technologies to deliver, support and enhance teaching and learning activities. So far the e-learning platform at SUA is not yet in place. However, the university has already acquired, adopted and continues to improve the ICT infrastructure that form the basis for implementation of e-learning.

From the literature review and the experience gained from other universities, the open source technology was selected for further evaluation of the available e-learning solutions it provides for the implementation of e-learning at SUA. The main functional requirement that was used to narrow down the analysis was if the platform is built from the sound pedagogical principles. This allows a large variety of pedagogical setup including widening of traditional classroom and online collaborative learning. Other criteria that were used for system evaluation included the following:

- Standards Compliancy: Different LMS were analysed if they adhere to specifications like SCORM, IMS, OKI, AiCC
- User management: This deals with user authorization and authentication
- Site management: This deals with system personalization, extensibility, multilingual capability etc
- Course management: This deals with learning flow management, course monitoring, supported course modules etc
- System features: Involves hardware, software, software quality, training and documentation, installation process, user base support etc

This feasibility analysis led to the close examination of the Moodle and Claroline e-learning software.

5.1 Closer examination of Moodle and Claroline e-learning software

5.1.1 Claroline

Claroline is developed by using PHP/MySQL It is built over sound pedagogical principles allowing a large variety of pedagogical setup including widening of traditional classroom and online collaborative learning. This study analyzed the version 1.7.0. The following is the summary of the features that were assessed:

1. *Standards Compliancy.* The system supports SCORM 1.2 for packaging and even for runtime. It's possible to import and export SCORM contents and it's possible to export tests in a IMS-QTI standard format
2. *Site management.* The customizations are at platform level (users cannot choose a different style or change it). APIs haven't been fully defined and there isn't a plug-in concept documented for functionalities extension. It is also a multilingual platform available in more than 30 languages.
3. *Course management.* It supports Learning paths that allows systems administrator to create a complete sequence of learning steps or activities that learners can follow. A range of modules such as wiki, chat, forum, assignments (e.g tests and assessments) internal email, and notes/files sharing tools are supported. In course monitoring, users can be enrolled by the teacher/admin or can enroll by themselves. It's possible to track a lot of information (particular objects, particular learners or access time).
4. *User management.* It has the SSO (Single Sign On) features based on the Central Authentication Service protocol which permits users to authenticate once and gain access to multiple systems. Permissions are handled in a role based style with four predefined roles: administrator, teacher, user and guest. However, it is not possible (in an easy way) to modify these roles or to create a new one.
5. *System feature.* It has a broad user base and strong reliability which is a good feature for the proposed system. It has extensive documentation, and discussion forums that support the users.
6. *Others.* As of Claroline 1.5, backup/restoring of courses is no longer possible.

5.1.2 Moodle

Moodle is a course management system (CMS) designed using sound pedagogical principles, to help educators create effective online learning communities. It provides a support for strong security and administration. At the time of the evaluation, 1.4.5 Moodle was analyzed, the features are summarized below:

1. *Standards Compliancy.* It is evolving towards IMS/SCORM standards. Moodle courses or SCORM 1.2. Packages can be imported and exported (in a proprietary format) with associated (proprietary) metadata.
2. *Site management.* It provides a Plug-in "themes" allow the admin to customize the site colors, fonts, layout etc to suit local needs. Plug-in activity modules can also be added to existing Moodle installations. It also supports about 40 languages.
3. *User management.* It supports a set of authentication mechanisms that can allow the university to integrate it with other existing system (i.e. LDAP, IMAP / POP3 / NNTP –Mail servers, External Database and manual). This is a good feature for the proposed system as it can allow the e-learning to be integrated with others existing systems within the University. Permissions are handled very simply via role based access control (i.e. Administrators, course authors, tutors, learners and guests).
4. *Course management.* The system doesn't support learning paths. The system partially supports learner portfolios (following up of all activities of the learner within one course is possible, but the concept of total supra-course portfolio of the learner does not exist).The user can select a course by using a range of possibilities: by week, by topic or a discussion-focused format. It support various course modules such as, forums, Journals, Quizzes, Resources, Choices, Surveys, Assignments, Chats, Workshops, Wiki. All grades for Forums, Journals, Quizzes and Assignments can be viewed and downloaded as a spreadsheet file. Teachers can define their own scales to be used for grading. It also provides full user logging and tracking. In course monitoring, Online/offlline times of courses can be scheduled in the system (registration period and blocking of course). Learners can enroll for a course and instructor approves enrollment.
5. *System feature.* The software has wide usage all over the world with active user forums and extensive documentation and bug tracking feature. It is also easy to install and it is built using PHP of which the SUA ICT experts have the required skill sets.
6. *Others.* Apart from the modules, there are numerous other additional features, such as a calendar listing site events, course events and user events, a backup facility to create backups of courses and the entire site, mathematics tools and a HTML editor for most text fields.

5.1.3 General overview
Generally, system analysis led to the selection of Moodle software since it possesses the desired functionalities required for the implementation of e-learning at SUA more than Claroline. Some of those features are summarized below.

Claroline code is quite clear and code conventions are normally respected; at the moment, APIs haven't been fully defined and there isn't a plug-in concept documented for functionalities extension (our requirements prefer a separation between the code in php and the GUI in html). Moodle has documented mechanisms for the extension of features in the development process. There is a plug-in concept. A defined API is also partially available. The system is (in parts) developed according to an object-oriented approach. The quality of the source code of the project is good.

Other added functionalities in Moodle include the Search capability provided in its modules such as forums, glossary, Wiki, course summaries, however no full text content search is provided. In Claroline, the search capabilitiy is only limited to documents, not in other tools. Additionally, Moodle's interface for creating course content is more intuitive, and its featured with a very simple to use What You See Is What You Get (WYSIWYG) editor. Furthermore, Moodle can optionally be integrated with other system such as it is available as a package in Debian. It can also optionally integrated with several other web applications such as Content Management Systems, for example Mambo, Xoops and Postnuke., and web hosting control panels that allow for simple installation of applications like Moodle, such as CPanel and Plesk.

5.2. Deployment and customization of Moodle at SUA

Currently, Moodle software is still not implemented at SUA due to financial constraints and many other challenges that are well explained in the following section 7. Generally, further development of e-learning platform at SUA is expected to make a ready-to-go prototype based on its original version immediately available, but with minor customisations to fit the university specific requirements, which are as follows:

- Registration and authentication of learners and trainers based on their university registration number as a unique key
- Enabling procedure for registration of learning managers and their account validation
- Customized administration module: interactive users database management via web to easy profile editing.
- customization of user interface – „Look and feel"

Screenshots of e-Learning prototype of Moodle software at SUA
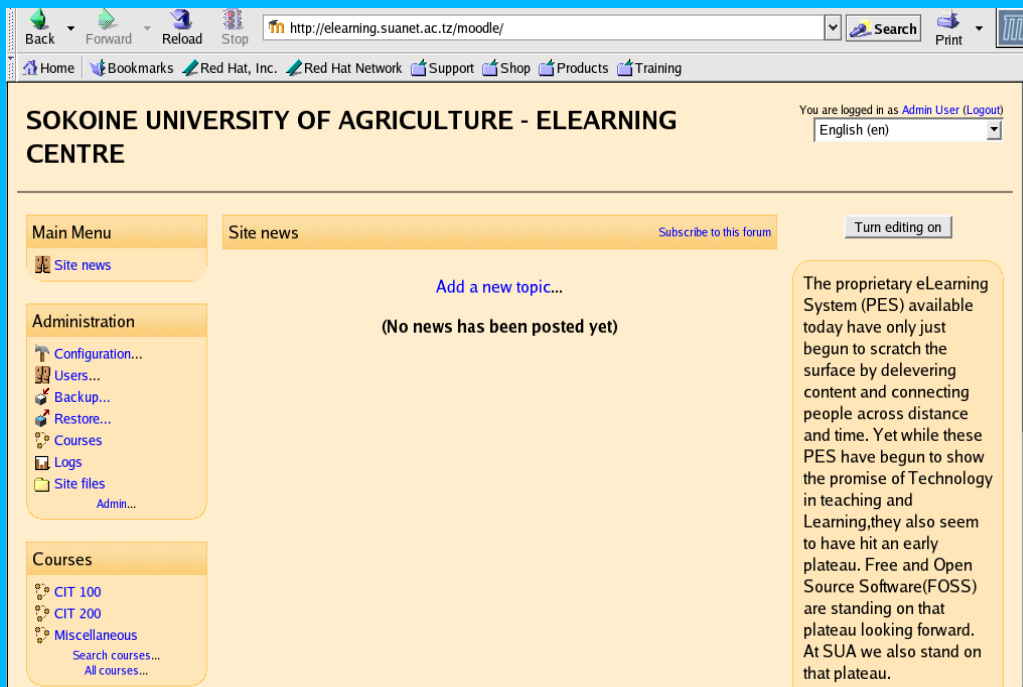
Figure 1: Window for Moodle Administrator. Administrator can either configure the software, deal with users (add, delete etc), make back up and deal with courses addition or deletion. This window allows a user/administrator to subscribe to a forum and to add news.

7. Challenges of implementing the e-learning platform

Although e-learning comes with many benefits, its introduction in most of developing countries higher education system including SUA presents many challenges major being financial constraints. This is mainly caused due to the low budget that is allotted to them by their governments.

Further, these universities face a lot of challenges in ICT utilization for teaching and learning due to *inadequate ICT facilities.* For example SUA has not yet been able to implement the e-learning platform due to inadequate facilities such as server for e-learning deployment and computers for students. Currently, the ratio of students per ICT facilities at SUA is very poor (i.e. 1:40). The implementation of e-leaning platform requires the availability of ICT facilities to the targeted users (i.e. both student and lecturers). So, its implementation will have no meaning, if the system can not be accessed and utilized by the targeted population.

There is also *inadequate number of ICT experts* in most of Tanzania universities to manage the systems like e-learning system. For example: SUA faces a lot of problems in retaining its ICT expertise due to low salaries being paid to the staff. Most of them tend to run into greener pastures. An example can be taken from the UDSM which had to establish a separate section to deal with e-learning, of which requires a separate number of ICT experts to man it.

Other challenges include *low bandwidth* in the connectivity and speed of delivery systems in most of the higher learning institutions in Africa. For example, SUA's bandwidth is as low as 256kbps downlink and 128kbps uplink to link to the Internet.

The *personnel reluctance* to switch from traditional methods of teaching to technology oriented approaches pose a problem in implementing e-Learning system in Tanzania including SUA. Most academicians are satisfied with the way they conduct lectures and interact with students. So, more awareness programs are needed to educate the university community about the importance of the e-learning system in higher education.

8. Conclusions and Recommendations
Open source technology provides great opportunity for developing countries universities to implement the e-learning platform at no cost. However, the implementation of these technologies in developing countries including Tanzania universities is still low. In Tanzania, there is only one university (University of dare s salaam) that has implemented the e-learning system. The Sokoine University of Agriculture (SUA) which was taken as a case study for this paper is still on its early stages of adopting the e-learning platform. However, this process is not yet to be realized in the near future, due to the constraints that are faced. This paper argues that the universities in developing countries should seek to adopt and implement the e-learning system, since it improves the quality of the teaching and learning processes. To conclude, this paper recommends the following for proper deployment of e-learning system in he universities:
1. Careful planning to ensure sustainability of the system
2. Usage of cost effective open source technologies for e-leaning
3. *A mix of face to face and online learning and teaching. T*here is research evidence that supports a mixed mode or blended approach in e-Learning provides the best results (Uys et al 2004).
4. *For hybrid computing environment,* this paper recommends a mixture of both free/open source software and proprietary software. As Paul Dravis et al (2003) wrote that "**Open Source Software** is **Not** an "**All or Nothing**" **Proposition**", that is some free and open source software can run in proprietary software environment and vice versa.
5. *Awareness building* must also be encouraged among African governments to ensure that policy and regulatory frameworks that allow development of sustainable information and communication technologies infrastructure are put in place.
6. *Training and capacity building* program should be developed for people in the educational sector, so as to develop ICT skills, skills on how to develop content for e-Learning and how to integrate ICT in the learning environment.
7. *Cooperation between universities or institutes (e.g* at national, sub-regional and regional level). This would enable the universities to meet the challenges of skills shortage, sustainability and technical support/training.

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