

An Interactive e-Learning Management System (e-LMS): A Solution to Tanzanian Secondary Schools' Education

A. Ellen Kalinga, R. B. Burchard Bagile, and Lena Trojer

Abstract—Information and Communications Technologies (ICT) has been integrated in education in many developing and developed countries alike, but the use of ICT in Tanzanian schools is dismal. Many Tanzanian secondary schools have no computers. The few schools with computers use them primarily for secretarial services and computer literacy training.

The Tanzanian education system at other levels like secondary school level has to undergo substantial transformation, underscored by the growing application of new information and communication technology. This paper presents the e-readiness survey result from secondary schools in Tanzania. The paper also suggests how Tanzania can make use of the few present ICT resources to support and improve teaching and learning functions to improve performance and acquisition of knowledge by using e-Learning Management System (e-LMS).

Keywords—e-Learning, ICT, Object-Oriented, Participatory design.

I. INTRODUCTION

TANZANIAN secondary schools in rural areas are geographically and socially isolated, hence face a number of problems in getting learning materials and quality teachers. The schools face three critical issues that are global in perspective, but remain focused on the learners' needs. These are shortage of teachers, quality of teaching and the capacity of schools in terms incentives/motivations [7]. The focus now in Tanzania to improve teaching and learning is to raise the standard of teachers' preparation programs, increase degree attainment of teachers and increase classroom strategies in service training. The drive can only be effective by providing support to teachers by providing adequacy access to basic up-to-date information resources like textbooks and reference materials. Also laboratories for science subjects need to be well equipped and teaching aids available. Even some regional schools can not attract good teachers because of opportunities in their locality and pay scale. The situation is aggravated by the low number of committed and competent teachers compared with demand.

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The Government is making big effort to improve the situation but is overwhelmed by the rate of increase secondary schools and students, which stretches beyond limit the available teachers and teaching and learning resources. These constraints result in poor performance and low morale, particularly in rural and in some urban schools. Performance is more critical in science and mathematics subjects in rural schools.

One of several ways to encounter these constraints is to make use of ICT. The National ICT Policy of Tanzania [9] [8] highlights that ICT encompasses telecommunications services, computers and associated peripherals, Internet services, e-mail, fax, broadcasting, TVs and other media. One of the objectives of the National ICT Policy of Tanzania is to use ICT to improve the quality of delivery of education and training in all areas including distance learning. Achieving these objectives is however a process.

II. TANZANIA SECONDARY SCHOOLS' E-READINESS SURVEY

E-readiness studies were conducted in Tanzania showing that the country is gradually entering the global information society, however the available resources limit the pace considerably. This study is part of a bigger project of ICT for e-learning in rural secondary schools.

Ten locations were chosen as pilot study areas, where six schools were selected in each area. These were visited and surveyed. The locations were: Bagamoyo, Iringa, Kibaha, Kilwa, Mkuranga, Moshi, Morogoro, Mwanza, Songea, Mbeya, Dodoma and Arusha. The survey covered e-readiness of schools, data providers and that of the relevant Ministry. The end selection of a pilot area was based on the following criteria: vicinity and accessibility from each other and teaching science based subjects.

A. Data Communication Service Providers

Twaakyoondo, Bhalalusesa and Ndalichako [10] found that Tanzania through its regulatory authority the Tanzania Communication Regulatory Authority (TCRA) has provided license to six companies to provide Public Data Communication Services. The licenses did not include provision of voice services. Only two companies were initially granted exclusive rights to provide wired network telecom services - one in each part of the republic.

Yonah [12] indicates that TTCL/SIMUNET is

implementing 10 zonal Points of Presence (PoP), 27 at regional level and over 70 at district level. The intention being to allow Internet-access connectivity by dial-up to become local calls in many places in Tanzania. There are five licensed mobile phone operators that use the services of fixed network companies for interconnection and for backbone services.

There are a number of licensed Internet Services Providers (ISPs) that is growing day by day. These are either using the Point-of-Presence or satellite connection.

B. Availability of Computers

In the study made to assess e-readiness in schools the availability of telecommunications services, computers and associated peripherals and Internet services to the schools were observed. The results show that many schools have acquired computers through own initiative or effort using school funds or donation from donors or provided by the Government. Many schools have landline telephone connection but only very few manage to have Internet service connected because of operational costs.

Table I and Fig. 1 show a summary state of availability of computers for the 71 secondary schools that were surveyed in 10 regions out of a total 21 regions of Tanzania Mainland. Assessment of availability of computers was considered to be fundamental because computer is a basic resource to facilitate use of ICT. It is important to note however that the student population in such schools range from 400 to 1500. This is clearly a desperate situation.

TABLE I
COMPUTER AVAILABILITY SUMMARY

Number of Computers in a school	Number of Schools
0	19
1 – 3	25
4 – 15	11
≥ 16	16

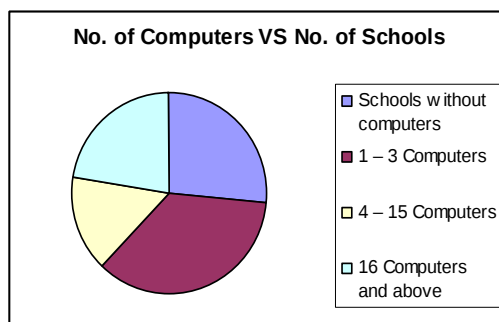


Fig. 1 Pattern of distribution of computers in schools

It was observed that many schools have desire for and are making efforts to procure computers. The adequacy of infrastructures, logistics and competent personnel in schools is a major constraint to the availability and use of ICT in

schools. Addo [2] considers the critical requirements to be a computer laboratory, a school library, electricity, a telephone and adequate security to ensure safekeeping of computer systems. The study shows that of the 71 surveyed schools 73 % have at least one computer, 35 % have one to three, 16 % have 4 to 15 computers and 22 % have more than 16 computers.

III. E-LEARNING PROJECT COMPONENTS

There have been efforts to improve secondary education in Tanzania using ICT through several projects. Some ended with static websites like: <http://www.distancelearning-tz.org>. Such websites are accessible to students in the urban areas where there are Internet cafes.

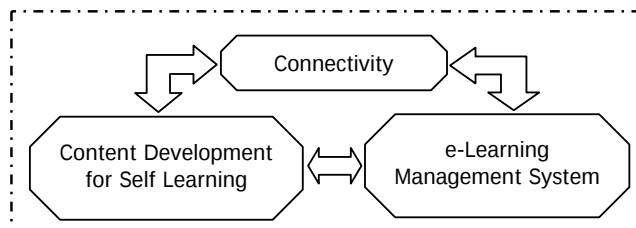


Fig. 2 e-Learning Project Components

To complement such efforts in a more dynamic way the University of Dar-es-Salaam through its College of Engineering and Technology conceived a research project to develop a tool to enable ICT support rural secondary schools. The focus is to enable ICT support with teaching materials, which are user friendly, facilitating self learning and information sharing, starting with science and mathematics. The success of this research work rests on realizing three basic pillars as shown in Fig. 2: Establishment of suitable and effective connectivity and configuration, development of a context centered platform which includes e-learning content management system based and development of the repository structure for local content materials to self learning environment and sharing. To minimize operational costs open source platform has been chosen.

Commercial use of ICT in e-learning is gaining momentum in Tanzania particularly when foreign universities use local universities and institutions to deliver their programs. There are local ventures but with limited scope. There is also a teleconference facility [5], a project funded by World Bank. But the cost for using the facilities is very high. Another African Virtual University (AVU) project established by the World Bank in 1997 involved a total of 31 learning centers established in 17 African Nations [6]. The benefits of using ICT for e-learning includes cost reduction, wider access beyond physical walls classrooms, performance improvement, quality enhancement and creation of new products and services.

IV. DEVELOPMENT OF E-LMS

E-learning is an attentive concept, subject to wide variation in practice, which has become a common mode of education delivery worldwide. Akeroyd [3] elaborates this by stating that the extreme case is the use of the web technology to facilitate the whole cycle of learning from initial sign-on to final certification. There will be a range of operations in between, with no or little physical interaction among learners. Hence, the World-Wide-Web (WWW) opened a new dimension to computer based training where learners can learn from anywhere, anytime with possibilities for huge cost savings in corporate training. Online learning has created new dimension to opportunities for collaboration among academic institutions and beyond. Access to academic resources is at a level that remained a dream two decades ago. The beneficiaries are town duelers in most developing countries.

The need for learning management systems (LMS) being developed is underlined by Watson et al [11] who argues that the e-learning industry, which includes different groups of users and knowledge requirements, needs effective manageable system to monitor the learners' learning, measure it and provide reports on learning efficiency. Hence, constant tracking of the learners' actions and online tests results can be done. LMS provide a technological, parameter driven framework to allow individuals develop and deliver learning content, to interact with students and to facilitate open discussion. Advancing LMS will support a range of administrative functions relating to course delivery and administration to enable e-learning such as content delivery, performance tracking, management of learners and their courses and students' collaboration.

A basic LMS is a Web application where the learner logs on and accesses the courses allocated to her/him. While the learner is going through the courseware, the LMS stores information about the learners' interactions, such as scores and answers to questions. LMS use this information to analyze how well the learner is performing, and are able to provide reports to the administrators and course tutors. Hence a LMS should contain an interface for managing users, adding/deleting new learners, organizing learners and allocating access rights/courses to uses and user groups.

The LMS to being developed is model driven and web-based platform in order to carter for wide access to a big number of rural secondary schools in different regions. As shown in Fig. 3, it is based on three-tier architecture and consists of the following:

Client-Tier: The user interface running in a web browser in the computer,

Application-Tier: Apache web server will be used running in LINUX platform and

Database-Tier: MySQL database running in LINUX platform.

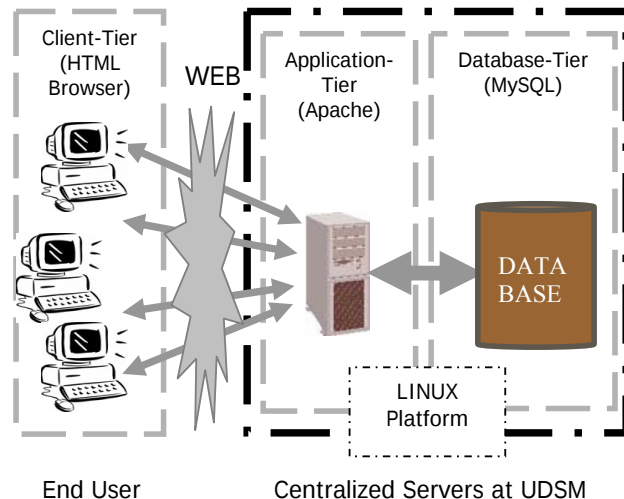


Fig. 3 e-LMS Three Tier Architecture

The e-learning materials will be centrally stored at the database server with functionality of mirror imaging to localities of school. Distributed users will be able to browse learning materials using any standard internet browser through application server. Security of information in the central server and its mirrors and that in schools is an issue that is still being considered. Both the central application server and the database server will be located at the University of Dar es Salaam, College of Engineering and Technology.

V. METHODOLOGY FOR E-LMS DEVELOPMENT

Software engineering principles applicable in software development shall be employed in the System Development Life-Cycle (SDLC). Open Source Software (OSS) platform based on LINUX operating system and Web based technologies like HTML markup language, Java Scripting language, Cascading Style Sheets (CSS), PHP server side scripting language, MySQL database management system, and Apache web server will be used. Understanding of database management systems (DBMS) and data modeling is critical.

The importance of considering users in developing computer systems in general has been recognized since the 1970s [1]. As a primary source of information our approach in developing e-LMS is participation of users from the analysis stage to implementation. Questioners, physical observation and group discussion with students, teachers and school administrator is employed. The students/learners remain the focal point for users of e-LMS, hence it should satisfy their needs and resolve their problems [4]. Others are teachers, school administrators, parents and education official from the Ministry.

Many of the students, teachers and administrators are not aware of the technology in ICT in education, though some are in contact with at least computers. With this respect, gathering user-requirement for a platform has also taken the approach to base on the user requirements on broader fundamentals, that

is, secondary source of data. This includes other researches' reports, recommendations from an analysis of current learning articles, journals, published and unpublished papers, as well as the investigation on the existing learning models from open source learning management systems.

An Object-Oriented system development approach is adopted in this research. The object-oriented analysis (OOA) technique used is based on the Model Driven Architecture (MDA) using Unified Modeling Language (UML) techniques for the design. Several types of diagrams such as use-case (plus high level and extended use cases), sequence, domain, collaboration and design class diagrams will be employed. For a web-based system, an extensible markup language (XML) technology is applied, which maps with the UML to create a dynamic, interactive web application. Modeling will be obtained by mapping UML and XML schema. A high-level design process will follow that evolves into a more detailed design i.e. implementation and testing stage. This will involve code generation using high-level language. Code from open source software will be used as a base.

VI. CONCLUSION

The use of ICT provides innovative ways to complement the traditional student-teacher interaction worldwide to optimize resource usage, sharing and collaboration. Therefore, the development of e-learning facilities for rural areas of Tanzania has high national priorities and hence relevance. Application of ICT in e-learning that is accessible in remote and rural schools will improve the performance of students in such schools in rural areas as well as raising morale for teachers and students.

A web-based e-learning management system for Tanzanian secondary schools is necessary and must address the peculiarities of local conditions of schools so that ICT resources can be used to improve teaching and learning functions accessible beyond urban communities. The e-LMS being developed will allow creation, storage, re-use and delivery of digital learning material, and will also manage these resources with users from central object repository. To affect the e-LMS, connectivity has to be established to secondary schools. Achieving the connectivity other services such as e-health, e-commerce, can be introduced in the surrounding areas.

REFERENCES

- [1] Abels E. G., White M. D., and Hahn K., (1998), "A User-Based Design Process for Web Sites", *Electronic Networking Applications and Policy*, Volume 8 · Number 1 · 1998 · pp. 39–48, MCB University Press · ISSN 1066-2243.
- [2] Addo, H. (2001), "Utilization of Information and Communication Technology for Education", *IFLA Journal* 27: 141-151.
- [3] Akeroyd, J., (2005), "Information Management and e-Learning", Vol. 57, No. 2, pp. 157-167, P ISSN: 0001-253X, Publisher: Emerald Group Publishing Limited.
- [4] Avgeriou, P., Papasalouros, A., Retalis, S., & Skordalakis, M. (2003). "Towards a Pattern Language for Learning Management Systems. *Educational Technology & Society*, 6(2), 11-24, Available at <http://ifets.ieee.org/periodical/6-2/2.html> (ISSN 1436-4522).
- [5] Victor W. A. Mbarika V. W. A, (2002), "TeleEducation in Africa: A Possible Panacea for Sub-Saharan Africa's Educational Dilemma".
- [6] Oketch M. O., (2004), "The African Virtual University—Development and Critique", *International Higher Education*.
- [7] Recesso, A., (2001), "Prospect of a Technology-Based Learner Interface for Schools", *Educational Technology and Society* 4(1), ISSN 1436-4522.
- [8] The United Republic of Tanzania (1997). *National Telecommunications Policy*. Government Printer, Dar es Salaam.
- [9] The United Republic of Tanzania, *National ICT Policy of Tanzania*, (2003).
- [10] Twaakondo H. M., Bhalalusesa E. P., and Ndalichako J. I., (2002) "Factors Shaping Successful Public Private Partnership in the ICT Sector in Developing Countries, the case of Tanzania".
- [11] Watson, J., and Pervaiz, K. A., (2004), "Learning in the Age of Global Information Technology: Development of Generic Architecture for an Advanced Learning Management System", Vol. 21, No. 1, pp. 4-21, Emerald Group Publishing Limited, ISSN: 1065-0741.
- [12] Yonah Z. O. (2000), "The Status of Information and Communication technology in TTCL).