

# Introduction of Open-Source e-Learning Environment and Resources: A Novel Approach for Secondary Schools in Tanzania

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**Abstract**—The concept of **e-Learning** is now emerging in Sub Saharan African countries like Tanzania. Due to economic constraints and other social and cultural factors faced by these countries, the use of Information and Communication Technology (ICT) is increasing at a very low pace. The digital divide threat has propelled the Government of Tanzania to put in place the national ICT Policy in 2003 which defines the direction of all ICT activities nationally. Among the main focused areas is the use of ICT in education, since for the development of any country, there is a need of creating knowledge based society. This paper discusses the initiatives made so far to introduce the use of ICT tools to some secondary schools using **open source software** in **e-content** development to facilitate a self-learning environment

**Keywords**—e-content, e-Learning, ICT, Open Source Software.

## I. INTRODUCTION

TANZANIA, like any other developing country in the sub-Saharan Africa faces many problems as far as education is concerned. One among the problems is lack of education and learning materials for secondary schools. This leads to inequality in accessing learning materials among schools or individual students. The problem has been there for a long time due to the economic hardships faced by the Government which has been the sole supplier of text books and learning aids to Government secondary schools. This problem hinders better performance of secondary schools in the compulsory national examinations.

In March 2003, the National Information and Communications Technology (ICT) policy was formulated in Tanzania. This ICT policy is a reflection of national goals, objectives and aspirations as expressed in Vision 2025. One among the focused areas in the Vision 2025 is a well educated and learning society. It is also noteworthy that the Vision 2025 explicitly includes ICT by noting “The new opportunities that ICT is opening up can be harnessed to meet goals of the Vision” [1]. The emphasis is on; (i) Educational Access to ICT, (ii) Enhancing Education using ICT and (iii) Developing the ICT workforce [2]. One of the policy objectives is to promote the use of ICT in developing and

sustaining local multi-media content for schools. Preliminary survey conducted in 2004/5 in different secondary schools in Tanzania has shown that most of these schools face similar problems, which are lack of text books and/or reference books and teaching aids. Most of the schools have semi furnished or no libraries at all and where there are libraries they are poorly stocked. The problem is compounded by the lack of qualified teachers. Data from the National Examination Council of Tanzania (NECTA) for the period 1994 – 2005 shows that performance in most of the subjects is poor, but that of mathematics and physics were comparatively poorer. There is a big performance disparity between schools in the rural areas and those in urban areas. Gender imbalance was also an issue.

This paper presents the results of the surveys conducted and proposes how best the problem can be solved using ICT in order to improve the accessibility of learning materials and improve secondary schools standard of education. The accessibility of learning materials can be improved by the use of ICT. The concept perceived makes use of open source software (OSS) packages to develop the learning content, store the content in a repository and make it available to schools with Internet access or distributed in Compact Discs (CDs) to schools which possess computers. Other options are being explored.

## II. PROBLEMS FACED BY TANZANIAN SECONDARY SCHOOLS

### A. Tanzanian Educational System

The educational system in Tanzania is based on the 7-4-2-3 system: 7 years of primary school education, followed by 4 years of secondary school education known as Ordinary Level (O-level), where students are required to sit for National Examinations and get Certificate of Secondary Education Examination (CSEE). Then followed by 2 more years of Advanced Level (A-level) secondary school education where students are required to sit for National Examinations and get Advanced Certificate of Secondary Education Examination (ACSEE). The CSEE and ACSEE are both administered by NECTA. After the secondary school A-Level, one can join university for a three years degree programme but some degree specializations require more time.

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**B. Data Collection Methodology**

To get a clear picture of the common problems faced by secondary schools in Tanzania, in 2006/7, we conducted another survey in the secondary schools. The survey was conducted in four regions; Arusha, Mbeya, Ruvuma and Dodoma. At least 6 schools were reached in each region and about five types of questionnaires were used in the data collection phase. The questionnaires were for Students, Teachers, Head Teacher, Librarian, and for the Ministry of Education and Vocational Training (MoEVT) as the education authority in Tanzania. The content of the questionnaires mainly focused on getting information about teaching and learning activities, status of books and reference materials, teaching methodologies, ICT awareness, students' performance, teachers' qualifications and their deployment status. In some cases, we conducted interviews with students and teachers using open ended questions. The questionnaire for the Ministry officials focused much more on obtaining information about the National ICT policy, Ministry ICT policy and integration of ICT in schools.

The visited schools were both O- and A- Levels, located in different environment. Some were easily accessible depending on roads conditions while others were not. Half of the visited schools are privately owned and half are Government schools. The Government schools are owned by the Government, and the private ownership includes religious institutions different non-governmental organizations and wealthy individuals.

In general, private schools seem to be in a better position on the issues of ICT awareness, facilities, learning and reference materials as compared to Government schools. This is mostly due to inadequate funds allocations to Government schools to cater for facilities and learning materials.

**C. Data Analysis**

The data in Fig. 1, presented in tabular and graphical formats clearly indicates the real situation in most of the rural secondary schools;

**1) Shortage of Learning and Reference Resources**

The average percentages of secondary schools with shortage of books vary from 70% in Arusha region to approximately 100% in Dodoma region. Textbook to student ratio is about 1:28 in the rural secondary schools and 1:10 in the urban secondary schools [3]. School libraries are ill furnished or there are no libraries at all. Many schools depend on availability of books in Regional Libraries.

**2) Inadequacy of Qualified Teachers Especially in Mathematics and Science Subjects**

Average Percentage of secondary schools with shortage of science and mathematics teachers in rural secondary schools lies between 60% in Mbeya region to 80% in Dodoma region. Low population, poor economic and social conditions in rural areas and unfavourable teaching environments are among the main factors which force qualified teachers to concentrate in urban schools or even run for alternative highly paying jobs. The pupil to teacher ratio stand at 22:1 but this ratio hides rural – urban disparities and shortages in subjects such as science and mathematics [4].

Failure in mathematics for the period 1994 – 2002 was 73%, which is attributed to among other things; shortage of text books and reference materials [5]. Table I shows the average failure rate for selected subjects for the years 1994 – 2005. It can be observed that most of the subjects have average failure rates of more than 40% and the worst condition is seen in mathematics.

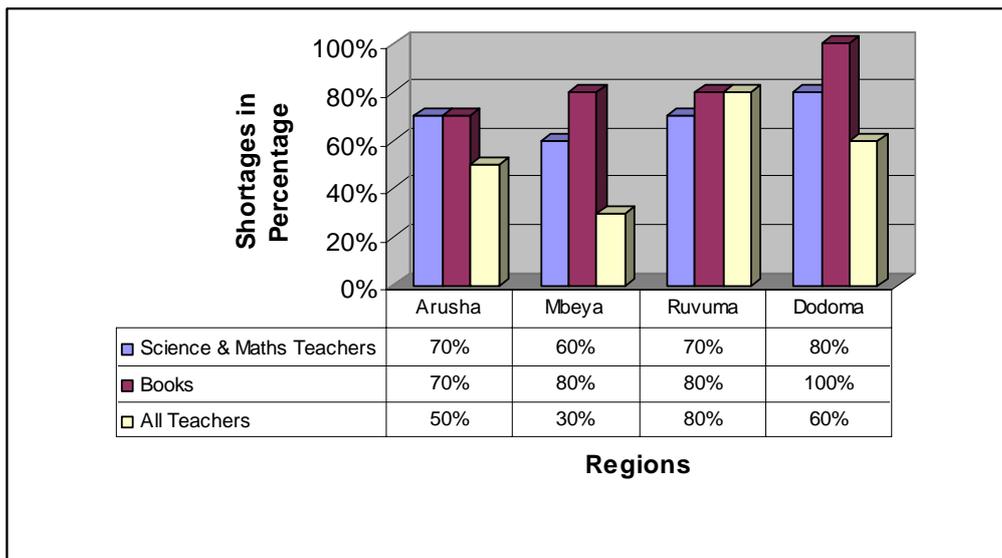


Fig. 1 Results of the ICT Survey Conducted in secondary schools within four regions in Tanzania

TABLE I  
1994 – 2005 SUBJECTS PERFORMANCE AT CSEE LEVEL

Sn	Subject	%Average Failure Rate
1	Mathematics	70%
2	Physics	46%
3	Chemistry	42%
4	History	51%
5	Geography	54%
6	Civics	44%
7	Commerce	62%

Source: NECTA Examination Results Statistics, 1994 - 2005

The failure factors given above clearly indicate a situation where radically changes have to be developed. While waiting for fundamental transformations and increased capacity in the whole education system, more immediate solutions have to be looked for. One of them is as presented in this paper, introduction of open source e-learning environments and resources.

### III. STRATEGIES FOR ESTABLISHING AN OPEN-SOURCE E-LEARNING ENVIRONMENT

A review of e-learning activities in Tanzania was made. It was found that currently there are very few e-learning initiatives in Tanzania and the focus is on the higher learning institutions. At the University of Dar es Salaam, there are two e-learning developments; the African Virtual University (AVU) which uses the WebCT e-learning platform and Technology Independent Learning (TEIL) based on Black Board e-learning platform. In the case of secondary schools e-learning, there is only one website with url <http://www.distancelearning-tz.org> which provides notes for secondary schools in different subjects, it is maintained by a non-governmental organization, International Institute for Communication and Development (IICD).

The Swedish International Development Cooperation Agency (Sida) and its Department for Research Cooperation (SAREC) - Sida/SAREC in supporting rural development in Sub-Saharan Africa has initiated and is funding an e-learning ICT research, conducted at the University of Dar es Salaam in collaboration with the Blekinge Institute of Technology in Sweden. The research has three main components; the development of the learning management system, the network connectivity and configuration and the development of e-learning contents. The MoEVT is also supported and assisted by Sida to work on two country-wide interventions; all teacher training colleges in Tanzania will be equipped with computers and Internet Connectivity and the e-schools programme, a programme aiming at equipping a number of secondary schools with ICT facilities [6].

This research work is concerned with the development of e-learning contents starting with the subjects of worst performance i.e. mathematics and science subjects. The content will be developed using open source software package which is free, comes with source codes which can be modified

to suit our context and have a great technological support from the people all over the world for its sustainability.

The e-learning content will be developed with a participatory approach and based on instructional system design, learning theories and pedagogical principles. Since if technology is applied together with pedagogical concepts it can create an effective student-centered environment and enhance learning outcomes [7], [8]. A participatory practice is incorporated in the development process.

The raw materials (notes) collected from the respective teachers are chunked down to form learning objects. Learning objects are elements of a new type of computer-based instruction grounded in the object-oriented paradigm of computer science [9]. Learning objects allow instructional designers to build small (relatively size of an entire course) instructional components that can be used a number of times in different learning contexts with the aim to increase the flexibility of training, and make updating courses much easier to manage [10].

The chunked material is stored in a content repository to be designed using MySQL open source database management system. The content is packaged based on Sharable Content Object Reference Module (SCORM) and Instructional Management System (IMS) standards to facilitate transfer and interoperability across systems. A content repository will allow users to find, retrieve publish or submit learning objects via a network, thereby allowing a sharing of objects across a wide variety of subjects and authors.

A self learning environment is going to be established in order to help students get control of the subjects even in the absence of a teacher or during self study. An instructionally user interface will be designed to provide this facility. The user interface is designed using open source software languages, mark-up languages; eXtensible Hypertext Markup Language (XHTML) and eXtensible Markup Language (XML), Scripting Languages; Predefined Hypertext Protocol (PHP) and Java Script, Cascaded Style Sheet (CSS) and eXtended Style Sheet Language Transformation (XSLT).

### IV. PROPOSED SYSTEM ARCHITECTURE AND COURSEWARE TREE

#### A. Proposed System Architecture

Fig. 2 shows proposed system architecture, it will be of three tier architecture, composed of three main components; web client, web server and the e-content repository.

The web client allows users to create, edit and access learning contents. The Web Server which stores scripting codes will provide scripting interface to allow communication between the web and the database. The repository stores the learning content.

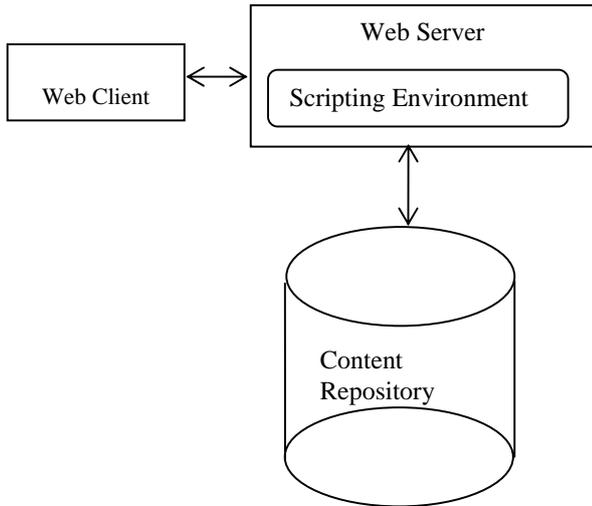


Fig. 2 Proposed System Architecture

**B. Courseware Tree**

The courseware tree is as shown in Fig. 3. It will be of modularized in nature designed based on the top-down approach. It will be composed of four levels which are; Course, Chapter, Topic, and Learning Object levels. The number of levels will depend on how the learning environment is planned. The learning objects will be accessible and reusable and could be linked to more than one to form a complete course.

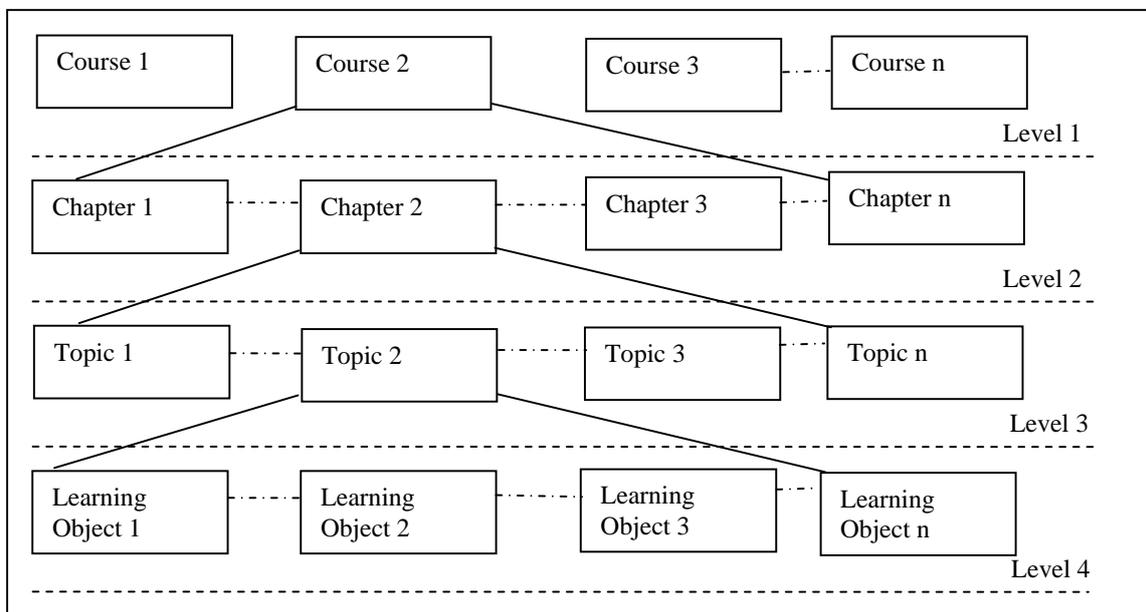


Fig. 3 Courseware Tree

**V. E-LEARNING CONTENT DELIVERY APPROACHES**

Various approaches can be used to make learning materials available over the web. The simplest approach is to generate web pages containing the resources and make the web pages available through a web for the course. The other approach is to use a full-fledged course management system such as Learning Content Management System (LCMS). The research is going to use any readily available LMS initially while developing one and/or off-line using Compact Discs (CDs).

**VI. CONCLUSION**

The paper has narrated clearly the problems faced by many secondary schools in Tanzania and have proved the existence of the problems through the conducted surveys. Although we are now in the 2007, still many schools in the urban areas do not have libraries at all and if there is one then the resources are very scarce and outdated hence depend on regional libraries; the case is much worse in rural areas schools as this option is not there. The use of ICT tools and especially e-Learning will be a viable solution to encounter the situation of the scarce resources. The choice of the open source software is the best, due to its many advantages over the proprietary packages; license free, can be customized to suit our context, has support for its sustainability etc. If up to now we cannot afford to buy text books, how can we afford the closed source licenses? The benefit of a modularized courseware approach is on the students' choices of learning by maximizing the benefits obtained in the combination of the face to face

classroom teaching and the e-learning teaching, since e-learning is going to provide support and flexible learning environment. This will also address the rural-urban education achievement and raise the livelihood of the rural community.

#### REFERENCES

- [1] The Tanzania Development Vision 2025, available at <http://www.tanzania.go.tz/vision.htm>, retrieved on 12 November, 2006.
- [2] The United Republic of Tanzania, Ministry of Communications and Transport, National Information and Communications Technologies Policy, 2003.
- [3] Sekwao, N.V. (2004), "National Report on the Development of Education 2001 – 2004", *The International Conference on Education*, 8-11 Sept, 2004, Geneva, Switzerland.
- [4] World Bank (2004), Programme Document for a Proposed Financing to the United Republic of Tanzania for a Secondary Education Development Program", Washington DC, World Bank, Report No 27613.
- [5] Mazigo, E.M. (2003), "Factors Influencing Poor Performance in Basic Mathematics and remedies": A discussion paper at a meeting between Japan Overseas Cooperation Volunteers and Officials of the Ministry of Education and Culture, 20 June 2003.
- [6] ICT4Africa – Country Report Tanzania (2006), available at <http://www.wikiedicator.org/ICT4Africa/Country-Report-Tanzania.pdf>, retrieved on 3 March, 2007.
- [7] Govindaswamy, T. (2002), "Successful Implementation of e-learning Pedagogical Considerations", *Internet and Higher Education*, Vol 4, pp. 287-299
- [8] Lating, P.O. (2006) "Hybrid E-Learning for Rural Secondary Schools in Uganda", Licentiate Dissertation Series No. 2006:10, ISBN 91-7295-095-1.
- [9] Willey, D. (2000), "Connecting Learning Objects to Insuractional Design Theory: A Definition, a Metaphor, and a Taxonomy, The Instructional Use of Learning Objects" available at <http://reusability.org/read/chapters/wiley.doc>, retrieved on 7<sup>th</sup> April, 2006.
- [10] Muzio, J.A., Heins, T., Mundell, R. (2002), "Experiences with Reusable e-Learning Objects from Theory to Practice". *Internet and Higher Education Journal* Vol. 5, pp 21-34.