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A Technical Framework for Assessing Higher Education E-Learning Readiness

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Abstract- E-learning is one of the fast growing technologies in Higher Education which has seen institutions adopting a platform to enhance their traditional teaching, learning and assessment methods. Most institutions use already established platforms like Blackboard and Moodle, where they pay a fee for using the facility. However institutions are limited by the Service level agreements with the service providers such that they may not use other environments effectively. The study is motivated by the challenges that institutions face after investing in this e-learning infrastructure. Institutions tend to under-utilise the implemented platform yet the implementation costs are high. A thorough analysis on the technical readiness of the institution is therefore required so as to inform the decision on whether to invest or not. A survey was conducted to identify the hardware, software and networking resource requirements for an e-learning platform. Questionnaires and interviews were used as data collection instruments. The study defines a framework that may be used to assess the technical readiness of a university to implement an e-learning platform. The framework also uses the e-LRS model to inform the readiness levels. The defined framework will be useful in ensuring that universities benefit from the huge investments in e-learning infrastructure.

Keywords: e-learning, readiness, framework.

I. INTRODUCTION

An e-learning platform is the software that provides the technical infrastructure on which e-learning activities can take place, (Piotrowski, 2010). E-learning platforms are enabled or supported by the use of electronic technologies and involves online interaction between the learner and teacher or peers. The platforms support activities such as access to learning content, assessments, communication, collaboration tools for students, course management and assessment facilities for instructors. Al-Amer and Al Soufi (2011) described e-learning as learning that is enabled by the use of digital tools and content, usually accessed via the internet. Given the challenging economic environment, it is important for institutions to evaluate their e-learning readiness first before embarking on the high investment costs (Schreurs et al, 2008). Many institutions of higher learning have adopted the use of e-learning in an effort to reach out to a larger student base which may otherwise be limited by geographical location. The e-learning platforms have made it possible for learners to enrol in programs without the need to physically attend classes in the far away campuses.

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For example, students are able to take up a degree with the Amity University (India) from anywhere in the world, without having to travel there. The introduction of e-learning has seen many students even those who are disabled to access education. For example people with disabilities, who would not benefit much from the face to face mode of instruction, are catered for by these e-learning platforms, (Piotrowski, 2010).E-learning allows students with different backgrounds and learning styles to learn at their own pace. A high fee is paid to access these services and if there are other features that the institution is not using, the institution may lose out. An informed study is therefore important so as to benefit from the huge investment.

So as much as universities in Africa may want to be in line with international trends/ universities, they cannot afford to make uninformed decisions which would squander the little resources available. Researchers have defined techniques and ways of evaluating e-learning readiness from a hardware, software and network requirements perspective. Given that many authors have suggested various assessment tools, this study seeks to define a framework that may be used by universities to standardise the evaluation process for universities, based on their technology. The rest of the study is organized as follows; section 2 reviews the literature in order to identify the requirements of implementing a successful platform, section 3 provides the methodology that is, describing how the study was conducted, section 4 looks at data analysis and interpretation, section 5 looks at results discussion while section 7 and 8 provides some conclusion and recommendations on how universities may use the proposed framework to evaluate their e-learning readiness respectively.

II. LITERATURE REVIEW

A. E-Learning Platforms

E-learning is a learning platform that is enabled or supported by the use of electronic technologies and involves online interaction between the learner and teacher or peers. The e-learning platforms normally includes access to curriculum learning content, tests, communication, collaboration tools for students, and course management and assessment facilities for instructors (Piotrowski, 2010). Higher learning institutions are using e-learning platforms to enhance their teaching and learning process. The platforms are used right from the admission point to manage admissions and enrolments, by instructors for course management and more oftenly by students to access their learning materials and assessments.

E-learning places today's university at an advantage by allowing easy interaction between students and their instructors. Most universities in the world are using the tool to improve the student-teacher interaction in the learning and teaching process. Robust technical infrastructure is required to support the implementation of e-learning and involves huge amounts of investments, in terms of resources, infrastructure and time. An inappropriate system would impact negatively on the institution hence the need to assess readiness prior to the implementation decision (Graham, 2006). Institutions need to analyse their technological infrastructure among other factors in order to establish whether adopting an e-learning system would be beneficial and cost effective. The e-learning systems usually involve big investments in terms of resources, infrastructure and time. There are platforms which may be rented by institutions to access e-learning services. Examples include Moodle, Blackboard, Desire2Learn and Sakai.

B. Requirements for Setting and E-Learning Platform

The successful implementation of an e-learning platform must be coupled by acquisition of adequate technological infrastructure and adequate educational content for those using and administering the platform. Apart from the technical perspectives there are other attributes that characterize an e-learning environment, such as policy, financial, human resources and pedagogy (Govindasamy, 2002; Psycharis, 2005).Building the e-learning system may consider technological, pedagogical and managerial issues, (Madar and Willis, 2014).Borotis and Poulymenakou (2004)suggested the categories/dimensions to be considered when setting up an e-learning platform as policies on the operations of the platform, the technology, financial and human resource requirements as well as the infrastructure are important in successfully implementing a platform.

An e-learning system is best implemented after ensuring that the needed components have been identified and established with their maintenance carefully planned. Institutions should avoid a system that does not meet users' needs and end up not being used, so they must consider the strategic issues before either outsourcing a tool like Blackboard which may not allow proper customization or developing a tool that is not useful. The study will focus on the technological, with other dimensions left for further work.

C. Technical Requirements

There is no standard model of implementing e-learning (Madar and Willis, 2014) .Different authors have their own perspective and idea of how the e-learning platform may be implemented. Generally no special hardware or networking hardware requirements are required for e-learning today; theoretically a computer with a web browser and internet access is necessary. Other e-learning applications use client side scripting while others provide a single consistent user interaction for all aspects of a course.

Factors such as hardware, software and network may be considered as the key technological indicators of an organisation's e-learning readiness (Aydin and Tasci, 2005). Schreurs, et.al (2008) mentioned that the infrastructure, internet connectivity, flexible LMS, student's portal and a system to track and connect learners' activity are technological features essential for the implementation of an e-learning platform. Internet Students Teaching Centre (ISTC) is an e-learning system whose implementation is based on internet technologies; a relational database connected to an internet browser and manages course materials in Microsoft Office formats (Howard Community College, 2012; Guminska and Madejski (2007). In other words, to implement an e-learning platform, the Internet, a database, a web browser and Microsoft Office are the basic requirements that an institution must meet. Institutions of higher learning have adopted the standards like SOAP, java and PHP to implement an effective e-learning environment. Table 1 shows the adopted standards that are used by different frameworks. They rely on open standards for information exchange and component integration (Leal and Queirós, n.d.). E-learning frameworks use adapted standards and they have common standards that are found in all the frameworks.

Table 1 some adopted Standards (Leal and Queirós, n.d.)

	LTSA	OKI	IAF	OUSS	SIF	e-F
Content Format	-	-	IMS CP SCORM	-	SCORM	IMS CP SCORM
Metadata	LOM	LOM	LOM	LOM	LOM	DC LOM
Service Description	WSDL	WSDL	WSDL	WSDL	WSDL	WSDL
Web Service	SOAP	SOAP	SOAP REST	SOAP	SOAP REST	SOAP REST
Language Bindings	-	JAVA, PHP, MS. NET, C#	JAVA	JAVA	JAVA	JAVA

D. How to measure the readiness levels

E-learning readiness is how ready the institution is on several aspects to implement e-learning. E-learning readiness is the mental or physical preparedness of an institution for an e-learning experience (Ouma et al, n.d). An institution must have the physical infrastructure for it to successfully implement an e-learning platform. Readiness assessment is done to help institutions to design and implement effective platforms. Schreurs et al (2008) emphasized the importance of establishing readiness first before rushing to implement a platform given the prevailing challenging economic competition. Okinda (2013) suggested the readiness assessment from various dimensions such as users, technology, institution's culture and the environment with many models that may be adopted. Examples of such models include Engholm's, Bakry's STOPE, BekimFetaji and Haney's models .The popularly used model is Engholm's model which captures respondent's perceptions along five dimensions on a five point Likert scale and the aggregating the individual readiness levels. Aydin and Tasci (2005) suggested that e-learning readiness can be measured on a scale of 1-5 and each component level of readiness assessed on a five point liker-type scale. The mean and standard deviation for all components is calculated and rated on the e-Learning Readiness Survey (e-LRS). Table 2 shows the scale and interpretations of the calculated means.

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Table 2 The Scale and Indication of mean (Aydin and Tasci, 2005)

Means	Scale
0-2.6	Not ready, needs lot of work
2.6-3.4	Not ready, needs some work
3.4-4.2	Ready but needs a few improvements
4.2-5	Ready to go ahead

According to Aydin and Tasci (2005), the readiness level would be benchmarked as not ready with a lot of work to be done for scores between 0 and 2.6, scores ranging from 2.6 to 3.4 means that the institution is not ready and some work still need to be done, 3.4 is the expected level of readiness which translate to ready but needs improvements and 4.2 to 5 indicates that the institution is ready to go.

Research shows that there are a number of models and frameworks that may be adopted to assess an institution's readiness level. No one model is appropriate but for an informed decision, a researcher may adopt several models and compare the outcomes.

III. METHODOLOGY

A literature survey was conducted to identify the technical requirements and how their availability may be measured. The main sources for this information were books, journal publications, research papers and research conference proceedings. Document analysis was done to gather requirements for various platforms as specified by the developers. The targeted platforms were the commonly used ones, some of which are open source like Sakai. Interviews were conducted and questionnaires administered to a sample consisting of 9 support analysts selected from the ICT departments of 3 universities, one in Botswana and 2 in Zimbabwe. Purposive sampling was used to select the respondents who are actively involved and responsible for maintaining and supporting the e-learning platforms at their universities. A questionnaire designed to establish whether the proposed checklist of requirements was complete, was distributed to the technical department representatives. The interviews and questionnaire were focused on establishing the components of the infrastructure on which their platforms are hosted.

IV. DATA PRESENTATION AND RESULTS DISCUSSION

The reporting of results and discussion is organised into three sections. The first section shows the mean scores for the most basic technical components of an e-learning system. Although the e-learning systems in use were different, the basic hardware, software and networking resources used were almost similar, with differences on their finer specifications and configurations Variationsmay occur depending on the nature and operating environment for each institution. The second section describes how the e-LRS Assessment Model (Aydin and Tasci, 2005) was combined with the framework in assessing the readiness level of each technical component. The third section outlines the framework that institutions may use to assess e-learning readiness.

A. Mean Scores

The information gathered from the survey was used as a basis to design a questionnaire which was distributed to the support analysts selected from the universities' ICT departments so that they could identify which components were more relevant in the universities environment. The requirements in the questionnaire were a summary of the technical aspects identified in the literature survey to be evaluated on a likert scale. The technical components were grouped into hardware, software, network and other for purposes of representing the results. Each group comprised of several related components. Table 3 shows a summary of the calculated mean and standard deviation for the components for each institution.

Table 3 Mean and standard deviation for each category by university

	Hardware	Software	Network	Other	Mean	Standard Deviation
University 1	3.33	3.92	3.59	2.78	3.41	0.12
University 2	3.27	3.67	4.08	3.06	3.52	0
University 3	3.43	3.67	3	3.89	3.49	0.05

The table shows the mean scores for each category of requirements as evaluated by each university. The mean scores were calculated by averaging the scores of each component on the Likert scale responses and then using them to calculate the mean score for the category. The hardware and software requirements scores were almost of the same value, ranging between 3.33 and 3.43, across the three universities with very minor deviations for the network and other requirements. A mean score for network requirements was calculated as 3.59, 4.08 and 3 for the respective institutions. The mean column shows the evaluation of all the component'availability for a specific university.

Figure 1 below shows the mean measure of relevance of each category of attributes as calculated for each university.

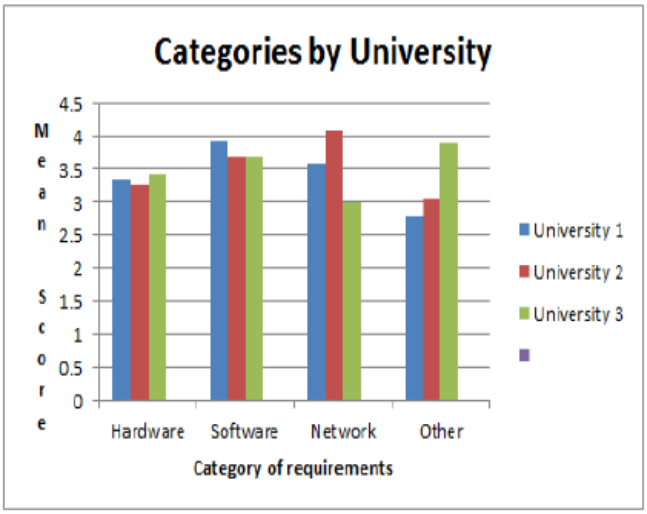

Figure 1 means score per category per university

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The calculated mean scores show that the basic hardware and software requirements for setting up an e-learning platform are generally similar for most institutions. The standard deviation values calculated reflects the deviation of the category means from the overall mean scores for the university.The deviations range from 0 to 0.12, which means that the individual university scores were almost similar on the identified components. The slight deviation which given the sample, may be attributed to the differences in location of the institutions. Two universities had an almost similar mean score and are located in the same country.

B. Using the e-LRS Assessment Model

To measure the extent of relevance for each attribute, the e-LRS model by Aydin and Tasci (2005) was used. The model requires that a mean and standard deviation for each attribute be calculated, and then placed on the e-LRS scale to determine the extent of its relevance. Attributes scoring a mean value between 0 and 2.6 were deemed not to be of importance, 2.7 to 3.4 may be required depending on the environment, 3.5 to 4.2 considered as required and those scoring 4.3 – 5 were considered to be a pre-requisite. Table 4 below summarises the model. Those attributes with scores between 3.4 and 5 were captured into the framework as the basic technical requirements. A mean score for each technical component was computed and analysed against the e-LRS Assessment Model designed by Aydin and Tasci (2005).

Table 4 The Scale and Indication of Means (Aydin and Tasci, 2005)

Means	Scale
0-2.6	Not ready, needs lot of work
2.6-3.4	Not ready, needs some work
3.4-4.2	Ready but needs a few improvements
4.2-5	Ready to go ahead

With reference to the table of mean scores calculated for each university Table 4, the e-LRS scale shows that for hardware and other dimensions, the universities are not ready and needs some work. Given the technological advancements, the institutions are still using the desktops in their laboratories with some still running on Windows XP. The economic constraints in the region may also explain this result.The overall mean scores for the universities (3.41, 3.52,3.49) show that all the universities are ready but needs a few improvements when mapped on the e-LRS Assessment Model.

The evaluation committees must consider this framework in an effort to make informed decisions on whether to invest in e-learning or not. It is important however to note that , it is not only the technological perspective that requires evaluation, other dimensions as discussed in our literature review need to be considered as well. An evaluation of all dimensions will better the chances of making an appropriate decision.

C. Suggested Framework

Availability or sufficiency of the technical component may be rated on a scale of 1 to 5 interpreted as follows;

: Means not available
: Very little of the resource available
: Adequate
: can sustain current number of users
: More than enough for current users

A space for comments has been provided for additional clarification on the exact resource available and has been configured.

Table 5: The Framework for assessing e-learning readiness of a University

TECHNICAL COMPONENT	RATING					COMMENTS
	1	2	3	4	5	
Hardware						
Application Server						
Servers						
Recent Computers						
UPS in classrooms, labs and offices						
Communication Infrastructure						
Mobile Devices						
Physical Security infrastructure						
Computer-Student ratio						
Computer-staff ratio						
Software						
Database Management System						
Web & File Services						
Learning Management System						
Web Browser						
Antivirus software						
Students Portal						
Offsite Backup						
Content Development Software						
Multimedia Support						
Network						
Internet availability						
Internet speed, quality						
Campus-wide backbone networks						
Website						
E-mail services						

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Infrastructure to multicast						
Extent of Online interaction						
Other Dimensions						
ICT experience level						
Frequency of upgrades in qualification						
User Training on ICT						
Support for learners using ICT infrastructure						
Students' basic computer skills & internet skills						
Instructors basic computer & internet skills						
Students' literacy on Software applications						
Instructors literacy on software applications						
Availability of Technical support						
Defined security privileges						
Availability of Computer room/lab/classroom						

The components included in Table 5 were identified as the basic technical requirements that universities may consider when assessing its e-learning readiness

V. CONCLUSION

The study focused on the technological dimension which we deemed key for e-learning implementation. Results show that despite the variances in universities' curriculum and location, the hardware, software and network requirements have the same extent of importance in the success of e-learning platforms. The sample institutions have already implemented e-learning systems and are utilised to an extent that policies to force teachers and students to use the platforms have been implemented. Perhaps a thorough analysis of their technical readiness could have influenced the decision of whether to invest or not. It is like they have made huge investments whose benefits are not being realised.

RECOMMENDATIONS AND FUTURE WORK

Our research looked at proposing a framework that might be applied to assess the readiness of institutions that want to implement e-learning infrastructure. We hope this will reduce situations whereby e-learning implementations fail before completion. The availability of the technical infrastructure at a University is not the only requirement for an effective e-learning platform. Successful implementation of e-learning involves adequate educational content for those using and administering the platform. This means that a university must evaluate the content development skills in their staff and provide training wherever necessary as a way of ensuring the effectiveness of the implemented platform. However, like any other system, the maintenance of the platform must be carefully planned to avoid a situation where the platform's usage is discontinued due to inadequate resources to keep it running.

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