Implementation of e-Learning in Ghanaian Tertiary Institutions (A Case Study of KNUST)

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Abstract

This study explores the implementation of e-learning in Ghanaian tertiary institutions with KNUST as a case study. The objectives of the study examined the advantages and disadvantages of e-learning to KNUST, the various types of e-learning systems considered by KNUST, the 'Moodle' E-learning system adopted by KNUST, the strategies involved in the e-learning system, the challenges faced by KNUST in the implementation of its e-learning system along with possible solutions and finally a recommendation on critical issues to be considered for the effective implementation of the e-learning system. A descriptive study with a cross-sectional design was done. For tertiary institutions in Ghana, recommendations were made for them to adopt e-learning to augment and highly impact teaching and learning given the ever-increasing enrolment figures. It was also recommended that they chose an e-learning system which blends open source system and course management system such as Moodle due to cost, features, specifications, support and mode of course management

1. Introduction

E-learning (or online education as it is still commonly termed) has been variously defined, but can be simply described as a learning process in which learners can communicate with their instructors and their peers, and access learning materials, over the internet or other computer networks (Curran, 2004). It therefore provides a means through which the powerful and pervasive computing and communications technologies can be applied to tertiary education – and to some of the key challenges now facing universities. According to a report by Ambient Insight, The global market for e-learning reached US$27.1 billion in 2009 and its demand is growing by a five-year compound annual growth rate of 12.8% with revenues expected to reach $49.6 billion by 2014.

E-Learning has become the protagonist for change in the education sector with the rising numbers in student enrolments and the masses of potential students that are turned away each year for lack of classrooms, accommodation and lecturers. Today lecturers are facing different challenges than their predecessors in teaching tomorrow's professional. In the past few decades, advances in academia have increased demands on academic faculty, resulting in less time for teaching than has previously been the case. Traditional instructor centred teaching is yielding to a learner centred model that puts learners in control of their own learning. A recent shift toward competency-based curricula emphasizes the learning outcome, not the process, of education. E-learning refers to the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance (Mushin, 2008). E-learning can be used by lecturers to improve the efficiency and effectiveness of

educational interventions in the face of the social, scientific, and pedagogical challenges. It has gained popularity in the past decade; however, its use is highly variable among universities.

E-Learning has the potential to transform Ghanaian universities. E-learning is increasingly gaining universal acceptance as a viable means of enabling large numbers of students to access education. Kwame Nkrumah University of Science and Technology (KNUST) in Ghana realising the enormous potential of e-learning as against the university's ever increasing student population has chosen to adopt e-learning as platform to transform KNUST into a modern citadel of academic knowledge in all spheres of science, humanities, business and more.

While technology has enabled online education in many countries, the same cannot be said for African Universities. Universities in Ghana have made some progress in building network infrastructure and acquiring computers, but integrating technology into the teaching and learning process has been a challenge (Awidi, 2008).

1.1. Background

Kwame Nkrumah University of Science and Technology, a public university in Ghana has over the past two years been going through several phases in the implementation of the university's e-learning system. The university started off by looking at the advantages and disadvantages of e-learning, the various types of e-learning systems. Among the e-learning systems considered were commercial, open source, course management and learning management systems. In the second semester of the 2005-2006 academic year the web team of the University Information Technology Services choose an open-source and course management e-learning system called 'Moodle' to use as the university's e-learning system. The web team however, modified the Moodle e-learning system to suit the needs of the university.

In the first semester of the 2006/2007 academic year, the Moodle e-learning system was piloted for two courses using two classes in the university. The system was then fine-tuned from the inputs given by the lecturers and students involved. The system was expected to be used on a large scale from the second semester of the 2006-2007. However, due to human resource and other challenges the whole process of large scale implementation was suspended. The web team however, after the adoption of the ICT policy of the university has re-strategise to deploy the e-learning system again in the first semester of the 2008/2009 academic year at the College of Engineering and the College of Science.

This study seeks to examine the advantages and disadvantages of e-learning to KNUST, the various types of e-learning systems considered by KNUST, the Moodle e-learning system adopted by the university, the e-learning implementation strategy of the university and the challenges encountered in the implementation process and their possible solutions. The study will also recommend critical issues to be considered for the effective implementation of the e-learning system. The aim of the study is to create awareness about the e-learning system of KNUST and bring to bear the pros and cons of e-learning for KNUST. It is also necessary to make the management of the university aware of the details of the type of e-learning system they have chosen and the challenges and solutions to the implementation strategy of the university's e-learning system. It is also to serve as guideline for other universities to follow in the implementation of their e-learning systems so as to avoid the pitfalls of the e-learning implementation strategy of KNUST.

1.1. Problem Statement

Despite the enormous benefits of e-learning systems, KNUST has problems and challenges with the implementation of its e-learning system after having piloted the system for a semester. Among the problems are inadequate ICT staffs to support and implement its e-learning systems, low motivation for lecturers to blend e-learning into their face to face lectures, inadequate bandwidth to support the e-learning system, poor financing for acquisition of ICT infrastructure and poor educational awareness of the e-learning system. Coupled with increasing student population and high student lecturer ratios, it is imperative that KNUST gets its e-learning implementation process going on and overcome the challenges involved in the process.

1.1. Objectives:

1. To examine the advantages and disadvantages of e-learning to KNUST.
1. To examine the various types of e-learning management systems considered by KNUST.
1. To examine the 'Moodle' E-learning system adopted by KNUST.
1. To examine the strategies involved in implementing KNUST's e-learning system.
1. To examine the challenges faced by KNUST in the implementation of its e-learning system and possible solutions.
1. To recommend critical issues to be considered for the effective implementation of the KNUST e-learning system.

1. Methodology

This was a descriptive study with a cross-sectional design. The study employed qualitative and quantitative variables. Specifically the study area covered KNUST's e-learning system and the implementation process of the e-learning system. Students and lecturers of KNUST who have used the e-learning system were interviewed. In addition, the ICT staff and personnel of KNUST who have been involved in the implementation process of the system were also interviewed

Students of the mechanical engineering department of KNUST who used the e-learning system in the first semester of the 2005-2006 academic years formed the sample units for the student interviewees. Lecturers who have experienced the e-learning system formed a part of the sample units. In addition, the university's administrators and information communication technology (ICT) personnel of the university who have been involved in the development and implementation of the e-learning system also formed part of the sample unit.

The sample size was made up of 50 students from each of the classes that used the e-learning system in its pilot testing stage, 5 lecturers, 15 ICT personnel and 5 university administrators. Questionnaires were used to collect the data from the sample. For sections of the questionnaire where an ICT expert advice was required, the sample size was narrowed to the 15 ICT personnel.

A semi-structured form of interview was used to interview the respondents. Students, lecturers, the ICT personnel and administrators were briefed about the purpose of the study and were assured of the confidentiality of responses. They were also informed to choose to answer and to stop at their own convenience. Responses were checked on the questionnaire as seem appropriate.

The study made use of Primary and Secondary data. The interview technique and records review were employed. Students, lecturers, ICT personnel and administrators were interviewed using semi-structured interviews; self administered questionnaires were given out to them to be answered. A checklist was used to collate information from the sample.

The pre testing of the interview guide questionnaire and checklist were done at the University of Ghana, Legon where a similar e-learning system called KEWL has been introduced. This was done to identify and detect ambiguous questions and level of interviewee's understanding with respect to the nature of the questions asked. Sentences, which were not clear and gave different, intended meaning and understanding by respondents, were modified accordingly. The checklist was also tested for suitability and precision as per the objectives of this study. This was to check for accuracy and completeness of data and to ensure quality. To do this questionnaire and interview guide were numbered serially. On daily basis, completed guides were checked thoroughly.

The analysis of data was done at the end of the data collection. The responses were grouped and categorized on the basis of information provided. The analysis was done using Microsoft Excel. The purpose of the research was explained to officials and those who were willing to respond to questions of the study.

1. Results

125 questionnaires in total were issued out to interviewees. The interviewees comprised of 100 students, 5 lecturers, 15 ICT personnel and 5 university administrators. The questionnaires were designed such that each section met one of the objectives of the dissertation. Out of the 125 questionnaires issued, 121 were received back representing a response rate of 97%.

1.1. Demography of Respondents

Out of the 121 respondents 96(79.34%) of respondents were students, 5 (4.13%) were lecturers, 15 (12.40%) were ICT personnel and 5 (4.13%) of respondents were university administrators (Fig 1)

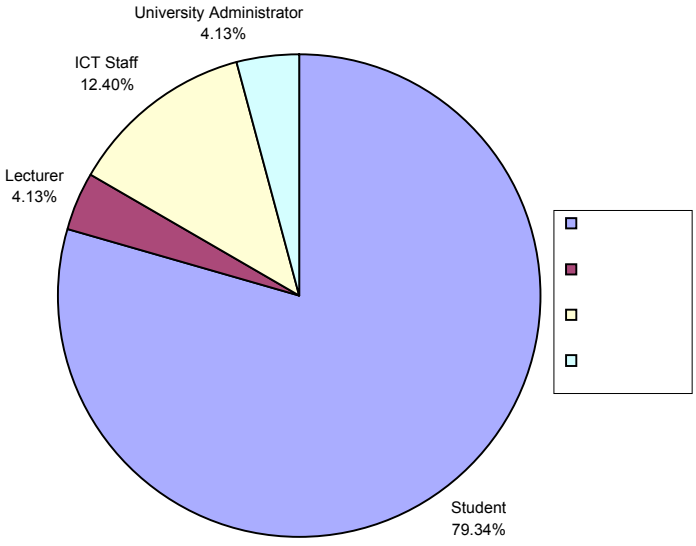

Fig. 1 Demographic Characteristics of Respondents

1.2. Advantages and Disadvantages of E-learning for KNUST

To ascertain whether it was advantageous for KNUST to have an e-learning system, the question was asked if the KNUST e-learning system will enhance teaching and learning at KNUST. To this question, 119 (98.35%) of the respondents said yes whiles 2 (1.65%) said no. Furthermore, views on some of the advantages of e-learning for KNUST from respondents who answered yes to the question were collated and for respondents who answered no to the question their views were gathered on some of the disadvantages of e-learning for KNUST.

The advantages included the following;

- Courses will be accessible on your schedule
- Online learning will not require physical attendance of student or lecturer
- Learning is self-paced
- Courses will be available 24 hours daily.
- Geographical barriers will be removed
- Materials can be read online or downloaded to be read later
- Online course materials can be reused or modified for a new class
- It will promote collaborative learning among students through technology tools
- It will promote greater student and lecturer contact
- The global learning community will be made available to learners through e-learning online.
- For open source e-learning systems KNUST will have low cost and support will be highly available
- It promotes the computer and internet skills of learners and lecturers
- Draws upon hundreds of years of established pedagogical principles
- E-learning will improve learners retention of knowledge by drawing learners to their topics of interest

The disadvantages included the following;

- Little internet Bandwidth will make e-learning at KNUST very difficult to transform teaching and learning
- Inadequate computers and other ICT infrastructure will make e-learning very difficult to transform teaching and learning at KNUST

1.3. Types of E-Learning Considered by KNUST

For the question of whether respondents have heard about the KNUST e-learning system 119 (98.35%) of the respondents said yes whereas 2 (1.65%) said no. In addition, to the question of what types of e-learning system respondents know about 83 (68.60%) 77 (63.64%), 105(86.78%) and 103(85.12%) of respondents said Course Management System, Learning Management System, Open Source System and Commercial System respectively (Fig 2).

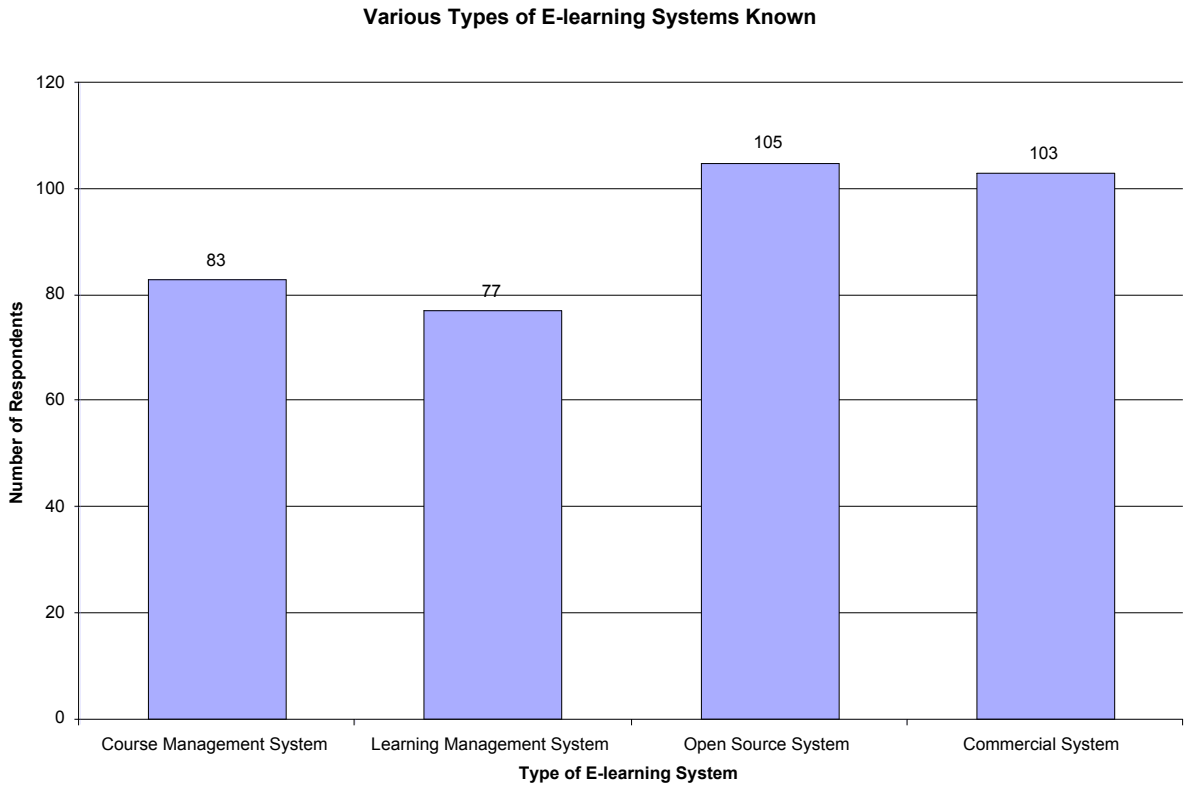

Fig. 2: Types of e-learning systems known by respondents

1.4. Choice of e-learning system recommended for KNUST

Respondents were also asked to choose one e-learning system on the basis of management for KNUST. The results to this question showed that 71(58.68%) chose Course Management System and 33(27.27%) chose Learning Management System. To add to it, respondents were also asked choose one e-learning system on the basis of cost, development continuity and support. To this question, 92 (76.03%) of respondents choose Open Source System whiles 27 (22.31%) choose Commercial System.

With regard to which of the e-learning software to be considered by KNUST has been heard of by Respondents. 22 (18.18%), 25 (20.66%), 17 (14.05%) and 23 (19.01%) of respondents chose Moodle, Blackboard, KEWL and WebCT respectively. Furthermore, respondents were asked which of the considered e-learning software by KNUST they will recommend for KNUST, 21(95.45%) of the 22 respondents who knew about the Moodle E-learning system recommended it for KNUST, 13(52.00%) of the 25 respondents who knew about the Blackboard E-learning system recommended it for KNUST, 5(29.41%) of the 17 respondents who knew about the KEWL E-learning system recommended it for KNUST and 11 (47.83%) of the 23 respondents who knew about the WebCT E-learning system recommended it for KNUST (Fig 3).

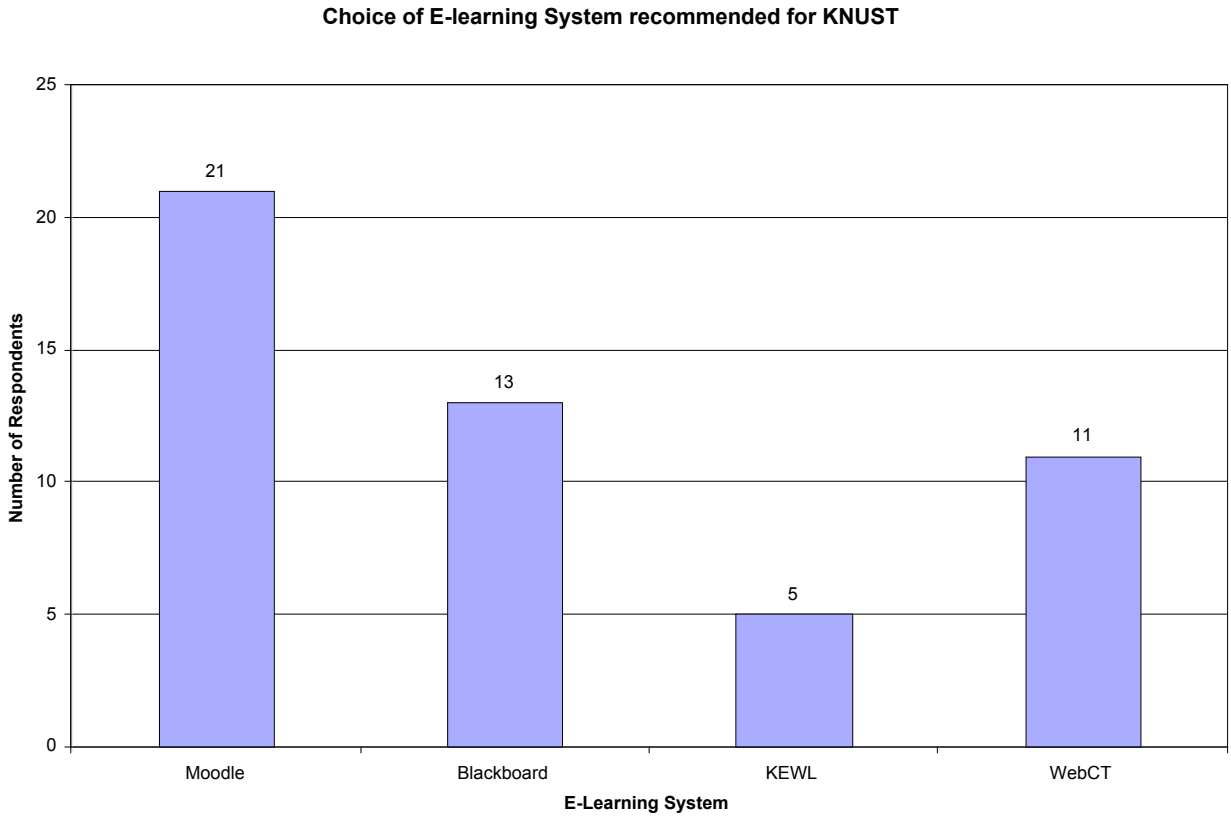

Fig 3: Choice of e-learning system recommended for KNUST

1.5. Examination of KNUST's Moodle E-learning System

The results for this section had a sample size being the 15 ICT staff only. Fourteen 14 (93.33%) of the ICT staff respondents knew that the KNUST E-learning system was a Moodle E-learning System while 1 (16.67%) did not know. Also all the 15 (100%) ICT staff said the Moodle E-learning system was a good e-learning system for KNUST on the basis of its features, specifications and cost. Reasons for this assertion includes

- Moodle is widely around the world by most universities
- It is easily customizable.
- It easily plugs into third party applications
- It supports several databases including MySQL, PostgrelSQL, Microsoft SQL, Oracle and others
- It has different enrolment and authentication methods.
- It supports different operating systems including Windows and Linux
- It is free to download and use, making less costly to deploy.
- It has a large user and developer community and support.

In addition, ICT staff was also asked to ascertain whether the current extent to which Moodle has been developed to suit KNUST was a success. To this question all the 15 (100%) ICT staff said yes.

1.6. E-learning Strategy for implementing Moodle at KNUST

This sections sample size comprised of all 121 respondents. Seventy three (60.33%) of respondents are of the view that KNUST had the necessary ICT hardware infrastructure to implement an E-learning System whiles 48(39.67%) of respondents did not agree to this. For respondents who did not agree to this, views were sought as what kind of ICT hardware infrastructure was necessary to implement KNUST's E-learning system. The views included the following;

- Each college should have at least 300 computers to support the e-learning
- Enough high end servers should be provided to support the e-learning system
- There should be quick provision of network cables when they get spoilt to ensure constant delivery of e-learning to all sections of the university.
- Replacement of computer parts should be done quickly to ensure that the computers for e-learning are in good shape.

Also, with regard to awareness and education, all one hundred and twenty one (100%) respondents said not enough. awareness and education has been done on KNUST campus about the KNUST e-learning system. The next question looked at whether KNUST had enough internet bandwidth to implement its e-learning system. The sample size to this question comprised of only the ICT staff. All the 15 (100) ICT staff said no to this question. Views were sought as what amount of internet bandwidth will be good to implement KNUST's E-learning system. The answer to this question ranged from 20MB to 100GB of bandwidth.

Also 37 (30.58%) of respondents were of the view that the implementation of the KNUST E-learning system has been a success whereas 84(69.42%) of respondents did not agree to this. .For those who did not agree, their views were sought as to what has made the implementation not successful and what suggestions they have to make it successful. A sampling of these views included the following;

- For most students their view was that the e-learning system is good but not much educational awareness has been done about it to students.
- For ICT staff, their views were that, not much practical effort is being given by the university and its authorities towards implementing the e-learning system.
- Some ICT staff suggested that their initial plan of implementing the e-learning system across the whole university campus was wrong. They further suggested that the system should be implemented from college to college over a time span.
- For some respondents, they were of the view that because no certificate is given to lecturers for the e-learning workshops they participate in most of them don't take it serious. Furthermore, some suggested that such a certificate should have relevance on the promotion of lecturers given the fact that today's world is a digital world where e-learning in universities cannot be left out.
- Good use should be made of the big intranet of the university to cut down on bandwidth needed for e-learning.
- Views from all respondents were also sought on some parameters they consider as a must for the successful implementation of the KNUST E-learning System. A sampling of these views included the following;
- The e-learning system should blend the traditional face to face with the virtual learning system.
- Online systems should be complemented with CD-ROM materials
- Deadlines for preparation of online material by lecturers and other activities so far as the e-learning system is concerned must be formulated and included in the academic calendar and ensured they are adhered to.
- The KNUST ICT Policy should elaborate more and be concrete on e-learning issues instead of being vague.
- Educational Awareness about the e-learning system should be done to gain student and lecturer support.

- The quality and assurance unit of the university should come out with an assessment mechanism to evaluate the e-learning implementation process.
- E-learning workshops should be conducted for lecturers to train them in content development and management during the academic year.
- KNUST authorities must do more to support the e-learning implementation process to ensure it success.

1.7. Challenges and Solutions in Implementing e-learning in KNUST

This section also had a sample size comprising of all the 121 respondents. The first question looked at whether KNUST has had some challenges in implementing its e-learning system. The results to this question showed that 108 (89.26%) of respondents said yes whiles 13 (10.74%) said they were not sure. For respondents who said yes to this question their views were sought on what kind of challenges KNUST has faced in implementing its e-learning system. The views included;

- Inadequate ICT infrastructure.
- Lecturers with very low ICT skills.
- Inadequate ICT staff to train users of the e-learning system.
- Low motivation for lecturers to blend e-learning into their face to face lectures.
- High cost of accessing e-learning by non-residential students.
- Inadequate finance for acquisition of ICT infrastructure.

The next question looked at whether to those who said yes the challenges were solvable. To this question, 101 (93.52%) of the 108 respondents who said yes to the initial preamble to this question said yes, 7 (6.48%) of the 108 respondents said no to this question. Views of solutions to the challenges were sought from the 101 respondents who said the yes. The views included;

- Organize e-learning training workshop for lecturers.
- Provide funds and a well elaborate plan for implementing e-learning at KNUST.
- Expansion of the university's network to non-residential areas via wireless.
- Provision of adequate ICT staff for e-learning training and management.
- Provision of adequate ICT infrastructure to support e-learning implementation

2. Discussion

Many institutions of Higher Education and Corporate Training Institutes are resorting to e-Learning as a means of solving authentic learning and performance problems, while other institutions are hopping onto the bandwagon simply because they do not want to be left behind. Success is crucial because an unsuccessful effort to implement e-learning will be clearly reflected in terms of the return of investment. This chapter discusses the results obtained from the survey in relation to the objectives set out for this thesis.

2.1. Demography of Respondents

Kwame Nkrumah University of Science and Technology has a ratio of students to lecturers and university administrators which include ICT staff of about 26:1(Planning Unit, KNUST). This high ratio shows that for a 121 respondent out of 125 interviewees with 79.34% being students, 4.13% being lecturers, 12.40% being ICT staff and 4.13% being university administrators a good distribution of the sample has being achieved. In addition, having ICT staff interviewee number of 15 is very good since certain sections of the questionnaire are technical

in nature and thus an expert's advice in the area is required to make sound judgement. To add to it, getting 121 respondents out of 125 interviewees which represent 96.80% response rate shows that the response obtained from interviewees is very good.

2.2. Advantages and Disadvantages of E-learning for KNUST

From the results relating to this section, 98.35% of respondents agreed that e-learning will transform teaching and learning at KNUST. This depict that e-learning is advantageous to transforming teaching and learning at KNUST. This observation affirms studies which showed that the pro's and con's of e-learning vary depending on program goals, target audience and organizational infrastructure and culture, but it's clear benefits will guarantee it a role in their overall learning strategy (Kruse, 2004). Among the e-learning advantages for KNUST cited by respondents, respondents said that learning will become self-paced and e-learning will improve learners retention this buttress some studies which showed that e-learning can improve retention, provide immediate feedback and allow learners to customize learning materials to meet their individual needs (Kirsh, 2002). Looking at the other advantages cited by respondents which include courses being available 24 hours daily, the ability to have materials both online and offline, the reusability of materials by lecturers, the low cost of open-source e-learning systems, the ability to have collaborative learning and access to information from the global community online indeed makes it a very good reason for KNUST to have an e-learning system to transform its teaching and learning.

There are however, 1.65% of respondents who said that e-learning will not transform teaching and learning at KNUST, thus to this few number of respondents e-learning is likely to be disadvantageous to KNUST. From their submissions on disadvantages of e-learning to KNUST, they cited limited bandwidth constraints as being a major reason why it will be disadvantageous. In addition, they also cited inadequate ICT infrastructure as another reason which make e-learning disadvantageous to KNUST. Indeed, these submissions are valid giving the fact that KNUST is located in a developing country where according to Awidi, (2008), the weaknesses in the infrastructure have hampered support of students both on campus and through alternative modes of instruction. As according to Kevin Kruse, (2004), the advantages and disadvantages of e-learning vary. However, the e-learning advantages will guarantee it a role in the overall learning strategy of an institution.

2.3. The Various Types of E-Learning Considered by KNUST

E-learning is grouped into various types. Prominent among these groupings are those grouped on the basis of management namely course management systems and learning management systems and those based on cost and support namely open source systems and commercial systems. Results for those based on management showed that 68.60 % of respondents were aware of the course management system and 63.64% were aware of the learning management system. To add to it, 58.68% of all respondents representing 85.54% of respondents who knew about the course management system said they will chose to recommend a course management system for KNUST as against 27.27% of all respondents representing 42.85% of respondents who knew about the learning management system This results show that quite a relative few respondents preferred learning management system compared to the course management system. This observation may be due to the fact that CMS's were designed for universities and other academic environments whiles learning management systems were designed for workplace learning environments according to Carliner, (2005). Given the demography of the respondents all those involved are from the academic circles thus the tendency for them to prefer a CMS vis-à-vis LMS.

A comparison of the e–learning system on the basis of cost and development continuity showed that 86.78% of all respondents depicted that they knew about the open-source system whiles 85.12% knew about commercial or

proprietary systems. Furthermore, 76.03% of all respondents representing 87.61% of respondents who knew about open-source systems choose to recommend an open source e-learning system for KNUST vis-à-vis 22.31% of all respondents representing 26.21% of respondents who knew about commercial systems. This observation depicts that an open source system is indeed a preferred choice of e-learning platform compared to a commercial e-learning system on the basis of cost and development continuity. This observation affirms the fact that open source provides unique advantages which include filling the low-cost high-control niche that are difficult, if not impossible, to achieve through commercial, proprietary avenues. In addition it also buttresses the fact that open source removes the commercial imperative to compete, enabling genuine cooperation between developers and institutions, among developers and between projects.

Considering the question of those who knew about the various e-learning software which KNUST considered before choosing its e-learning software, the percentages of 18.18%, 20.66%, 14.05% and 19.01% for Moodle, Blackboard, KEWL and WebCT showed that very few respondents were abreast with the different types of e-learning software considered by KNUST. However, on the question of which of the e-learning systems respondents will choose for KNUST, the percentages were 95.45%, 52.00%, 29.41% and 47.83% of respondents who had knowledge of Moodle, Blackboard, KEWL and WebCT software respectively. These percentages depict that though a few respondents are aware of the various types of e-learning software quite a big percentage of these respondents prefer the Moodle software. This is likely due to the fact that the Moodle system is both a course management system and an open source system. From earlier discussions, it will be noted that the greatest percentage of respondents prefer both the course management system and open source system thus given the bridge the Moodle system is likely to be a much preferred choice compared to Blackboard which is a commercial software and a course management system. Though KEWL is a course management and open source system its popularity is not well known compared to the others thus accounting for its bad results from respondents. Given WebCT, it is also commercial and a course management system but its popularity among respondents is very low thus accounting for its bad results.

For Moodle and KEWL their recommendation may be primarily due to the fact that as open source software they are free to download therefore lower in cost. They are also flexible and capable of being customised by the university's programmers. For some respondents the choice may be due to the fact that Moodle and KEWL had widespread user communities that form a good technical support base. These reasons affirms observations made by Peters, 2007 as being true for open source software in general in her article open source vs. proprietary software.

For WebCT and Blackboard respondents choice may primarily be due to the fact that they are reliable, have professional support and training on the software could easily be done by the proprietors training personnel. For some their reasons depicted that they believe in cost going with quality. Thus, the need for proprietary e-learning software such as WebCT and Blackboard.

2.4. KNUST's Moodle E-learning System

Results from this section sought an ICT experts view on the Moodle e-learning system of KNUST. The first question in this section sought to find out whether the ICT experts knew that KNUST's e-learning system was Moodle e-learning software. 93.33% of respondents said they knew that the KNUST e-learning system was a Moodle e-learning system. This implied that the majority of the experts were much familiar with the KNUST system. Furthermore, a question of whether experts think Moodle is suitable for KNUST on the basis of its features, specifications, support and cost depicted that 100% of the ICT experts said it was suitable. Reasons

sought from the ICT experts as to why Moodle is a good e-learning system for KNUST though varied brought to bear Moodle's excellent features which included Moodle's extensive and multiple authentication and enrolment methods, its ability to work with other plugins of varied kinds, it versatility in working with other well known commercial e-learning systems such as Blackboard, WebCT and others and its ability to support different kinds of databases including Oracle, Microsoft SQL server, MySQL, PostgrelSQL and others to mention a few. For its excellent specifications much reasons given by the experts were around the ability of Moodle to operate on different operating systems including Windows and Linux compared to commercial systems such as Blackboard which primarily operates on Windows. In addition, for support of Moodle most of the of the ICT experts liked the fact that Moodle like all other open source systems had a large user and developer community from which support could easily be obtained from. In relation to cost, most of the experts were of the view the fact that it is free to download and setup under the GNU Public License made Moodle very suitable for KNUST given the fact that the university had constant financial constraints. The varied reasons given by the ICT experts buttresses Peters, (2007) acclamation about open source systems for which Moodle is one of them.

2.5. E-learning strategy to implement Moodle at KNUST

For 60.33% of respondents the hardware infrastructure of KNUST seems adequate for e-learning. This fact indeed is quite through given the data and information given by the UITS office of the university (UITS, 2008). It is estimated by the data that there about 3000 computers on the KNUST campus a number of them as computer pools at various departments, colleges and the largest number of close to 300 computers being at the ICT centre of the university. Given the student and academic staff population of the university to be about 23000 and 2000 respectively, it places the ratio of computer to student or academic staff at 1 : 8.3 which is an a good ratio for the hardware infrastructure. However, the distribution of these computers throughout the university is disadvantageous to the students of the university since not much of these computers are at student computer pools where students can access computers. However, information from the UITS of KNUST suggests that about 50% of students in university are believed to have laptops. This also seems to go a long way to supplement the computers needed for effective implementation of e-learning.

On the issue of bandwidth, additional information gathered from the UITS and the KNUST ICT policy of the university suggests that the current bandwidth of 9MB expected to be upgraded to 10MB by 2009 is woefully inadequate for the implementation of e-learning at KNUST given that the uplink bandwidth which is actually needed for hosting the e-learning is only 7.5MB. This is buttressed by the ICT experts answer to the question of adequacy of the bandwidth available to KNUST where 100% of respondents said that the bandwidth was inadequate. Furthermore, given that the adequate bandwidth suggestions from the experts ranged from 20MB to 2GB indicates that the 9MB bandwidth of KNUST is woefully inadequate for e-learning.

On educational awareness of the e-learning system at KNUST, the 100% respondent answer of no to the question shows that not much is being done by KNUST to make students and staff aware of the KNUST e-learning system. Indeed, a thorough look at the ICT policy of the university provision is not made for the educational awareness of the e-learning at KNUST. Information from the UITS depicts that not much support is being practically given to make students and staff aware of the KNUST e-learning system. However, the UITS admission to organising workshops for some lectures of the university shows something little is being done towards this awareness though the results yielded out of the initial workshops were not much successful. The implementation of e-learning system at KNUST has not been successfully given that 69.42% representing more

than two-thirds of respondents said no to the question whether the KNUST e-learning implementation has been successful.

Views gathered from the "no" respondents as to what has made the implementation not successful and suggestions they have to make it successful buttress (Heinrich et al, 2007) assertion of things necessary to affect the success of e-learning implementation. Heinrich et al, (2007) assertion included institutional support, student and lecturer support, evaluation and assessment and more to mention a few. In addition, the definition of e-learning as given by Govindasamy, (2002) includes teaching and learning delivery through electronic media such as the CD-ROM. This definition also supports the suggestion of some respondents to complement the online delivery with CD-ROM instructional materials.

2.6. Challenges and Solutions in Implementing E-learning at KNUST

For 89.26% of respondents to agree that KNUST has had some challenges in implementing its e-learning systems affirm why a large percentage of 69.42% of respondents claim that e-learning implementation at KNUST has not been successful. According to Mutula (2000), e-learning introduction into traditional learning has some ramifications, however in the case of KNUST it has been not been rewarding enough give that a great percentage of 89.26% respondents think that KNUST has had challenges in implementing its e-learning system and large percentage of 69.42% of respondents claim that the e-learning implementation has not been successful.

Views gathered from respondents agree with Mahmud (2009) assertion that inadequate ICT infrastructure is a challenge capable of hindering e-learning implementation success. Mutula (2002), also talks about the lack of funds being a challenge to implementing e-learning at KNUST. Thus, the challenge of inadequate finance to procure ICT infrastructure to support e-learning is a problem which needs to be resolved to ensure a successfully implemented.

To add to it, inadequate numbers of well trained staff to guide lecturers and students through the e-learning system is a challenge which Mutula (2002) talks about as necessary to provide solutions to ensure the success of implementing e-learning.

The unavailability of an established reward system to motivate lecturers to incorporate e-learning into their traditional face to face lecturers is a challenge which Mutula (2002), proposes must be solved to ensure e-learning successful.

For solutions to these challenges, the greater portion 93.56% of respondents who said yes to KNUST having had challenges in implementing its e-learning also agree that the challenges are solvable. This depicts that e-learning challenges are really solvable and solutions such as workshop training, available of funds, adequate ICT infrastructure, adequate ICT staff and expansion of wireless network as cited by respondents and buttressed by Mutula (2002) and Mahmud (2009) in their literature will indeed be helpful in overcoming e-learning challenges at KNUST.

3. Conclusion and Recomendations

3.1. Conclusion

The advantages and disadvantages of e-learning span from course accessibility on schedule, availability of courses 24 hours daily, removal of geographical barriers, reduction in the cost of delivering teaching and learning, increased interaction of students and lecturers, material availability both online and offline, improved computer and internet skills of learners and lecturers and accessibility to a wide array of learning resources via the web. Given the disadvantages of e-learning ranging from inadequate bandwidth to inadequate ICT infrastructure the advantages of e-learning for KNUST far outweighs the disadvantages of e-learning at KNUST and other universities in Ghana.

Looking at course management in universities, cost, features, specifications and support for an e-learning system, an e-learning which blends the advantages of a course management system and an open source system is ideal for universities in Ghana and KNUST giving that availability of funds is a major challenge for most universities in developing countries such as Ghana. The Moodle e-learning system considered by KNUST gives an excellent blend of a course management system and an open source system. For KNUST Moodle has been well customised to suit its teaching and learning environment by its programmers.

However, the e-learning strategy adopted by KNUST is not well elaborate in its ICT policy. In addition, the e-learning implementation has been a failure due a wide variety of reasons notably among them is poor student and lecturer educational awareness, low motivation for lecturers to blend e-learning into their traditional face to face teaching and learning modes, the inability of the university to adequately support the ICT staff to implement the e-learning system, inadequate bandwidth for implementing the e-learning system and inadequate ICT infrastructure at the university.

Challenges are bound to come along in the implementation of any system. For KNUST, the challenges to implementing its e-learning system range from inadequate ICT infrastructure, poor ICT skills of some lecturers, inadequate funds for implementation, inadequate ICT staff, high cost of accessibility of e-learning by non-residential students and low motivation for lecturers to accept and use e-learning. However, the challenges can be solved using measures such as provision of ICT infrastructure over a period, expansion of KNUST intranet and internet to non-residential student areas via wireless, provision of adequate ICT staff, provision of adequate funds and organisation of e-learning workshops.

3.2. Recommendation

The planning and implementation of an e-learning strategy involves multiple dimensions that need to be taken together for the project to succeed. It is therefore recommended that;

1. A reconnaissance of the available ICT infrastructure at KNUST is determined and an elaborate plan drawn and implemented to provide and maintain ICT infrastructure at the university.
2. Wireless facilities should be extended by KNUST to non-residential student areas for them to have access to the intranet facilities offered by KNUST to reduce the consumption of bandwidth needed by the e-learning system.
3. Educational e-learning workshops should be organised regularly for students and lecturers of KNUST to bring awareness about the e-learning system to them.
4. An elaborate e-learning policy must be drawn out and used to implement e-learning at KNUST.

5. A reward system must be developed for lecturers who blend e-learning into their face to face lectures as a way to motivate lecturers to use the e-learning system.
6. Adequate and well trained ICT staff must be employed by the university to augment its existing ICT staff to help implement e-learning at KNUST.
7. A blend of open source system and course management system such as Moodle is ideal for Ghanaian universities given its cost, features, specifications, support and mode of course management.
8. E-learning should be adopted in all Ghanaian universities to augment and highly impact teaching and learning given the ever-increasing enrolment figures of most universities.

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