Unlocking the Potential of ICT in Higher Education: Case Studies of the Educational Technology Initiatives at African Universities

Partnership for Higher Education in Africa

Saide South African Institute for Distance Education

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14th Floor
Rennie House
19 Ameshof Street
Braamfontein
Johannesburg
Tel: + 27 11 403 2813
www.saide.org.za
info@saide.org.za

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The Partnership for Higher Education in Africa (PHEA) was a joint project of the Carnegie Corporation of New York, the Ford Foundation, the John D. and Catherine T. MacArthur Foundation, the Rockefeller Foundation, the William and Flora Hewlett Foundation, the Andrew W. Mellon Foundation, and the Kresge Foundation.

The following higher education institutions participated in the PHEA Educational Technology Initiative (ETI):
Catholic University of Mozambique
Kenyatta University, Kenya
Makerere University, Uganda
University of Dar es Salaam, Tanzania
University of Education Winneba, Ghana
University of Ibadan, Nigeria
University of Jos, Nigeria

In several cases, versions of the case studies have been published in conference proceedings and/or international peer-reviewed journals:
Joel S. Mtebe and Hashim M. Twaakyondo: 'Developing and Using Animations and Simulations to Teach Computer Science Courses' – *Proceedings of International Conference on e-Learning and e-Technologies in Education (ICEEE)*, 2012: 240–246; Joel S. Mtebe and Hashim M. Twaakyondo: 'Are Animations Effective Tools for Teaching Computer Science Courses in Developing Countries? The case of University of Dar es Salaam' – *International Journal of Digital Information and Wireless Communications (IJDIWC)* 2(2), April, 2012: 202–207; Hashim Twaakyondo and Mulembwa Munaku: 'Experience of Course Migration from Blackboard to Moodle LMS' – *International Journal of Computing and ICT Research,* 6(2), December, 2012: 33–45; Gloria Adedoja, Omobola Adelore, Francis Egbokhare and Ayodeji Oluleye: 'Learners' Acceptance of the Use of Mobile Phones to Deliver Tutorials in a Distance Learning Context: A case study at the University of Ibadan' – *African Journal of Information Systems (AJIS)*, 5(3), 2013: 79–93; Ayotola Aremu, Olaosebikan Fakolujo and Ayodeji Oluleye: 'Designing and Developing e-Content in Higher Education' – under review at *Research in Learning Technology: The Journal for the Association of Learning Technology (ALT-J)*; John Kandiri and Joel S. Mtebe: 'Determinants of the Success of Diffusion of Technology Innovations in Higher Education Institutions in Africa: A Social Network Approach' – under review at *African Journal of Information Systems (AJIS)*; Brenda Mallinson and Greig Krull: 'An Investigation of the Deployment of the Moodle Virtual Learning Environment at Eight African Universities' – under review at *International Journal of Education and Development Using Information and Communication Technology (IJEDICT)*; and Andrew Mwanika, Ian Munabi and Tito Okumu: 'The Design and Feasibility of Adoption of a Special Purpose e-Portfolio in an African University' – under review at *International Journal of Education and Development Using Information and Communication Technology (IJEDICT).*

Contents

Abbreviations and Acronyms

3G	Third Generation (Mobile Phone Technology)
CD	Compact Disc
CPU	Central Processing Unit
C-TAM	Combined Technology Acceptance Model
CVL	Centre for Virtual Learning
DLC	Distance Learning Centre
DVD	Digital Video Disc
ETI	Educational Technology Initiative
FGD	Focus Group Discussion
FTP	File Transfer Protocol
ICT	Information and Communication Technology
IT	Information Technology
Gb	Gigabyte
GHz	Gigahertz
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HoD	Head of Department
LAN	Local Area Network
LMS	Learning Management System
Mb	Megabyte
MEd	Masters in Education
m-Learning	Mobile Learning
MUELE	Makerere University Electronic Learning Environment
NUC	National Universities Commission
OER	Open Educational Resource(s)
OS	Open Source
PDA	Personal Digital Assistant
PDF	Portable Document Format
PHEA	Partnership for Higher Education in Africa
QI	Quality Improvement
ROM	Read-only Memory
RPM	Revolutions Per Minute
Saide	South African Institute for Distance Education
SATA	Serial Advanced Technology Attachment
SMS	Short Message Service
SPSS	Statistical Package for the Social Sciences
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
UDSM	University of Dar es Salaam
UEW	University of Education, Winneba
UI	University of Ibadan
VC	Vice-chancellor
VLE	Virtual Learning Environment

Introduction

The Partnership for Higher Education in Africa (PHEA) was a ten-year funder collaboration[1] that supported the strengthening of higher education in Africa. The PHEA financially supported research and strategic interventions that encouraged systemic and sustainable change in selected African countries. It identified interventions to strengthen the use of educational technology in African universities. In October, 2006, the PHEA convened an Educational Technology Think Tank for Africa, which was hosted by the Centre for Educational Technology (CET) (now known as the Centre for Innovation in Learning and Teaching) at the University of Cape Town.

One of the developments flowing from the work of this Think Tank was the launch, in August, 2008, of the PHEA Educational Technology Initiative (ETI). This ambitious five-year programme[2] focused on improving the use of educational technology within the ambit of context-specific educational challenges in African universities. This meant that participating institutions not only had to design interventions that served the purpose of introducing technology to improve teaching and learning, but had to do this in a way that accounted for the specific challenges related to the context in developing countries and within the participating institutions themselves. This programme served two primary goals. Firstly, it was established to support educational technology interventions in African universities. Secondly, it created an opportunity for evidence-based knowledge sharing and innovation.

The participating institutions were the Catholic University of Mozambique (UCM – *Universidade Católica de Moçambique)*; Kenyatta University (KU), Kenya; Makerere University (MAK), Uganda; University of Dar es Salaam (UDSM), Tanzania; University of Education, Winneba (UEW), Ghana; University of Ibadan (UI), Nigeria; and University of Jos (UJ), Nigeria. The PHEA ETI was conducted under the auspices of Saide, the South African Institute for Distance Education, in collaboration with CET.

In many respects, the design of the programme has made the PHEA ETI a unique initiative that has allowed for sustained interaction and dialogue with and between seven African universities over an extended period. The programme has generated several opportunities to research and identify effective strategies for deploying information and communication technology (ICT) to support teaching and learning in resource-scarce university environments. This collection of case studies seeks to present some of the key lessons generated from these opportunities. They do not seek just to showcase best practice (although they often do so); they also serve to highlight the many challenges that face universities aiming to integrate ICT effectively into their operations, and they serve to demonstrate how these universities are tackling these challenges.

The case studies represent the culmination of many years of hard work by a wide network of people. Acknowledgement must go first and foremost to the dedicated project teams assembled at each of the participating universities. Their commitment to the task at hand and willingness to put long hours into making their projects a success took the PHEA ETI well beyond the expected project deliverables, generating results and new capacities that will be sustained long beyond the lifetime of the programme.

1 The original members of the PHEA were the Carnegie Corporation of New York and the Rockefeller, Ford and John D. and Catherine T. MacArthur Foundations. The William and Flora Hewlett Foundation, the Andrew W. Mellon Foundation and the Kresge Foundation later joined the partnership.

2 The ETI is often referred to as a project but we refer to it as a programme to distinguish it from the 26 projects that it encompassed.

This commitment and effort was also matched by the strong team of specialists from Saide and its network of sub-contractors. The team was remarkably consistent and stable throughout the programme, despite its duration, and feedback from institutions attests to the excellent work that this team has done in supporting institutions to achieve their goals.

Finally, the programme would not have been possible without the support of the five key funders: the Carnegie Corporation of New York, the Rockefeller Foundation, the Ford Foundation, the John D. and Catherine T. MacArthur Foundation, and the Kresge Foundation. This support was not only financial; it came also in the form of excellent advice and human support during the formative stages of the programme, as well as in the willingness to allow the programme time to evolve so that universities could define for themselves the most suitable pathways forward for e-learning in their institutions. This is a rare luxury in funded programmes, and we hope the results of the programme – some captured in this collection of case studies – speak for themselves.

NEIL BUTCHER
PHEA ETI Project Leader

EPHRAIM MHLANGA
Case Study Project Manager

Embedding Quality Improvement in Online Courses: A case study of seven African universities

Ephraim Mhlanga
Saide
ephraimm@saide.org.za

Greig Krull
Saide
greigk@saide.org.za

Brenda Mallinson
Saide; Rhodes University, South Africa
brendam@saide.org.za; B.Mallinson@ru.ac.za

ABSTRACT

The project activities within the Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI) involved many facets of the deployment of educational technology to support teaching and learning at seven sub-Saharan African universities. One of the major components of the project was the design and development of online courses. This case study presents the capacity-building processes implemented to embed quality and post-review improvement in these courses to ensure high quality outputs. The different phases of the review process are described, including the creation of a course review instrument and the feedback from a set of external reviewers. The successes and challenges of the quality improvement processes are examined, with the case study culminating in a set of lessons learned.

Keywords: quality assurance, quality improvement, online course design, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

INTRODUCTION

Quality assurance is a vital part of the course design and development process. It aims to promote effective teaching and learning and the development of relevant knowledge and skills on the part of students. High quality online courses need to be intentionally designed for an online learning environment in order to maximise the affordances of the changed environment. Jung and Latchem (2012) emphasise that basic competencies for the provision of e-learning are crucial, but note that the skills required for sustaining quality in this area are constantly evolving. Sound instructional design combined with high quality content includes the selection of a learning approach, the selection/development of appropriate learning content, the sequencing of learning, and the alignment of activities and assessments (Uvalić-Trumbić & Daniel, 2013).

However, Grifoll et al. (2010) report a paucity of research in benchmarking and quality in e-learning. Although universities typically have defined policies and procedures to ensure the quality of courses, when academics begin to convert existing courses for online delivery quality assurance is often an afterthought and is sometimes attempted by integrating online learning good practice guidelines with regular quality assurance; in some cases, online courses slip through cracks in the institutional system and do not undergo any quality assurance processes at all. Initial research by Lund University (Grifoll et al., 2010) has shown that benchmarking initiatives can and should have a positive impact on regular on-campus course delivery, with many of these online courses now being offered in blended learning mode.

The current case study examines the concentrated quality improvement (QI) process that was initiated within a large educational technology project to support online course design and development at seven sub-Saharan African universities. The case study sketches the background to the project, explains the aim of the QI process and discusses the different phases that made up the process. The case study reflects on the successes and challenges encountered, and concludes with a set of lessons learned.

BACKGROUND TO THE STUDY

The PHEA ETI aimed to support interventions in the participant universities[1] to make increasingly effective use of educational technology to address some of the underlying educational challenges facing the higher education sector in Africa. An important component of the project was ensuring the quality of courses developed at each of the institutions. For most of the participating institutions, existing quality criteria did not specifically include provision for online or blended course delivery. The project support team therefore proposed and implemented, as part of this initiative, two inter-related strategies for the improvement of quality. The first strategy was the implementation of a set of structured quality improvement activities that would result in the development of high quality courses. It is this strategy that is reported in this case study. The second strategy was the refinement of institutional quality systems to improve and monitor technology-enhanced teaching and learning processes.

THE QUALITY IMPROVEMENT PROCESS

One of the intended outcomes of the project was to make some of the designed and developed courses available as openly licensed resources. Thus, for both internal institutional and external purposes, the high quality of courses was imperative. This led to the design and development of the quality improvement (QI) processes, one of which was the internal and external formative review of the online courses. The purpose of the quality review process was to support course developers to improve the quality of their online courses. It was thought that subjecting the courses to scrutiny by external reviewers would benchmark the quality of courses in comparison to regional and international standards. Additionally, independent external review would provide the courses with credibility from this perspective. A secondary objective of the review process was to identify common shortcomings in courses and indicate where future support would be required.

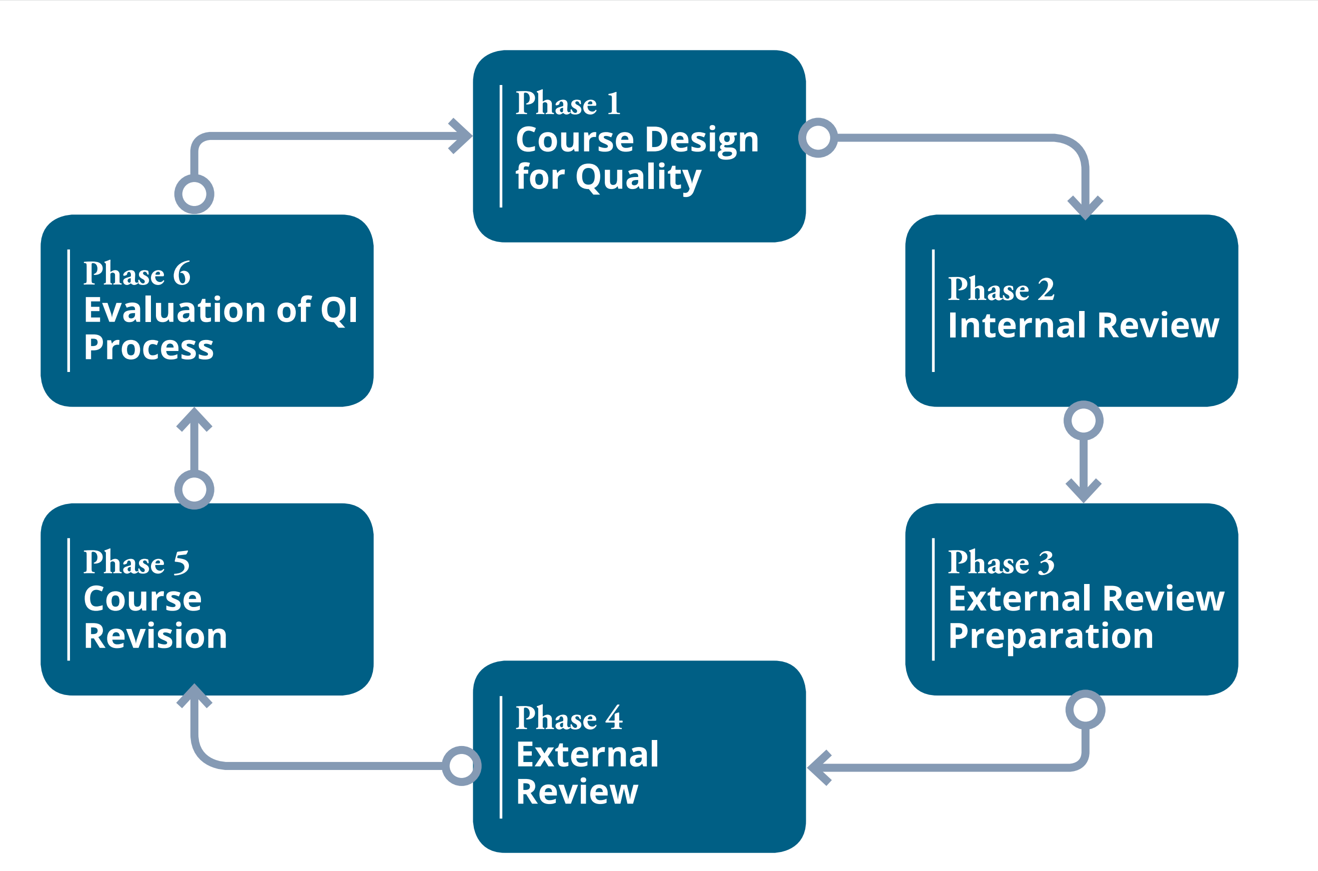
The QI process affected a number of stakeholder groups:

- Course developers;
- The institutional project support teams (including project leaders and any centralised support units);
- The external project support team; and
- External reviewers.

The phases making up the QI process are reflected in Figure 1. The sections that follow describe each of the phases in detail.

1 The participating higher education institutions were Kenyatta University (Kenya), University of Dar es Salaam (Tanzania), University of Ibadan (Nigeria), University of Education Winneba (Ghana), University of Jos (Nigeria), Catholic University of Mozambique (*Universidade Católica de Moçambique*), and Makerere University (Uganda).

Figure 1: The QI process



Phase 1: Course design for quality

The design and development of the online courses began with a series of capacity development initiatives and follow-up support, by the external project support team, at each of the participating institutions. As most of the course developers involved had not previously designed courses for online or blended delivery, the aims of the capacity-building initiatives were to prepare and support the course developers in designing and mounting their courses online on their institutional Moodle servers. During and between these capacity-building interventions and extensive follow-up support, course developers continued to work on their courses.

The capacity-building workshops included specific focus on the following:

- Designing and developing effective online courses;
- Designing and developing multimedia learning objects (where required);
- Moodle virtual learning environment (VLE) functionality;
- QI (where the QI process was introduced); and
- Deploying open educational resources (OER).

Phase 2: Internal review

As part of the QI process, a number of reviews were undertaken at an early stage of the course development. Course developers first undertook a self-evaluation of their courses, and then undertook peer reviews of other courses at their institutions being developed under the PHEA ETI. The feedback from peer reviews was shared to inform all developers of issues that their colleagues were encountering, many of which were common. In this way, good practices and problems could be discussed and solutions offered. Informal review input was also provided by the external project support team, which identified common challenges. A review of multimedia content developed for use in some of the courses was also undertaken. After each review iteration, course developers continued with the development of their courses and implemented the recommended quality improvements. As part of the review process, one of the members of the project support team collaborated with one of the institutions to develop an initial spreadsheet review instrument, which was shared with all and used to support and guide the review processes.

Phase 3: External review preparation

The diagram in the Appendix illustrates the process that evolved and was adhered to for the external review with reference to the relevant stakeholders, including Phases 3 (external review preparation), 4 (external review), 5 (course revision), and 6 (evaluation of the QI process).

Development of the review instrument

In defining a review instrument to use, the project support team set about identifying internationally recognised quality practices and standards. Several benchmarks or quality standards have been defined and tested internationally (Uvalić-Trumbić & Daniel, 2013). The team examined the available instruments, what form they took, their scope, and the criteria identified. The following standards and instruments were examined:

- *Quality Matters (QM) Rubric Standards* (Quality Matters Program, 2011): The Quality Matters Rubric is a set of eight general standards and 41 specific standards used to evaluate the design of online and blended courses. The rubric is complete with annotations that explain the application of the standards and the relationship between them. A scoring system and set of online tools facilitate the evaluation by a team of reviewers;
- *Essential Quality Standards (EQS)* (eCampusAlberta, 2012): The eCampusAlberta Quality Suite comprises four components to be used together to assist faculty and instructional designers with online curriculum development. The four components are the Quality Standards White Paper, the eLearning Rubric (available in print and online), the institutional Curricula Self-assessment Scorecard, and the Essential Quality Standards (EQS);
- *Online Course Evaluation Project (OCEP)* (Monterey Institute for Technology and Education, 2010): This project identifies and evaluates existing online courses in higher education, among other sectors. The goal of OCEP is to provide the academic community with a criteria-based evaluation tool to assess and compare the quality of online courses. The focus of the evaluation is on the presentation of the content and the pedagogical aspects of online courses, but the evaluation also considers the instructional and communication methods so vital in a successful online learning experience; and
- *OPEN e-Learning in Capacity Building (ECB) Check* (European Foundation for Quality in e-Learning, 2011): The ECBCheck initiative is a professional community of organisations that are interested in quality issues in the field of e-learning for capacity building. This community offers an environment in which members can professionalise their own quality practices up to the point of certification of their programmes or even certification of their whole institution. One possible activity within this community concerns the sharing of experiences and best practices and aggregating these experiences into benchmarking and bench-learning processes. The ECBCheck criteria analyse a wide variety of indicators, all contained in the openly available toolkit.

Although each of these instruments had many useful components, the project support team felt that no single instrument among these would meet the needs of the external review process, but would be highly useful to inform the design of a new instrument to suit the project context. The perceived need was largely to identify areas that needed improvement and facilitate the communication of the information/feedback to course developers in the most user-friendly way. The team therefore combined elements from the above instruments to create an easy-to-use instrument that would meet the needs of the project.

Four broad areas were identified to focus on in terms of quality:

A. *Course design:* The course has clear learning outcomes that are appropriate to the level of study and the content; the teaching, learning and assessment methods encourage the achievement of the course aims and outcomes. The course design encourages active learning and collaboration. The course has clearly defined learning pathways that students should follow to meet their needs as well as the learning outcomes of the course.
B. *Course activities:* Course activities are designed in such a way that they are aligned with course outcomes, have clearly defined objectives, encourage active learning, and cover different levels of cognitive skill. Examples of such learning activities could be assignments and quizzes.
C. *Assessment:* Course assessment is designed in such a way that it is aligned with course outcomes, has clearly defined objectives, and covers different levels of cognitive skill.
D. *Technology:* The technology used in teaching and learning is appropriate, up to date, and readily accessible to students and staff. The type of technology used is guided by the pedagogical approach of the provider.

Each of the four quality areas consists of several quality elements, with the instrument comprising 34 quality elements in all. These elements are shown in Table 1.

Table 1: The 34 elements of the review instrument

A: Course design	
Introduction elements	
1	A clear course title and short description are provided.
2	Students are provided with a clear picture of what will be involved in taking the course and the expectations that will be placed on them.
3	Instructions indicate how the student can access support of various types: academic, technical etc.
Course information and layout elements	
4	The learning outcomes are present, specific, measurable and achievable.
5	Intellectual property and copyright issues are well taken care of in the course (e.g. appropriate referencing, use of OER – the reviewer should request and check a sample of referencing).
6	The lecturer and the students introduce themselves in an appropriate manner.
7	The course encourages students to evaluate the course (feedback for course improvement e.g. an evaluation form).
8	The course interface is designed for consistency, readability and attractiveness (e.g. use of pictures, icons, consistency of headings, font size, colour and spacing).
9	The interface has no information overload and has internal links to the necessary additional information.
10	The course is easily navigable and navigation is clearly indicated.

Learning and teaching strategy elements	
11	The learning and teaching or pedagogical approach guides the use of the technology.
12	There is a clear *learning pathway* built into the course. (The learning pathway is an integration of appropriate content – i.e. learning resources – learning activities, guided feedback on activities, and linked assessment activities, all of which enable students to achieve the specified outcomes of the course.)
13	The course content is accurate, up to date and pitched 'appropriately to the level of study' and 'at the right educational level' of the target group.
14	The course design recognises the diversity of students e.g. sensitivity to gender/ethnic/cultural aspects of teaching and learning in the language and examples used.
15	The course design promotes and supports collaborative learning (e.g. has collaborative learning tools such as blogs and discussion forums).
16	The course is designed in such a way that students feel the 'presence of the teacher'.
17	The course is designed in such a way that it facilitates individual study and the development of study skills.
18	The course contains a useful glossary.
B: Course activities	
19	Activities are pitched at the appropriate level of the course. Activities cover different cognitive and practical skills (where indicated) in line with the course outcomes.
20	The course offers ample opportunities for interaction and communication with other students, with the instructor, and with the content.
21	The purpose/objective of each activity is clearly spelled out to enable students to understand what knowledge, skills and values they are expected to learn or demonstrate.
22	Students are provided with guidance on how long they should take to complete each activity.
23	There are clear instructions on how students should undertake the activities and what resources they should use.
24	There are clear instructions on how and when students should expect feedback.
C: Assessment	
25	There is upfront information on how students will be assessed on the course.
26	Assessment tasks are appropriately paced in the course to enable students to gauge their mastery of all the concepts in the course.
27	Assessment tasks are stated clearly enough for students to know how they should respond and the resources they should use to do them.
28	Assessment tasks cover different levels of cognitive skills and are appropriately pitched.
29	Timely feedback is provided on assessment tasks.

D: Technology	
30	The learning and teaching or pedagogical approach guides the use of the technology.
31	Wherever possible, a range of technologies – such as forums, chats, wikis, blogs etc. – are used to support learning, and these technologies are appropriate for the pedagogical approach chosen.
32	There are suitable multimedia objects – such as illustrations, video clips, PowerPoint slides, animations, simulations – to facilitate understanding of the content.
33	There is seamless integration of the different multimedia elements in the course.
34	Internal and external hyperlinks are provided and they are always active.

The external reviewers were invited to review the draft instrument and provide suggestions for improvement prior to deployment. This enabled the external reviewers to become familiar with the instrument, seek clarification where required and provide input into the design of the final instrument. Subsequent to this, a draft instrument was circulated to course developers at participating institutions. The intention was to enable course developers to be fully aware of the review criteria as well as check their understanding of the instrument. The external project support team also encouraged course developers to use the review instrument for self-evaluation purposes with respect to their own courses. The final review instrument was then circulated for the external review process after updates had been made. For example, course reviewers and developers were not clear on one element regarding the meaning of a 'learning pathway'. A definition of learning pathway was then included in the element.

Identification of expert reviewers

It was important to identify a group of external reviewers early on so that they could provide formative input to the review instrument before making use of it. Reviewers were selected from a variety of African countries as the project was taking place within this context. The selection criteria used to assemble the team were their expertise in and prior experience with online course design, development and facilitation. The reviewers were not necessarily selected on the basis of their expertise in subject content as the focus of the review process was on course design and not content. In order to ensure anonymity between reviewers and course developers and avoid any potential bias, no reviewers were selected from the participating institutions. The reviewers selected consisted of seven academic staff from various sub-Saharan Africa higher education institutions, and five educational consultants.

Identification of courses for review

Institutional project leaders and course developers were requested to identify completed courses to submit for external review. In total, 136 courses were received from all the participating institutions. The courses received tended to correspond roughly to the total number of courses being developed at each institution under the PHEA ETI. For each course, institutions were required to submit the course code and name, the site URL, and guest access login details. Guest access was provided so that no changes to the course could be made inadvertently and live courses would not be compromised. Prior to course allocation to reviewers, the external project support team checked the authenticity of the courses and access details provided, in order to minimise any access problems; it was found that in some instances incomplete or blank course details had been sent.

Phase 4: External review

Course allocation for review

The project support team created a composite review register to track the progress of the reviews. The register contained a list per institution of courses submitted for review, the allocated reviewer, date sent for review, expected date of feedback, and actual date feedback was received. This was helpful as courses were received from institutions and reviewers at different times. The register also recorded when reviews were mediated and when the feedback was sent to institutions.

Reviewers were allocated courses in different stages. Reviewers were initially given a limited number of courses to review to be able to get a sense of the usefulness of their review and feedback comments, and assess their time management capability. Reviewers were provided with clear instructions for undertaking reviews. In brief, these instructions included:

- Background to the review process and how to complete the instrument;
- Guidelines for time to take for reviews and the nature of comments expected; and
- The date review feedback was expected.

External review of courses

Reviewers were required to review each course against the 34 quality elements and provide a rating for each element, as well as a comment clarifying the status of each of the elements. The rating scale used was to select the rating that best matched the element statement. Figure 2 illustrates an extract from the review instrument.

Figure 2: Extract from the course review instrument

Ratings: Select a check box that best fits the criterion. You may place only one tick per statement.
0 = 'Not at all'
1= ' A little bit'
2 = ' A fair amount'
3 = 'To a large extent'

A **Course Design:** The course has clear learning outcomes that are appropriate to the level of study and the content; teaching and learning and assessment methods encourage the achievement of the course aims and outcomes. The course design encourages active learning and collaboration. The course has clearly defined learning pathways learners have to follow to meet their needs as well as the learning outcomes of the course.

	Introduction Elements	0	1	2	3	Comments
1	A clear course title and short description are provided	☐	☐	☐	☐	
2	Students are provided with a clear picture of what will be involved in taking the course and the expectations that will be placed on them	☐	☐	☐	☐	
3	Instructions indicate how the student can access support of various types: academic, technical etc	☐	☐	☐	☐	

Additionally, once reviewers had completed the review against the 34 quality elements, the review instrument contained a summary tab for reviewers to write general comments for each of the four broad areas of the review in terms of strengths identified, areas for improvement identified and overall recommendations.

Mediation of feedback

As the completed reviews were received from the reviewers, the external project support team checked that the reviewer had completed all sections of the instrument and, where necessary, mediated the feedback in terms of adding or editing the comments. This was to ensure the comments could be usefully interpreted in all cases. The project support team sent the review feedback to the institutional project leaders, who then distributed the feedback to the individual course developers.

Phase 5: Course revision

Once course developers had received their course feedback, they could look at addressing the reviewer comments. The institutional project leaders, supported by the local support team, had responsibility for guiding the course developers in the implementation of the feedback and ensuring the feedback was acted upon. During site visits to institutions, the external project support team would check the progress on course revisions with the course developers and provide further support for the process. These institutional visits served also as catalysts for renewed impetus in terms of course improvement.

Phase 6: Evaluation of the QI process

Second round of reviews

In order to verify improvement in the quality of courses, each institution was requested to submit a limited number of courses for a second round of review using the same review instrument. Institutions submitted a total of 20 courses, which was 15% of the courses reviewed in the first round. The submission of courses per institution is shown in Table 2.

Table 2: Institutional course submissions for review

Institution	Submitted for first review	Submitted for second review
Institution 1	19	2
Institution 2	11	3
Institution 3	6	2
Institution 4	40	5
Institution 5	42	4
Institution 6	14	4
Institution 7	4	0
Total	**136**	**20**

Note: The seventh institution did not submit any courses for the second round of reviews.

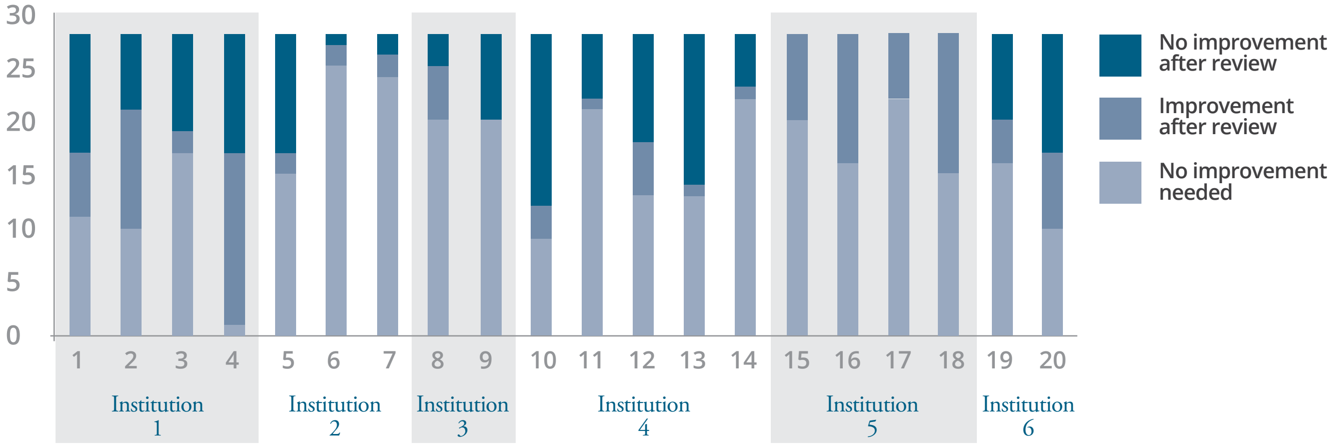
The second round of reviews was conducted by the external project support team. Reference was made to the feedback in the external review. Once again, feedback was sent to course developers via institutional project leaders to act upon the comments, if and as necessary.

The second review was primarily conducted to establish the extent of improvement based on weaknesses and recommendations identified in the external review. The scoring of each of the 34 quality elements was compared with the scoring in the second review. These scores were then grouped into three categories:

- Quality element was reviewed favourably by external reviewer and therefore no major improvement was required.
- Quality element was reviewed unfavourably by external reviewer and an improvement was made.
- Quality element was reviewed unfavourably by external reviewer and yet no improvement was made.

Figure 3 shows the results of the quality element comparisons grouped into the three categories. Three findings emerged from the analysis of the second round of reviews. Firstly, it was found that most of the courses had been reviewed favourably by the external reviewers in the first round, as evidenced by the large proportion of quality elements where no major improvement was required. Secondly, although there were many elements indicating good quality, there was also a lot of improvement to be made after the first round of external review. All the courses, except in one case, exhibited various degrees of improvement after the external review. Thirdly, although some improvements were made, the majority of courses continued to exhibit the weaknesses initially identified in the external review. This may be an indication of problems with the internal quality processes.

Figure 3: Quality element comparisons after the second review



Review reflection and feedback

In order to validate the impact of the QI process, feedback was obtained from the stakeholders involved. Course developers and institutional project leaders were sent a link to an online survey to evaluate the QI process using a set of structured questions. Only 30 out of about 100 course developers responded to the survey. The external reviewers were required to complete a short questionnaire based on the courses they had reviewed. The questions were:

1. What is your general opinion on the quality of the courses?
2. What are the common strengths?
3. What are the common area(s) that need improvement?
4. What suggestions do you make for improving the evaluation instrument?

Finally, the project support team members submitted short reflection reports on the process and outcomes of the QI process. The analysis of the feedback from the various stakeholder groups is discussed in the following section.

SUCCESSES AND CHALLENGES

Successes experienced

The positive feedback from the course developers indicated the following:

- The categories and quality elements used in the review made sense (according to 89% of those who responded);
- The external review process helped to improve the quality of their online courses (according to 83% of the respondents); and
- The reviews validated the learning design approach taken during the initial design of their courses in terms of the structure and tools (according to most of the respondents).

Feedback from the external reviewers indicated that generally the courses reviewed were of good quality and provided students with the basic elements that one would expect to find in an online course. Reviewers commented that the courses were a good start from first-time online course developers. The following were found to be common areas of strength in the courses:

- Most of the courses had a consistent, easy-to-navigate layout;
- The courses provided students with an opportunity for collaborative discussions and activities;
- The online teaching approach was emphasised and instructors created elements to establish the presence of the 'teacher';
- The use of visual aids was good (although overused in some courses);
- Course introductory matter was clearly indicated, including indications for opportunities of support (academic and technical) being provided in most courses; and
- The courses provided a clear link between the course objectives and the resources and learning activities.

Feedback from the external project support team indicated that the QI process had been a worthwhile exercise in assuring the quality of courses and that for course developers it had embedded notions of quality. It was noted that the careful planning and coordination of the QI process, although requiring significant time and effort, was critical to the success of the process. It was also noted that the refinement of the review instrument during this process had led to a tool that can be used and adapted for a variety of review contexts.[2]

Challenges encountered

The following key challenges were indicated by institutional course developers:

- They did not see the review criteria prior to submitting their courses for external review (this was according to 39% of the course developers). This suggests communication problems between the institutional project leaders and the course developers;
- They did not have the criteria sufficiently explained to them by the institutional support team before the review was conducted (this was according to 33% of the respondents);
- Feedback from external course reviewers was not passed on to them by the institutional coordinator who received the feedback from the external project support team (according to 6% of the respondents); and
- They did not have sufficient time to address the feedback before the second round of reviews was due (a few of the respondents reported thus).

Feedback from the external reviewers indicated that although the good quality was noted, there was ample room for further improvement. A particular area of attention noted by the reviewers was that of preferred pedagogical approaches, which should be guided by both the nature of the courses and the target audience's entrance knowledge, skills, attitudes, and aspirations.

The reviewers identified the following common areas of weakness needing improvement:

- A lack of visible interactive sessions;
- A lack of provision for course evaluation in order to get feedback from students on their experience of taking part in the course;
- A shortage of the use of multimedia elements such as videos (in some cases these were not of a satisfactory quality);
- A lack of clear indication of how much time students would need to complete assignments and activities;
- A number of broken hyperlinks that needed to be fixed;
- Poor acknowledgement of reference materials (especially diagrams) from other sources; and
- Although the courses started well, the quality of the courses tended to diminish by the end of the course. This indicated a need for course developers to maintain consistent focus and commitment to quality.

2 The online course review instrument has since been revised by the Saide project team and released on the Saide website under an open licence.

The external project support team feedback indicated several challenges experienced during this process:

- The limited time availability of course developers and reviewers due to their other institutional responsibilities led to significant delays in the development and review process;
- Some developers had very little expertise in course design, which led to pedagogical challenges that inhibited good online course design; and
- Communications with and within institutions was sometimes a major problem, particularly experienced between institutional project leaders and the course developers.

LESSONS LEARNED

There are a number of lessons of experience that can be drawn from the QI process undertaken in this initiative:

1. *Capacity development in course design*: Although effort had been made, in the design of the capacity-building interventions, to include a focus on pedagogical considerations, it became clear that some of the factors limiting the quality of the online course development were due to pedagogical challenges experienced by some of the course developers. For future capacity-building interventions it is recommended that more time be allocated to this.
2. *Quality as a continual process*: An important point the external project support team needed to share with the course developers was that for the most part a high quality course cannot be achieved during the initial development and review of the course; rather, the quality of the courses would be improved over time, during the subsequent delivery of the course to students and as a result of subsequent iterations of course revision. As Uvalić-Trumbić and Daniel (2013) note, quality enhancement will occur only 'when the lessons from evaluation are reflected in the next offering of the course'.
3. *Allocation of reviewers*: Although the availability of reviewers was limited, it was necessary to select a sufficient number of reviewers so that the allocation of reviews could be fairly distributed and occur within an expected timeframe. In most cases, the turnaround time for reviews was longer than anticipated. Another aspect to consider is the distribution of courses. It was found that it was best to distribute courses from one institution to more than one reviewer. This is because different reviewers tend to prioritise certain aspects of course design. Additionally, in this process reviewers were selected based on their expertise in online course design; it may be advantageous in future though to obtain the services of reviewers who are also discipline experts and who are thus able to provide a comprehensive evaluation, including of the actual content.
4. *Communication*: Several communication challenges were experienced in the implementation of the QI process. It was discovered that part of the challenge was the use of institutional e-mails. Regular follow-ups had to be made via alternative e-mail addresses as well as via telephone. Additionally a communication protocol needed to be established to ensure regular communication between the project team members within an institution.
5. *Mediation of feedback*: The project support team determined it was important to check and mediate the feedback from reviewers before sending it on to the course developers. This was to ensure that the feedback could be clearly understood and that the tone was consistently constructive.
6. *Local support and motivation*: Due to the institutional commitments of the course developers, the institutional support team was vital in ensuring the continued focus on quality improvement. The institutional support teams provided encouragement and guidance to ensure the sustainability of the QI process.
7. *Institutional quality processes*: In many of the institutions, the internal processes for quality improvement are either not clearly prescribed or not well understood. This led to challenges with regard to differing expectations regarding quality and the completion of quality-related activities.

CONCLUSION

This case study examined the QI process undertaken to ensure high quality project outputs within a large, distributed educational technology project. The QI process that was developed aimed at improving the quality of online courses developed as part of the PHEA ETI. Quality was an element built into the course development process. Several rounds of review were undertaken in order to ensure quality improvement. It is acknowledged that the process of quality improvement does not occur in a single cycle but is a continual effort. In total, 136 courses were reviewed from the seven participating sub-Saharan African higher education institutions. As an outcome of the project, these institutions will release a proportion of the courses (or elements of courses) that have undergone review as OER, to be made available to other institutions to adapt and share. Such collaboration and sharing will not only improve the quality of the resources but will also continue to build capacity in the use of educational technologies in African universities.

The course review instrument has been refined from the feedback obtained and, as already mentioned, is available as an OER on the Saide website. Course developers are encouraged to use and adapt the instrument for quality improvement processes. It is anticipated the institutional quality assurance units will continue to work together with course developers in order to refine quality assurance frameworks for online course design and delivery.

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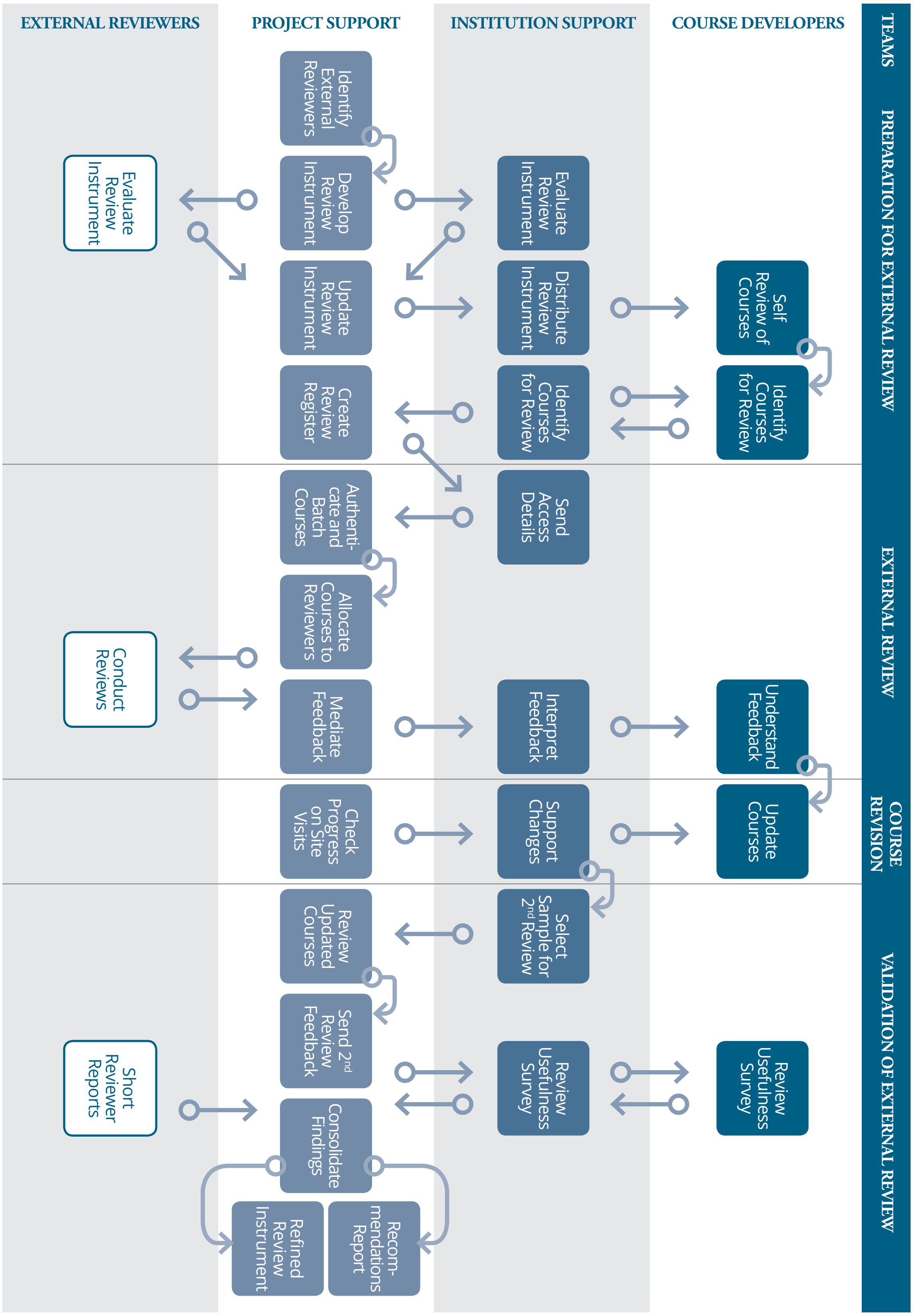
APPENDIX: SUMMARY OF EXTERNAL REVIEW PROCESS



Determinants of the Successful Diffusion of Technology Innovations in Higher Education Institutions in Africa: A social network approach

John Kandiri
Kenyatta University, Kenya
jkandiri@gmail.com

Joel S. Mtebe
University of Dar es Salaam, Tanzania
jmtebe@gmail.com

ABSTRACT

This study investigated how the institutional social networks of project coordinators and/or team leaders contributed towards the success or failure of the 26 technology innovation diffusion projects that were implemented under the Partnership for Higher Education in Africa Educational Technology Initiative across seven higher education institutions in Africa. The study used 105 questionnaires, 34 face-to-face interviews and 19 focus group discussions to survey respondents who were involved in the implementation of technology innovations. The study found that the appointment of institutional project coordinators and/or team leaders and the selection of team members were key to the success of technology innovation diffusion. Additionally, institutional coordinators and/or team leaders who inclined more to the centre of their institutional social networks proved to be a significant factor in the success of technology innovation implementation in their institutions. The findings of this study have significant implications for those involved in implementing educational technology innovation in higher education institutions in Africa, and may well be helpful for funders, project teams, and university management.

Keywords: opinion leaders, social network analysis, innovation diffusion, social system, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

INTRODUCTION

Higher education institutions in Africa have been adopting and integrating educational technologies into teaching and learning in a bid to reap some of the benefits to be had. Specifically, such benefits include expanding access, reducing costs, and improving quality (Linna, 2013), as well as providing access to a wide range of educational resources electronically to supplement face-to-face delivery (Unwin et al., 2010). The Association of African Universities argues that proper use of educational technologies in African higher education institutions can reduce the knowledge, technology, and economic gaps between Africa and the rest of the world (Farrell & Isaacs, 2007).

The perceived benefits of educational technologies have motivated numerous institutions and international agencies – such as the World Bank, the Swedish International Development Cooperation Agency (SIDA), the

United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Development Programme (UNDP), and the United States Agency for International Development (USAID) – to pilot and implement various educational technology projects in Africa (Farrell & Isaacs, 2007). At the same time, higher education institutions have continued to spend hundreds of thousands of dollars on establishing computer laboratories and learning management systems, on capacity building, and on upgrading Internet connections (Zimmerman & Yohon, 2004). Recently, the Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI), funded by a consortium of American foundations and managed by the South African Institute for Distance Education (Saide), supported seven universities in Africa to integrate various educational technologies into teaching and learning (Hoosen & Butcher, 2012).

Through the support of Saide, in total 26 projects were developed and funded at the seven participating institutions. During project implementation, Saide provided various forms of technical and pedagogical support to participating institutions in order to enable smooth implementation of the projects. The support covered the following areas:

- Deployment of learning management systems, and technical capacity building in the maintenance of such platforms;
- Producing, piloting and reviewing e-learning courses;
- Building instructional design and technical capacity among course development teams;
- Procuring the software applications necessary to produce effective e-learning courses; and
- Conducting research to assess the use and impact of e-learning on campus.

The evaluation conducted at the end of project implementation showed that 16 out of the 20 implementation projects that had online courses as their tangible outputs had fully achieved or exceeded their original targets (Spaven, 2013: 30). Moreover, approximately 250 online course modules had been produced or improved. Some courses had been enhanced with multimedia elements to make them interactive. In addition, 26,520 past examination papers had been digitized and made available to users. In all seven of the participating institutions, learning management systems – specifically, Moodle – had been installed and/or upgraded. Some of the institutions managed to develop mobile learning platforms, radio scripts and voicing for 100 courses, and e-portfolio models. Four of the 26 projects were independent research projects and, of those, one exceeded its original targets.

Despite these successes, the implementation of these projects faced various challenges and unpredictable results. According to Spaven (2013), the majority of the projects took longer to produce expected results than was originally planned, and they requested extension beyond 2012 to complete their targets. More specifically, by June 2013, eight of the 26 projects had not fully achieved their targets. By the end of the programme (December 2013), of the 26 projects, eight had partially achieved their targets (Spaven, 2013: 30, 46).

The failure of technology innovation implementation projects in Africa is a common phenomenon. For instance, the project failure rate of projects implemented in Africa by the World Bank was over 50% until 2000, while Independent Evaluation Group (IEG) research discovered that 39% of World Bank projects were unsuccessful in 2010 (Ika, Diallo & Thuillier, 2012: 105). The majority of projects implemented in Africa tend to fail: either totally or partially. 'Total failure' means the innovation was implemented but immediately abandoned, while 'partial failure' means major goals were unattained or there were significant undesirable outcomes (Heeks, 2002). Therefore, there is a pressing need for institutions in Africa to understand what determines the effective implementation of technology innovation, in order to minimize the risk of future failures. This is because failure of technology innovation projects in Africa is likely to continue to be high due to limited resources such as capital and skilled labour (Heeks, 2002).

Previous studies have tended to focus on the role of top management, financial motivation, organizational culture, and organizational climate in determining educational technology innovation implementation effectiveness (Peansupap & Walker, 2005). While empirical data shows that these factors are determinants of success in technology implementation, the role of social networks – and especially the role of team leaders and/or coordinators – has not been well considered. As a result, relatively little is known about the leadership characteristics and practices that may explain why, specifically in Africa, some educational technology innovations diffuse fast, while others diffuse slowly, and yet others fail – partially or totally.

The objective of this case study is to investigate the influence of social networks, and specifically the role of project leadership, on technology innovation implementation effectiveness, focusing on the 26 projects implemented in the seven PHEA ETI participating institutions. Specifically, the study investigated the following:

- How the institutional coordinators and team leaders were appointed;
- How team members in institutions were selected;
- The relationship between institutional project coordinators, team leaders and team members;
- Team members' perceptions of institutional project coordinators and/or team leaders; and
- The motivation and fidelity of institutional project coordinators and team leaders during the technology innovation diffusion process.

THEORETICAL FRAMEWORK

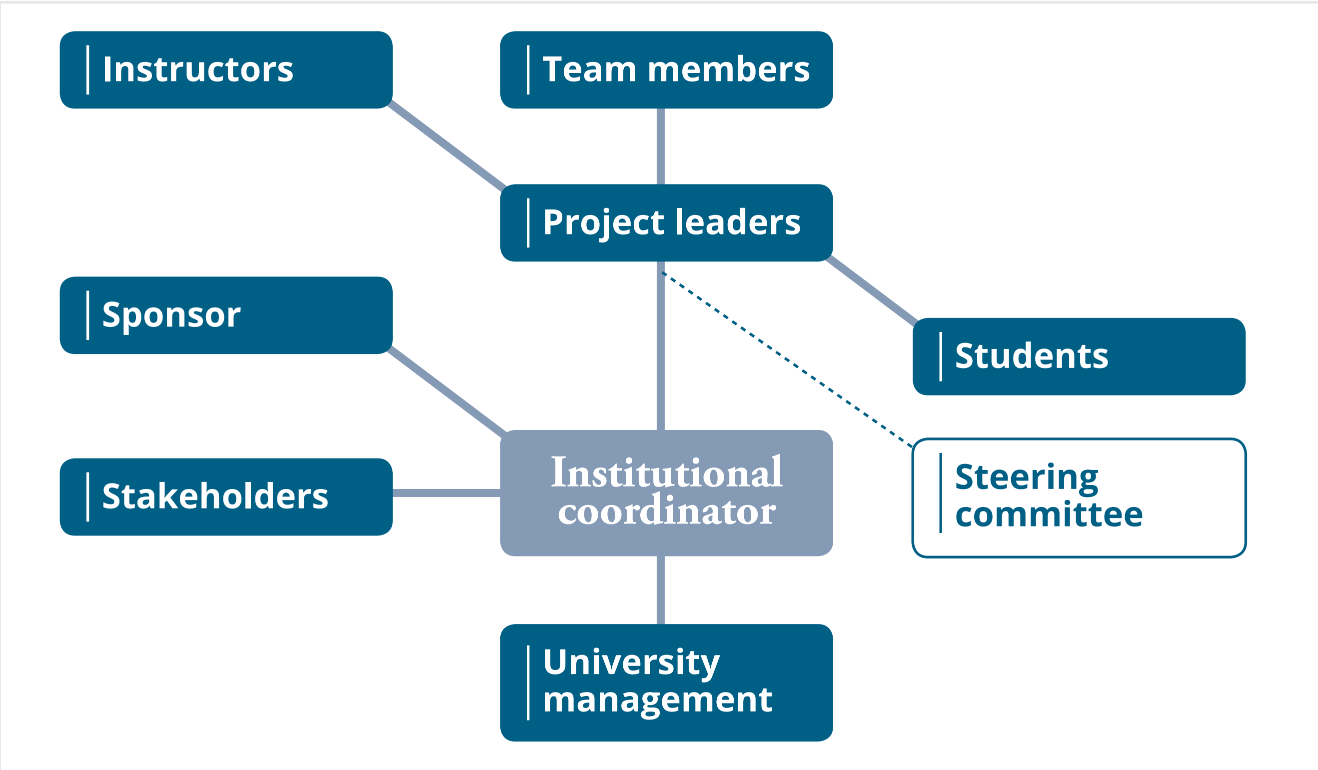
The theory of social networks has been widely used to explain the rate at which an innovation diffuses in a given context as well as to explain why some innovations diffuse better than others (Abrahamson & Rosenkopf, 1997; Valente & Davis, 1999). Social network analysis has been used as an effective approach to facilitating the dissemination of information about new technologies and thus promoting adoption (Mirriahi, Dawson & Hoven, 2012). Rogers (1995) defines diffusion as 'a process by which an innovation is communicated through certain channels over time among the members of a social system' (1995: 5). He adds that the diffusion of a new idea has four elements: the innovation itself, communication channels, time, and members of a social system.

In the context of the current study, innovations are those outputs of the projects implemented in seven institutions in Africa that were spread through various communication channels. These communication channels include the training workshops and meetings that were carried out during project implementation. Innovations normally diffuse through social networks linking individuals who are involved in the adoption process in the institutions (Abrahamson & Rosenkopf, 1997; Rogers, 2003). This group of individuals is what is termed a 'social system'. Rogers (2003) defined the social system as 'a set of interrelated units engaged in joint problem solving to accomplish a common goal' (2003: 23). In the PHEA ETI projects that were the focus of this case study, the social system included institutional project coordinators, team leaders, team members, students, instructors, and other stakeholders who were involved in project implementation.

Rogers (2003) argues that the structure and nature of a social system has a major influence on innovation diffusion adoption decisions. The structure determines how individuals are involved in the creation of the innovations and in diffusion of innovations, as well as determining the types of innovation decisions and norms within the system. The choice of structure of a social system depends on the nature of innovation, the context in which the innovation is diffused, and the type of users. Consequently, several types of social network exist. However, most of the PHEA ETI projects adopted centrally structured networks coordinated by institutional project coordinators. The coordinators were closely assisted by individual team leaders, who managed day-to-day project activities.

The project coordinators were positioned at the centre of the social network, as illustrated in Figure 1. Several studies describe project coordinators so positioned as being opinion leaders (Valente & Davis, 1999). Freeman (1978) defines the central position as having the maximum possible connection to others, the shortest possible path to other points, and the minimum distance from all other points in the social network. In the context of the current study, they are close to all individual team leaders, sponsors, other stakeholders, and the university management. Also, they can quickly interact and communicate with all the people in the network without going through many intermediaries (Landherr, Friedl & Heidemann, 2010).

Figure 1: Example of a social network in PHEA ETI projects



Due to their position, institutional project coordinators are seen by team leaders, team members and other people involved in the diffusion of innovation as a major channel for information (Freeman, 1978). Consequently, they play a vital role in the success or failure of the project implementation. They must be willing to be active participants in project implementation during the diffusion process (Valente & Davis, 1999). At the same time, they should be able to share information, encourage others, and collaborate in different ways with all the people involved in the technology innovation process at the university, in order to facilitate the adoption and use of the innovation (Hamre & Vidgen, 2008).

By the same token, institutional project coordinators can inhibit the implementation of a technology innovation if they are not active, if they distort information in transmission, and/or if they are too busy to share innovation ideas with the people involved in the technology innovation diffusion process (Freeman, 1978; Hamre & Vidgen, 2008). They may also affect the implementation of innovation if they are not aware of the needs of the project and/or are not knowledgeable about the innovation they are implementing (Valente & Davis, 1999).

In fact, the role of opinion leaders in the diffusion of innovations is well researched and documented. For example, in the North American context, Mirriahi et al. (2012) investigated the relationship between the position of instructors in the departmental social network and their facilitation (or otherwise) of technology adoption in higher education. Using a sample of 75 instructors from three departments, the study revealed that those instructors who adopted a greater number of technologies were in an intermediary position in their departmental social network, and hence assisted with the spreading of information across that network.

Similar conclusions were reached in studies that investigated the role of opinion leaders in the diffusion of medical nutrition innovation (Weenen, Pronker, Commandeur & Claassen, 2013), and online learning communities (Li, Ma, Zhang & Huang, 2013). However, research on the role of coordinators or opinion leaders in facilitating innovation diffusion in educational technologies in higher education institutions in Africa is limited. As a result, relatively little is known about the leadership characteristics and practices that may explain why some educational technology innovations diffuse fast while others diffuse slowly or even fail in Africa.

METHODOLOGY

The current study used both questionnaires and interviews. The questionnaire was distributed via e-mail. An Internet-facilitated survey was appropriate for this study due to the fact that the study was on technology adoption and all the projects being implemented were using the Internet and information and communication technologies (ICTs). Moreover, the wide geographical spread of the respondents made it convenient, both cost-wise and logistically, to administer the questionnaire by e-mail. This also enhanced the return rate of the questionnaires. SPSS version 17 was used in analysing the quantitative data.

For the qualitative data, 34 face-to-face in-depth interviews and 19 focus group discussions were held. The interviews were transcribed verbatim and then theoretical thematic analysis was conducted. The transcribed write-up was read and re-read and the analysts extracted the overarching themes.

RESEARCH FINDINGS

Demography

Out of the 163 targeted e-mail questionnaire respondents, 105 replies were usable for the study, giving a response rate of 64.4%, which is higher than similar studies in the domain of science implementation. The number of respondents per participating university is shown in Figure 2.

Figure 2: Questionnaire respondents, by university

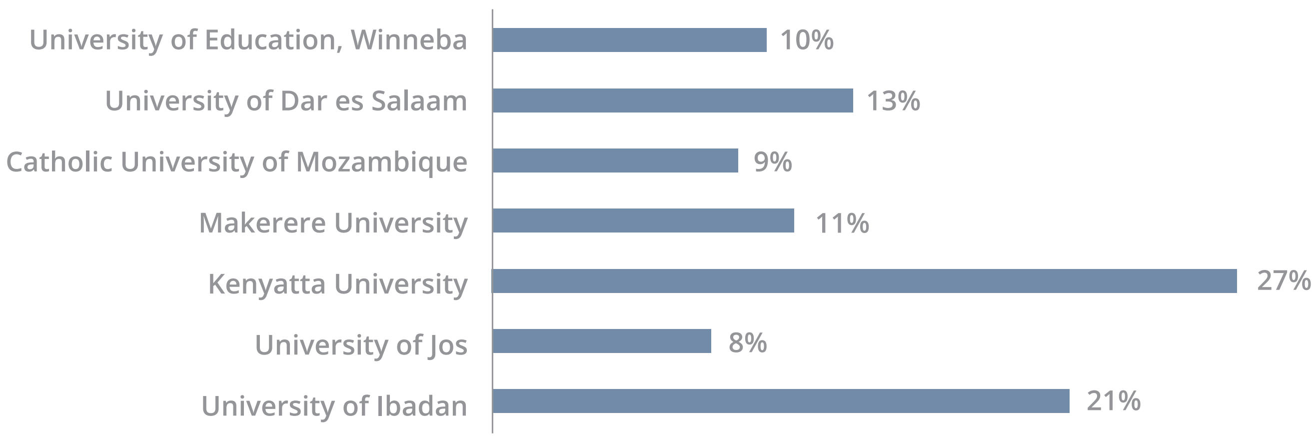
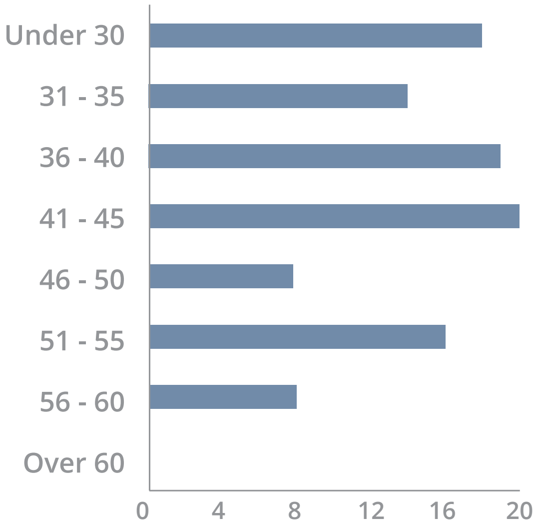


Figure 3: Age of respondents



As shown in Figure 3, the majority of respondents were below 45 years of age.

With regard to the highest level of education among respondents, the findings were as follows: the majority (47 in number, 44.7%) had a masters degree, followed by senior lecturers (PhDs: 15 in total, at 14%). Of the PhD holders, ten were full professors, and five were associate professors, while undergraduate degree holders numbered 13, diploma holders numbered six, and none of the respondents were at certificate level in terms of academic qualification.

In terms of level of ICT skills, 12% of the respondents had basic computing skills, 45% could use and develop computer applications, 25% could do some programming and 17% had advanced knowledge and could specify requirements.

Appointment of institutional project coordinators and team leaders

The study investigated how institutional project coordinators were appointed. There were great variations between institutions on how the coordinators were nominated to lead the PHEA ETI projects. The study revealed that 57.1% of the institutional project coordinators were appointed by the vice-chancellor (VC) of the respective institutions. This was borne out by the interview responses of some of the institutional project coordinators. For instance, the respondent from one institution said:

> *When the request for participation came I was then the acting director of the university ICT directorate. The VC sent a document to me for study and advice. I studied it, and advised the VC on what the document was all about, so he subsequently sent and forwarded my name to Saide as the contact for the process of whatever this project [entailed].*

On the other hand, 42.9% of the institutional project coordinators were the very people who had initiated the technology innovation and written the project concept note, and thus they automatically became the institutional coordinators or team leaders. For example, when asked how he became team leader, one of the participants commented: 'It naturally happened that people who were working on the proposals became the team leaders of each and every proposal which they were leading.'

Similarly, a team leader from another institution said:

> *Our university exhibits a unique [opportunity] in a way that if individuals kind of set up their initiatives in terms of project programmes they are always given an opportunity to lead them. So there wasn't any other meeting that we needed to choose the leaders; automatically I became the leader of that team because I really understood what I wanted and how I wanted it.*

According to a respondent from another institution:

> *The team leaders kind of were default in the sense that when we started discussions with Saide there were many, many projects; and people who fronted projects did concept notes and then we had meetings, and Saide decided which projects were finally going to be funded. So the leaders of those projects which were ultimately chosen became the automatic team leaders of those projects because they were the division bearers of those constituency projects.*

Regardless of the selection criteria, the study revealed that the majority of institutional project coordinators and team leaders (60%) held a senior administrative post in the university. Some were deans, heads of department, heads of e-learning sections or heads of the section in which the project was based. Furthermore, some of those institutional project coordinators went on to appoint project steering committees that would brainstorm the project progress.

Selection of team members

The study investigated how team members were selected to join specific projects. When asked how team members were picked, 65% of respondents answered that they were picked because they worked in the section in which the project was being implemented. Team players were also highly regarded in picking team members. This was evident from the response to the question regarding whether team play was a consideration in terms of who was picked for inclusion in the team: 50 respondents (47.6%) indicated they agreed, while 19 others (18%) indicated they strongly agreed.

In some institutions formal appointments were made through invitation letters, while in other institutions the selection was totally informal. For example, when team members were asked through a questionnaire if they received an invitation letter to join the team, 26% responded that they did not get an invitation letter. Another 13% were not sure, but 55% either agreed (30%) or strongly agreed (25%). In a follow-up interview, it was revealed that at some institutions members were picked from the department based on their competence, but that this was done informally. One of the team members from a participating institution explained as follows:

> *…there was no letter; it was a sort of a 'gentlemen's understanding'. The HoD told me that I was nominated and the team leader informed me that it is about the one of science and technology…It was a matter of calling me on the phone and telling me that I was also a member of that group.*

Similar comments were received from the other institutions. When asked if they had joined the project because they were originators of the idea, only 25% either agreed or strongly agreed, with a large number (60%) either strongly disagreeing or disagreeing.

Closeness between institutional project coordinators, team leaders and team members

The findings from interviews revealed that there was a close relationship between the project coordinators, team leaders and team members. In four institutions, which had a total of eleven projects (42%), the institutional coordinators appointed both team leaders and project team members; while in one institution, the institutional coordinator, the team leaders and the team members were appointed by university management. Furthermore, in three projects (11.5%), the team leaders, in consultation with institutional coordinators, appointed the team members. At the University of Ibadan, for example, during the focus group discussions, eight out of the ten respondents indicated that they were either former students of the team leaders and/or project coordinators or they worked in the same department. At Kenyatta University, all the team members in the online executive MBA project were logically drawn from the same school under the dean. This meant that the dean wielded the power, and that power association moved the team. In the project focusing on digitization of past examination papers, the deputy librarian was a team member and this also meant that implementers knew they were working with their boss. In all the projects at the Catholic University of Mozambique, the institutional coordinator and the team leader were the ICT director and Distance Education director respectively. The team members were drawn from their sections. This was also the case for all projects at the University of Dar es Salaam: the team members were drawn from the Centre for Virtual Learning (CVL), or from the Department of Computer Science and Engineering.

Team members' perceptions of institutional project coordinators and/or project leaders

When the respondents were asked to describe their team leaders, 71% believed their leaders were focused, and 53% believed they were inspiring, with only 2% and 4% indicating that their leaders tended to be inactive, and too busy to engage in project activities. When asked if team leaders' knowledge contributed to project success, 78% of the respondents either agreed or strongly agreed, while only 8% disagreed and none strongly disagreed. The same responses were replicated when respondents were asked if team members' knowledge of ICT facilitated success. This was further backed up by the interviews. For example, when asked if the project leaders and institutional coordinators contributed towards the success of the project, one respondent said: 'To me project coordinators played a greater role in project success because they are the ones who initiated the various training interventions for us. They even struggled for us to train outside the country.'

Similarly, one of the respondents from another institution said:

> *[The] team leader will have all it takes to encourage his followers or members of his team, even when certain expectations are not met. If we ask what it takes to lead we always have that kind of a word they need at any point in time to keep them moving.*

Motivation and fidelity of institutional project coordinators and team leaders

In some of the projects, the institutional coordinators and team leaders lacked fidelity especially on reporting project outputs as well as project success. This finding became evident in the qualitative data. Lack of fidelity was evident in four (15%) of the 26 projects. In one of the projects, content was meant to be animated but the team leader went for adding graphics. A respondent from one of the institutions evidently illustrated that:

> *No, that was the first phase; the next phase had materials so they were to add graphics and animations. But let me be clear; they did not add animations to all twelve. I think they picked a few [laughs] and added graphics.*

In another project the team leader agreed there was lack of fidelity:

> *Yes, and apart from that it had its limitations: number one, unless it is archived students cannot go back to that same session. Once the sessions [is] over, one hour, two hours, that's it? […] so I sat them down as the director, I sold this idea to them; something came up so suddenly then I carried them along under this new proposal, the revised proposal is that we will simulate a class instead of having radio and TV sessions as initially proposed.*

There was a noted lack of voluntariness from project leaders. A case of leaders who came in simply in order to 'comply' can be seen from the following explanation by one of the respondents:

> *But like I mentioned to you in an earlier chat, leaders of some projects were imposed on the project. They had no interest, no motivation and therefore acted for a while as a hindrance to project progress rather than as facilitators.*

Additionally, in some projects, it was evident that the lack of proper networks inhibited project implementation. This was where institutional project coordinators and/or team leaders treated their projects as 'islands' of innovation instead of working with other staff members in their departments. From the interviews, it was evident that four projects were affected by the existence of a silo mentality. Some of the departments were reluctant to share technology knowledge, while in other cases there were individuals who did not want to share. Fragmented adoption remained a challenge and 'pockets of innovation' are risky and do not become stable for acceptability by other departments.

DISCUSSION

The study investigated how the position of institutional coordinators and project leaders in their institutional social networks contributed to the success or failure of the technology innovation projects implemented across the seven African higher education institutions. The study found that project coordinators and project leaders were at the centre of communication in the implementation of the innovations in their institutions. The findings of the study are consistent with those of Hamre and Vidgen (2008), who found that individuals at the centre of the social network influenced the diffusion of finance management system implementation in a higher education organization.

The study also found that institutional project coordinators and team leaders played a significant contributing role in the success of the projects, especially those that met their targets. In these projects, institutional project coordinators were active, dedicated, and involved in almost all the implementation activities such as planning, promotion, training, resource allocation and technology pilot testing. These findings corroborate those of Hamre and Vidgen (2008), and those of Mirriahi et al. (2012), already mentioned.

However, Landherr et al. (2010) argue that one of the main challenges facing diffusion of technology innovation is how to identify key persons (opinion leaders) in a social network during the technology innovation diffusion process. In the PHEA ETI projects, the current study found that two methods were used. Firstly, those who initiated the project ideas automatically became coordinators and/or team leaders. These individuals were knowledgeable with regard to the domain of the technology innovation to be implemented and therefore contributed towards its success. According to Valente and Davis (1999), leaders with sufficient knowledge of the technology innovations are important as they are aware of the types of technology innovation likely to succeed and how they should be implemented.

Secondly, in some institutions, institutional project coordinators and team leaders were appointed by the top university management from within the implementing unit; therefore, there was a political connection and trust between the project coordinators and/or team leaders and top management. The involvement of top management in the PHEA ETI projects had a significant positive impact on the success of the technology innovations (Spaven, 2013). Top management could offer a range of support services such as additional funding support, technological support, and experience support, which contributes to the success of the technology innovation beyond project implementation (Lin, Ma & Lin, 2011).

Institutions that were not able to identify key persons with qualities of opinion leaders experienced a number of challenges during the technology innovation diffusion. This was argued by Spaven (2013), who claims that some of the PHEA ETI projects did not have available key personnel to facilitate the implementation and diffusion of technology innovation in their institutions. In the majority of those projects, institutional coordinators and/or team leaders were not active and could not share technology innovation in the institutional social network. This finding was further backed up by the quantitative data, when respondents were asked to rate the commitment of coordinators and project leaders. It was found that 6% answered that their institutional project coordinators and/or team leaders were either 'laid back' (2%) or too busy for the project (4%). It is likely that such coordinators/leaders were not aware of the needs of the project or were not knowledgeable about the innovation they were implementing (Valente & Davis, 1999).

In addition to project coordinators and team leaders, the selection of team members was a key factor in the success of the majority of the PHEA ETI projects. Spaven (2013) describes the project teams and team members as the 'building blocks' of the PHEA ETI project implementation. The current study revealed that almost two-thirds (65%) of the team members were selected by the institutional project coordinators and/or project leaders, and that the majority of them came from the project implementing unit in the institution. As a result, most of them trusted their leaders, and had positive perceptions of the technology innovations coordinated by their project coordinators. According to Rogers (2003), such perceptions are a critical factor in the adoption decision process. The perceptions of team members of their coordinators and team leaders were evidenced by the responses of the team members when asked to rate the performance of their leaders during technology innovation implementation. The majority of the team members concurred that their team leaders either provided an inspiration or were quite focused on results (with 71% of the respondents answering that team leaders were focused and 54% answering that they provided inspiration).

CONCLUSION

This case study investigated the role of institutional project coordinators and/or team leaders in institutional social networks in the success of PHEA ETI projects implemented in seven higher education institutions in Africa. Generally, it was found that the projects that were successful and managed to meet all the intended projects outputs were those in which institutional coordinators acted as opinion leaders during the technology innovation process. On the other hand, in the case of most of the projects that did not achieve all their intended outcomes – and could thus be termed partial failures – the institutional coordinators did not harness the resources of the social network system as opinion leaders. The current findings add substantially to our understanding of the role of institutional coordinators and/or team leaders in the diffusion of educational technology innovation in higher education specifically in Africa.

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NOTES:

An Investigation of the Deployment of the Moodle Virtual Learning Environment at Eight African Universities

Brenda Mallinson
Saide; Rhodes University, South Africa
brendam@saide.org.za; B.Mallinson@ru.ac.za

Greig Krull
Saide
greigk@saide.org.za

ABSTRACT

The deployment of educational technology to support teaching and learning at universities can take many forms. Critically, one of the major components for the delivery of online courses is the setup and management of a virtual learning environment (VLE). This case study considers VLE implementation challenges from a technological perspective and investigates the VLE deployment within eight sub-Saharan African universities. Each university adopted or migrated to the open source Moodle VLE. The associated strengths and weaknesses of implementation in the participating universities are examined. Finally, the lessons learned are collated into a set of guidelines for VLE implementation and maintenance processes for successful implementation within this context.

Keywords: Moodle, virtual learning environment, educational technology, e-learning implementation, distance education, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

INTRODUCTION

Using technology in support of teaching and learning is increasingly a priority for higher education institutions in their efforts to engage learners in meaningful educational experiences. EDUCAUSE (2003) reports that this commitment is driven by many factors, including the widely prevalent strategic vision of enhancing the teaching and learning environment and responding to changing faculty and student needs for increased flexibility with respect to time, place and mode of course delivery.

While the deployment of educational technology in the higher education sector in Africa can be perceived as a solution to some challenges, it raises additional issues such as coping with unreliable power supply, limited Internet access, pedagogical considerations, and the need for sufficient local expertise to support such deployment. A key consideration is the technical infrastructure and environment enabling the use of the technology for teaching and learning. This case study explores the technological challenges involved in deploying the Moodle virtual learning environment (VLE) at higher education institutions in the sub-Saharan African context and provides some recommendations for overcoming these challenges.

BACKGROUND TO THE STUDY

As explained in the introduction to these case studies, each of the seven participating sub-Saharan African universities conceptualised and developed its own projects, resulting in 26 distinct projects in the four-year initiative. Of these 26 projects, eleven individual projects involved the use of a VLE, for mounting over 140 online courses as project deliverables. Ensuring the successful implementation and maintenance of the VLE at each institution was therefore a crucial component of the overall programme. It should be noted that the participating higher education institutions were largely on-campus institutions that were planning to adopt a blended approach to using technology to support their teaching and learning activities. In this respect the environment could be considered low-risk in that there were elements of scheduled face-to-face instruction and communication that were to take place concurrently with the online interactions within the VLE.

In addition to the seven universities participating in the PHEA ETI,[1] the Open University of Tanzania (OUT) was included in this Moodle survey because although OUT was not part of the PHEA ETI, there was an ongoing concurrent relationship with the institution, and it is geographically close to one of the participating universities.

SELECTION AND USE OF A VLE

A comprehensive VLE is an important means for delivering distance learning, but is also crucial in a blended learning situation, allowing students to access a range of electronic resources to supplement traditional face-to-face teaching (Unwin et al., 2010: 5). A VLE or learning management system (LMS) is used to house and deliver learning content, and facilitate and add value to the teaching and learning process. A VLE can be viewed as an integrated distributed learning environment and a good starting framework in developing country contexts where higher education institutions wish to embark on the deployment of supporting technologies. The notion of a single-user sign-on to a single software application, within a relatively simple and safe learning environment, engenders confidence for new users – be they lecturers or students. Typical features of a VLE include (Sife, Lwoga & Sanga, 2007: 59):

- Learning activity types (individual and collaborative) including forums, quizzes, assignments, and wikis;
- Communication tools including journals and instant messaging;
- Access to resources including embedded web pages, internal uploaded and linked files, and external links to websites; and
- Administration tools including user authentication, grading and student enrolment.

There are many different VLEs available on the market. There are proprietary solutions such as Blackboard as well as open source solutions such as Moodle and Sakai (Unwin et al., 2010; Sife et al., 2007). In the current study all eight participating institutions elected to either adopt or migrate to the Moodle VLE. Moodle is a free, open source e-learning platform available under the GNU Public Licence, and has a vibrant user and developer online community at Moodle.org. The Moodle.org community is a network of over a million registered users, who interact through the community website to share ideas, code, information and free support. At the time of this investigation, there were 66,617 active sites registered on Moodle.org from 215 countries. The numbers of registered Moodle sites listed from PHEA ETI participating countries were: Uganda: 11, Nigeria: 55, Ghana: 24, Mozambique: 12, Tanzania: 20 and Kenya: 80 (Moodle, 2012a).

There were a number of reasons for selecting Moodle, including that the system is open source (no licence cost) in nature and very well supported (Twaakyondo & Munaku, 2012: 34). Studies on factors affecting

1 Kenyatta University (Kenya), University of Dar es Salaam (Tanzania), University of Ibadan (Nigeria), University of Education Winneba (Ghana), University of Jos (Nigeria), Catholic University of Mozambique (*Universidade Católica de Moçambique*) and Makerere University (Uganda).

acceptance and use of Moodle include that undertaken by Sumak, Hericko, Pusnik and Polancic (2011), whose analysis revealed that the actual use of Moodle depends on the behavioural intention and attitudes towards using Moodle, and that perceived ease of use has a significant impact on perceived usefulness. In an evaluative comparison study using weighted criteria representing the needs of Canada's Athabasca University, Stewart et al. (2007) reported that Moodle was a clear choice for them, achieving 58 (of 71) first-place preferences in terms of individual criteria among the three VLEs evaluated. In the current case study, in order to ensure support for the implementation, maintenance and end use of this system at each participating higher education institution, it was essential to identify and investigate technological challenges associated with VLE implementation, so that such challenges might be addressed.

BARRIERS TO SUCCESSFUL VLE IMPLEMENTATION

Marquard's (2013) Educational Technology Stack provides a structured approach within which to examine a number of institutional educational technology elements and their associated considerations. Suggested layers to be considered start from policies and strategies and take cognisance of many interlinked factors, including programme, curriculum and learning design, academic staff professional development, the literacies of the target learners and their access to the course, student support, and appropriate ICT infrastructure, as well as referencing existing software platforms and modus operandi at the higher education institution. In the literature, some of these layers were identified as potential challenges to successful technical deployment.

Lack of institutional policies

Sife et al. (2007) identify failure to take a *systemic* approach to information and communication technology (ICT) implementation as a major challenge to successful implementation, and advocate an institutional ICT policy and an institutional strategic plan for ICT project implementation. Unwin et al. (2010: 17) found that the absence of an e-learning policy in institutions can be a major factor limiting the use of the VLE.

Limited technological infrastructure

Network infrastructure, Internet access and power supply: Unwin et al. (2010: 17) suggest that it is 'primarily the technical and infrastructural aspects' of VLE deployment that are the main factors preventing wider roll out. Poor Internet access is acknowledged as a major limiting factor in African VLE implementations (Ssekakubo, Suleman & Marsden, 2011: 234). Limited bandwidth and very high costs of Internet access continue to inhibit the effective use of e-learning across Africa (Unwin et al., 2010: 19). Despite bandwidth and connectivity issues, with careful planning and allocation of scarce resources institutions can deploy effective digital learning environments. For example, a university may be able to build a sound intranet that does not rely on external Internet access (Unwin et al., 2010). Consistent Internet bandwidth was identified as a considerable challenge at each of the eight participating institutions, while the local intranets were found to be more stable. Thus each institution continued or decided to host its own Moodle platform on campus. Unwin et al. (2010: 17) and Mtebe, Dachi and Raphael (2011: 292) identified a further major factor limiting the use of the VLE: an unreliable supply of electricity, with institutions facing intermittent power cuts from a limited national electricity grid.

Configuration of hardware and software: Mtebe et al. (2011: 289) report that a major barrier to e-learning uptake is access to hardware and software. Appropriate server configuration is critical in order to maximise the affordances of the chosen hardware and software.

Ineffective maintenance: For VLE implementations, maintenance and user support are crucial, being the mechanisms through which inefficiencies and other usability problems can be identified and addressed. However many institutions lack maintenance strategies (Ssekakubo et al., 2011: 235).

Lack of technical support

Universities require an ICT technical unit to offer support to users. In many cases these units are understaffed or staff are insufficiently trained to be able to deal with tasks at the level required (Ssekakubo et al., 2011: 235; Sife et al., 2007). Unwin et al. (2010: 20) found that levels of training in the use of VLE were generally very low at African universities. Staff may be unaware of the full functionality of VLEs and do not have the practical experience to implement the functionality effectively.

AIMS OF THE STUDY

One of the main activities within the PHEA ETI involved the design, development and deployment of online courses. In order for the initiative to be sustainable, appropriate supporting technologies such as the VLE needed to be successfully implemented. Failure to correctly install and optimally maintain the VLEs would potentially jeopardize achievement of the project objectives. Thus the current study was formulated to evaluate the VLE deployments at each participating institution, to ensure that the implementation challenges identified above could be addressed. The areas of investigation for the study were identified from a combination of experience from previous VLE site deployments and a brief literature survey. At the time that the study was conceived there was very little literature available on VLE usage in Africa (see Unwin et al., 2010; Sife et al., 2007) and even less regarding the technical and infrastructural aspects of VLE deployment in African universities. It is hoped that the results of this study will add to this body of knowledge. The survey questions were also informed by the 'technological' dimension of Khan's e-Learning Framework (Khan, 2005). This dimension examines issues within the technology infrastructure, including infrastructure planning, technical capability, policy, hardware and software.

The aims of this study were to:

- Collect and evaluate data concerning the respective site deployments of the VLEs;
- Examine these institutional VLE environments and investigate the individual deployment characteristics with a view to eventual contextual optimisation;
- Establish the associated strengths and weaknesses; and
- Collate lessons learned into a set of guidelines relating to implementation and maintenance processes.

DATA COLLECTION

The investigation consisted of a short literature review, an analysis of institutional policy documents, structured interviews with relevant university staff, reviews of the system infrastructure, and general site observations. A survey instrument for data gathering was developed and comprised the following sections:

- Network Environment Policies and Infrastructure;
- Hardware and Software Specifications and Configuration;
- Moodle Site Policies;
- Maintenance and Backup Processes; and
- Technical Support.

Data was collected through the following process:

- An initial request was made to each institutional coordinator to supply relevant institutional VLE policy documents. An analysis of the received institutional policy documents was performed;
- Arrangements were made for the project technical support partner (James Swash of Neil Butcher & Associates) to travel to each institution to conduct structured interviews, review the system infrastructure, and make general site observations. The data was gathered from the eight site visits (one visit to each higher education institution);

- Structured interviews were set up with relevant staff at each university over the period September 2010 to October 2011. This included PHEA ETI project coordinators, institutional systems administrators from Information Technology divisions, and Moodle server administrators. Interviews were conducted with two to four employees with these roles at each institution. During these site visits, an attempt was made to obtain any missing policy documentation from the first request; and
- After the site visits, further information was ascertained via follow-up e-mails.

FINDINGS

The results of the data collection indicated that experience at these higher education institutions of using technology to support teaching and learning varied considerably, with some institutions having been early adopters and others having only recently thought of engaging in e-learning practices. This led to a wide range in general status of the various Moodle installations. One of the opportunities presented by this variety was the possibility of being able to share the specific deployment successes and failures of the early adopters with the more recent technology adopters, thus providing the potential for fast-tracking uptake.

Although the institutions varied in terms of addressing the challenges associated with VLE implementation, a positive finding was that each institution was using a Moodle server to mount a number of live courses and that each VLE was reliable in terms of user availability. The number of courses and users varied greatly between institutions, depending on their environment. Table 1 provides an overview of the broad Moodle environment at each university.

Table 1: Broad Moodle environment at the universities

Aspect	U1	U2	U3	U4	U5	U6	U7	U8
Dedicated Moodle administrator	✓							
Established e-learning/virtual learning unit	✓	✓					✓	✓
Regular staff training	✓	✓		✓	✓	✓	✓	✓
Regular student training	✓	✓		✓	✓	✓	✓	✓
Sufficient budget and skill sets	✓			✓				
Adequate network access for students	✓	✓		✓	✓		✓	
VLE policy in place	✓							

As expected, universities that had been the earliest adopters of a VLE were the most likely to have the optimal environments in place. Only one university (U1) was found to have a conducive environment for successful deployment that covered almost all aspects of the evaluation. At the other end of the scale, the university with the most recent deployment of Moodle (U3) did not yet have any aspects of the broad Moodle environment in place.

The analysis of the findings is presented below according to the possible barriers to successful VLE implementation identified.

Institutional policy

Institutional policies are a useful basis for implementation, practice and procedure. Without institutional policies, decisions tend to occur on an ad hoc basis without proper planning. The participating higher education institutions were at different points in developing policies related to their deployment of the Moodle VLE, with only one (U1) having a comprehensive policy in place. It was found that a comprehensive VLE policy needed to provide guidance relating to both front- and back-end administration, including:

- Administrator roles and responsibilities;
- User authentication;
- Disaster recovery;
- Upgrades and updates;
- Course creation and maintenance; and
- Antivirus and security.

All the universities surveyed had policy development and maintenance processes defined. It was found that policy development processes in the universities are often inclusive and participatory, which means that they take considerable time to complete. Thus even though the surveyed institutions have various VLE-related policy documents in development, in most cases the policies had not yet been approved. Further time is then required before the new policies are accessible and/or disseminated within the institution and well understood by staff. However, it was also found that in general policies are not disseminated and understood by staff. In some cases, each university department was found to be operating its own internal systems and networks, which leads to fragmentation and some departments having inferior and/or unstable environments. A concern was raised by respondents in terms of what mechanisms universities might use to guide or enforce policy implementation.

Technological infrastructure

Network infrastructure, Internet access, and power supply

Only two institutions reported that budget and skills capacity were not constraints for the deployment of the VLE. For the other institutions, the systems administrators made do with existing infrastructure (that may not operate optimally) until more funds became available. In terms of connectivity, some networking challenges were encountered with regard to the number of students needing to be supported. For example, universities did not factor in the need for additional Internet usage during scheduled practical sessions in campus computer laboratories. There was also a shortage of computer lab space for all students. The location and capacity of wireless hotspots also presented challenges: routers experienced overload if the maximum number of users connected.

It was found that all the institutions were affected by unreliable and inconsistent power supply and Internet availability on campuses. This impacted on administrative tasks, as well as interrupting the teaching and learning using the VLE. In some cases, institutions made use of generators to deal with the unreliable power supply, although this proved to be an expensive undertaking. As Internet connectivity was found to be generally unstable, institutions made use of their intranets to minimise the impact of unreliable Internet connectivity.

Hardware and software configuration

The configuration of the hardware is critical for the successful deployment of a Moodle platform: if the server is underpowered or unstable, this will have a detrimental effect on any educational technology initiatives. A comparison was done of the Moodle server specifications and configuration at each institution, as shown in Table 2.

Table 2: Moodle server specifications at the universities

Servers	U1	U2	U3	U4	U5	U6	U7	U8
Operating system	Redhat 32 bit Linux	Ubuntu 9.10 32 bit	CentOS 5.3 64 bit Linux	FreeBSD 7.2 32 bit Linux	CentOS 5.5 64 bit Linux	CentOS 5.5 64 bit Linux	Ubuntu 10.04 32 bit Linux	Slackware 13.1 64 bit Linux
Processor	2 x E5120 1.86 GHz CPU	1 x Intel E5320 1.86 GHz CPU	1 x Intel E5405 2 GHz CPU	2 x Intel X5560 2.8 GHz CPU	2 x Intel X5560 2.8 GHz CPU	1 x Intel E5405 2.0 GHz CPU	1 x Intel 3050 2.13 GHz CPU	2 x Intel E5520 2.27 GHz CPU
Processor use	5%	0.1%	0.1%	1%	1%	1%	10%	5%
RAM capacity	3.4 Gb	2 Gb	4 Gb	2 Gb	12 Gb	4 Gb	2 Gb	4 Gb
Available RAM	60%	56%	10%	60%	87%	0.2%	81%	40%
Hard drives	7	2	Not established	1	4 x 2.5" 7,200 RPM SATA	6 x 3.5" 7,200 RPM SATA	1	6 x 3.5" 7,200 RPM SATA
Drive raid level	5	1	5	Not used	5	5	Not used	0
Hard drive capacity	624 Gb	130 Gb	500 Gb	300 Gb	1,420 Gb	1,000 Gb	249 Gb	1,600 Gb
Space available	400 Gb	119 Gb	242 Gb	105 Gb	1,380 Gb	500 Gb	71 Gb	1,300 Gb
Network adaptors	2 x 1,000 Mb	2 x 1,000 Mb	2 x 1,000 Mb	2 x 1,000 Mb	4 x 1,000 Mb	2 x 1,000 Mb	1 x 1,000 Mb	2x 1,000 Mb
Websites on server	3 Moodle sites	1 Moodle site	1 Moodle site and 1 other site	1 Moodle site	1 Moodle site	1 Moodle site and 3 other sites	1 Moodle site	1 Moodle site
Memory usage per site	20 Mb per thread	20 Mb per thread	20 Mb per thread	20 Mb per thread	20 Mb per thread	20 Mb per thread	24.6 Mb per thread	20 Mb per thread
Server casing	Tower casing	Tower casing	Rack-mount chassis	Tower casing	Rack-mount chassis	Rack-mount chassis	Tower casing	Rack-mount chassis

An identified area of strength was that institutions have sufficient server hard drive space available for all course files. The areas of weakness found were that two institutions (U4 and U7) had insufficient memory to support the growing number of student users and that data redundancy was not always built in (i.e. the institution would lose data in the event of hard drive failure). In terms of hardware and software procurement, one institution flagged procurement problems – in the form of internal processes and regulations – as an obstacle to the acquisition of the necessary hardware for the VLE.

One of the benefits of installing Moodle is its interoperability and ability to integrate with a variety of platforms (Moodle, 2012b). It was found that a variety of operating systems that were stable for the Moodle platform were being used by the institutions, with Linux being the most popular option.

Maintenance

Maintenance must be planned for before failures occur (i.e. preventive maintenance) and should not be treated as an afterthought but as an integral part of the daily running of the systems. At the time of data collection it was found that most participating institutions conducted hardware maintenance on an ad hoc (responsive) rather than a planned basis.

The Moodle.org community frequently updates its application software with new functionality and bug fixes. In addition, there are many very useful optional contributed (add-on/plug-in) modules that may be installed to obtain additional functionality in a particular Moodle server installation (Moodle, 2012d). It was found that software updates and upgrades were performed at different timings across institutions, usually on an ad hoc basis. Additionally, institutions were found to lag by one or two releases behind the latest version of Moodle. Most institutions were still using version 1.9, while version 2+ had been released. However, as an example of cross-institutional sharing of knowledge and skills, at a PHEA ETI inter-institutional workshop, a session was dedicated to sharing the deployment migratory experience from Moodle v1.9 to Moodle v2.x by an early adopting institution (Saide, 2012: 14).

Both the server and Moodle installation running on the server need to be backed up regularly. It was found that backup servers were not in place at the majority of institutions at the time of the survey, which indicates there would be a delay in recovery if there were a server problem. However, all institutions performed regular backups. The timeframes varied from institution to institution, with one of the universities (U3) only performing backups on a monthly basis. All institutions regularly tested their backups for recovery purposes.

Technical support

Only four of the eight institutions had dedicated e-learning support centres/units. The benefits of the presence of a centralised institutional e-learning unit have been noted for being able to provide technical and pedagogical support to academic staff and students (Mtebe et al., 2011: 290). The existence of such centralised support units was also taken by the external project team to be an indication of the level of interest in and understanding of the potential of using educational technologies in support of teaching and learning at project inception within each higher education institution.

A finding of concern was that only one university (U1) had a dedicated Moodle administrator. At the other universities, the role of Moodle administrator was performed by a systems administrator, who was responsible for a variety of systems, not just the Moodle system. A lack of priority focus on Moodle may mean that certain administrative functions would not get the attention they require. In addition, the purpose of a VLE demands a deeper understanding of the academic teaching and learning environment in order to deploy and maintain it successfully; a general systems administrator would have to develop such an understanding over time. Equally concerning was that only one institution had clearly described the roles and responsibilities of the Moodle administrator.

Staff and students need to be oriented to online teaching and learning, and trained and supported in the use of Moodle, to be able to engage effectively in their learning. It was found that the universities recognised the importance of supporting the Moodle users. It was also found that in all but one of the institutions, regular staff and student training takes place. The lack of regular training was an issue at the university that was the most recent to deploy Moodle. In the majority of the institutions, initial staff training was conducted by the external project team, which initially focused on staff capacity building. In most cases, this training has been taken forward by internal support staff. The higher education institutions with centralised support units were at an advantage here as the structures were already in place to propagate good practice and disseminate the new knowledge acquired.

RECOMMENDATIONS

The integration of educational technology into the higher education institution can be a complex issue. Each institution requires clear policies and strategic plans to provide the framework for the development and implementation of specific supporting technologies. Issues that need to be taken into consideration are the diversity of stakeholders, ICT skills levels, staff and student numbers and projected growth, cost-effectiveness analysis, and staff development in new technologies (Sife et al., 2007: 63). Financial resources are also imperative to the successful implementation and integration of technology in education (Sife et al., 2007: 64). For the implementation of a VLE, careful planning and the allocation of resources are required, and institutions often struggle with insufficient funds. The following guidelines are relevant for overcoming technological challenges associated with VLE implementation.

Institutional policy guidelines

The formulation and implementation of an e-learning strategy with a guiding policy is reported by De Freitas and Oliver (2005) to be a possible driver of institutional change. They note a number of factors to be considered, including: cross-institutional sharing of lessons regarding successes and failures; consultations with experts, staff and students; and partnerships within and outside the institution. It is recommended that a comprehensive e-learning and/or VLE policy be developed, approved and implemented at the institutional level. This policy could be stand-alone or an extension of any existing broader institutional ICT or teaching and learning policies. The creation of this policy should be guided by the regular, existing institutional policy development guidelines, and the policy should be easily accessible, clear to understand and, most importantly, enforceable by the organisation. Universities are encouraged to integrate broader aspects of general ICT policies to ensure an optimal environment for the VLE deployment to support teaching and learning. These points of integration may include:

- Network and Internet bandwidth;
- Network structure and maintenance;
- Device provision and maintenance (thin clients, desktops etc.);
- Device- and laboratory-to-user ratios;
- Server procurement, usage and maintenance; and
- Server disaster recovery (backup and restoring).

It is likely that the VLE usage policies of different institutions will be substantially similar, and for this reason it is recommended that institutions with a more mature deployment of Moodle share policies and lessons learned from policy development with the universities with more recent installations.

In addition to the existence of a policy, there should be institutional guidance regarding how the policy is to be reflected in the practice of the university community. Walker (2013) categorizes institutional good practice issues as follows: content creation and deployment, intellectual property rights and copyright legislation, responsible use of the VLE, and provision for obtaining further help regarding access and ownership issues. It should be recognized that the academic community requires practical guidance around these issues in order to promote ethical use of the VLE.

Infrastructure guidelines

Network infrastructure, Internet access and power supply

Institutions have limited bandwidth, which means that it needs to be used optimally and fairly. The monitoring of network access is required to ensure fair usage. Sufficient bandwidth and access (either via wired computer laboratories or wireless access) is required for students to access Moodle. It is suggested that buildings be linked directly to the fibre optic trunk to ensure stable network connections. Universities also need to plan for increased user numbers in the future.

The issue of unreliable power supply should be planned for and mitigated by consistently carrying out scheduled backup and maintenance procedures and the use of backup power supply. Similarly, the VLE deployment should make good use of the institutional intranet to alleviate the problem of interrupted Internet access. Academic staff should be prepared to make alternative plans should either power or connectivity interruption occur during their course delivery.

Hardware and software configuration guidelines

The study concluded that the Moodle.org community (Moodle, 2012b) is the best source of practical guidance concerning recommended practices with regard to server hardware and software. Several specifications were suggested for optimal use of hardware and software based on the findings. These specifications were provided along with Moodle suggested minimum specifications (Moodle, 2012b). Noting the hardware specifications for the Moodle server can make it easier to understand the possible limitations of the Moodle installation, while knowing which software is installed will affect how operations are performed on the server. Table 3 provides these specification guidelines as they were at the time of the study. However, they are continually updated on Moodle.org, making it a primary reference for new and updated installations.

Table 3: Suggested optimal server specifications

Specifications	Moodle suggested minimum	Suggested optimal specifications
Hardware		
Processor	Not specified	2 x Intel® Xeon™ DP 5620 processors – 2.4GHz quad core
RAM capacity	Average 1 Gb per 10–20 concurrent users	32 Gb

Number of hard drives	Not specified	6 x serial attached SCSI (SAS) – 16 Mb 15,000 RPM hard disk drives
Hard drive raid level	Not specified	5 or 10 depending on preference
Total hard drive capacity	5 Gb minimum	Over 500 Gb
Backup storage	As per hard drive capacity	Enough storage for backups and archives
Optical media	Not specified	DVD-ROM
Number of network adapters and speed	Not specified	2x 1,000 Mb (if one adapter fails, the other takes over)
Server casing	Not specified	Rack-mount chassis
Additional server administration access	Not specified	Remote access via secure shell (SSH) network protocol FTP access for transferring files to Moodle directories
Software		
Operating system	Linux or Windows	64 bit version of Linux
Web server	Apache or IIS	Apache 2
Scripting language	PHP	PHP 5
Database	MySQL or PostgreSQL	MySQL

Source: Moodle.org (2012b)

The Moodle.org community also provides guidelines for managing the site, for example, managing performance (Moodle, 2012c). The processor load should be carefully monitored to assess peak usage and determine if the server is overloaded. It is advisable for each Moodle site administrator to have a separate account so that an audit trail can be kept.

Maintenance guidelines

A combination of project experience and guidance from the Moodle.org community (Moodle, 2012c) provided a baseline for elements of managing activities such as updates and upgrades for a Moodle server. A maintenance process determines when and how often maintenance should occur, and this should cause as little disruption as possible for the minimum amount of time. A maintenance process should include:

- Hard disk drive and database defragmentation;
- Log checking;
- Server performance optimization;
- Server usage monitoring; and
- Upgrade and update planning.

A Moodle administrator can configure a schedule for automated course backups of some or all of the system's parts (Moodle, 2013), usually scheduled for a period of low usage. Both the server and the Moodle installation running on the server need to be backed up to a safe place for a period of time as defined in the maintenance policy. General practice is to keep backups available for five years and then archived for ten or more years. It should also be noted that Moodle backups from older versions of courses can be restored in newer versions, but it is still advisable to back up the courses. Backups need to be tested for their integrity, to be restored in the shortest time possible, minimising downtime. Backups can be stored on writable DVDs and can be performed weekly or, ideally, nightly. In addition to this, each course residing on the Moodle server should be individually backed up on an ad hoc basis by a course creator or teacher with editing rights for individual backup purposes.

New features and security fixes are continually being released and having an unsecured website containing sensitive student data is a major risk. Although the update process is generally safe, precautions should still be taken. These should form part of the institution's upgrade policy, which will also define the best times for server downtime and the process for notifying all relevant parties. Operating systems are also frequently updated. Here, too, the timing of upgrades requires planning as it may be necessary to reconfigure settings or restart the server. Updates/upgrades should be done on a planned monthly basis. When upgrading Moodle, the latest 'stable' versions should be used and not the development versions. Consideration needs to be given to consistency in the use of themes that influence the look and feel of the Moodle site as well as the operation of any plugins. Institutions should plan their upgrades and updates very carefully so as not to disrupt the live teaching and learning activities at the institution. Ideally, major upgrades should occur outside the university terms/semesters, and even minor updates should be effected without perceived disruption to the VLE users (lecturers and students). With the Moodle.org site being constantly updated, this was considered a good source of reference for institutions when planning a new installation or upgrade (Moodle, 2012b).

Technical support guidelines

Unsurprisingly, universities that have functional technical and user support units are in a better position to handle usability issues and other technical problems, thereby encouraging and retaining users on the system (Ssekakubo et al., 2011: 236). It is recommended that institutions establish a dedicated e-learning unit, which may start small but grow as Moodle usage increases. This specialised unit needs to be structured so that it runs parallel to institutional faculties and departments, supporting all staff and students. Ideally the head of this unit would be answerable to a member of the institutional senior management, so that the unit is not seen by staff as a subset of a particular department or faculty. Having interests that stretch well beyond technical support, such a unit should not be part of the ICT division. While it will work closely with the institutional technical unit, it must be autonomous. Govindasamy (2002) argues that such a unit should have a pedagogical foundation, as a prerequisite for successful e-learning implementation. This indicates that it is difficult and perhaps unwise to attempt to completely separate the ICT support function for deployment of a VLE from the pedagogical purpose that it serves. The e-learning unit effectively bridges the gap between the academic and technical teams and is tasked with ensuring that courses and materials are optimally designed and suit their purpose, that the online learner experience is as 'friendly' as possible, and that technology is exploited when and where appropriate.

It is important for institutions to engage in continuing professional development and sharing of knowledge, creating redundancy within the supporting units and academic departments. This applies to ICT support units, academic staff development units, e-learning support units, and the academic staff themselves. This also highlights the importance of a specialised central support unit that is able to satisfy a variety of needs at a higher education institution when engaging in deploying educational technology to support teaching and learning (Twaakyondo & Munaku, 2012).

Administrative support is critical to the successful integration of technologies into teaching and learning practices (Sife et al., 2007: 63). The role of the Moodle administrative team cannot be underestimated. In terms of the amount of effort required, EDUCAUSE (2003: 6) reports that the e-learning support requires the following activities: assisting with hardware, network or technology (25%); infrastructure training for instructors (20%); assisting with pedagogy issues (12%); assisting with technology tools and resource selection (11%); and managing network availability and capacity (10%).

Care must be taken in providing for the training and support of each of the required user groups to meet their particular needs. Moodle technical staff will require additional technical skills outside of the Moodle platform. Conversely, general technical staff will require additional training in the specific deployment and maintenance of the Moodle server and environment. Responsible academic support staff members, possibly within some form of centralised e-learning support unit, require the knowledge and aptitude to train and encourage all staff and students on using Moodle. EDUCAUSE (2003) categorises the support needed into: equipment and infrastructure resources, training and course/curriculum resources, support/help resources, and organising to support e-learning. Table 4 provides a summary of potential user groups and their required skills and responsibilities.

Table 4: Support and user groups, with their associated responsibilities

User group	Skills and responsibilities
Technical staff capacity	
System/server administrators	Proficient in Linux, PHP, MySQL, networking and website hosting. Responsible for anything server or software related.
Network administrators	Proficient in networking and Linux. Work closely with system administrator. Responsible for connectivity of servers, students and academic staff.
Laboratory administrators	Require minimal networking knowledge but must be able to troubleshoot various simple network and computer-related issues. Provide computer support and training for students.
Website administrators	Require knowledge of Linux, website hosting and Moodle. Implement website changes. Support the system administrator.
Centralised e-learning/virtual learning unit	Requires general knowledge of all the components of Moodle. Requires the knowledge and aptitude to train and encourage all staff and students on the optimal methods for using Moodle. Requires the skills to develop and deploy multimedia within Moodle. Responsible for providing central support for administrators, academic staff and students.
General user capacity	
Course developers	Require support and training to develop online courses.
Facilitators	Require support and training to facilitate online courses.
Students	Require support and training to be able to use Moodle and take online courses.

CONCLUSION

There are several challenges that need to be carefully considered and addressed in order to successfully implement a VLE within an African higher education context. These include ensuring institutional support aided by the development of institutional policies. VLE implementation should take place within the context of the broader institutional environment. Thus, plans need to be put in place to deal with any technical infrastructure limitations in the form of network infrastructure, Internet connectivity and electricity supply. The configuration of hardware and software together with the required maintenance processes needs to be handled in a systematic way. Additionally, adequate support and skills development need to be put in place to support the VLE users.

Making the most of what a VLE has to offer in terms of functionality and securing a stable environment for supporting teaching and learning requires considerable effort and expertise. A full understanding of 'what it takes' to optimise the affordances of the online teaching and learning environment has yet to be achieved at the majority of these higher education institutions. The status of the deployment of the Moodle VLEs varied considerably, with some institutions being early adopters and others having only recently engaged in e-learning practices. Each institution undertook a unique approach to the deployment of the VLE. Institutions made use of a top-down (management) approach, a bottom-up approach (individual academic or technical driving person) or an externally funded project opportunity. Supporting and maintaining each installation may require a different institutional approach in terms of responding to drivers and champions, working within the boundaries of authorisation paths, and strategy. Nevertheless, within each unique institutional environment, initiatives in this area should be undertaken in a systematic manner rather than on an ad hoc basis. The benefits of gathering and sharing information of this technical nature across participating institutions were noteworthy. This verified the argument of De Freitas and Oliver (2005), who include cross-institutional sharing as a factor to consider when developing and implementing an e-learning strategy.

In addition to the invaluable technical and user support already provided by the Moodle.org community, it is anticipated that the current guidelines could help to lay a foundation for the provision of a robust, stable, secure and sustainable hosting environment for VLEs at other higher education institutions in Africa. Future research will look at the impact of the adoption of these guidelines to ensure replicable patterns for implementation success. Future research could also include ensuring the sustainability of the VLE through investigating new affordances of technology, such as the potential use of hosted solutions (through cloud computing) or a cluster approach (where institutions share cross-campus infrastructure).

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NOTES:

The Experience of Course Migration from the Blackboard to the Moodle LMS: A case study from the University of Dar es Salaam

Hashim M. Twaakyondo
Department of Computer Science
University of Dar es Salaam,Tanzania
hmtwaaky@yahoo.com

Mulembwa Munaku
University of Dar es Salaam, Tanzania
munaku@udsm.ac.tz

ABSTRACT

After ten years of using the Blackboard Learning Management System (LMS), in 2008 the University of Dar es Salaam (USDM) decided to switch to an open source LMS, principally due to the high cost of annual licensing for the proprietary system. In addition to their cost-saving benefits, open source LMSs offer the potential for customization and for being community driven and therefore community serving. This case study explores – primarily through the themes of institutional organization, staff development, and technical issues that arose in the course of the exercise – the university's experience in migrating existing (Blackboard) courses to the Moodle LMS. The case study analyses the processes and outcomes of the migration initiative, with a view to guiding internal future planning. While the USDM experience emphasizes that the choice of migration approach should depend on locally available resources and particular environmental contexts, it could also provide other higher education institutions with a tried and tested migration process model for replication in similar projects.

Keywords: learning management system (LMS) migration, course migration, Moodle migration, University of Dar es Salaam case study, distance education, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

INTRODUCTION

Information and communication technology (ICT) is a principal driver of economic development and social change the world over. The increasing use of ICT in teaching and learning is inevitable for the purposes of improving equity, access and quality of education. This is because advances in ICT make it possible to support students' and teachers' activities, enhance collaboration and resources, improve administrative processes, deliver programmes without the constraints of physical boundaries, and improve learning interactions among students and instructors.

Higher education institutions have adopted a range of ICT systems that enhance the delivery of academic programmes. This includes the deployment of learning management systems (LMSs), which automate the administration, documentation, tracking, reporting and delivery of online education courses or training programmes. Alias and Zainuddin (2005) define an LMS as 'a software application or Web-based technology used to plan, implement, and assess a specific learning process' (2005: 28). Mohawk College (2009) suggests that an 'LMS can be broadly described as a web-accessible platform for the "anytime" delivery, tracking and management of education and training' (2009: 5). The deployment of LMSs in higher education institutions varies, in that some institutions use proprietary LMSs while others use open source (OS) ones. In recent years, OS LMSs have become popular and widely used by many institutions, with many adopting online course-building applications, or LMSs, such as Blackboard (previously WebCT) and Moodle, to facilitate online learning (Vrasidas, 2004). Deployment of an LMS is a complex process that requires proper planning and considerations of technological, pedagogical, ethical, resource support, institutional and management issues.

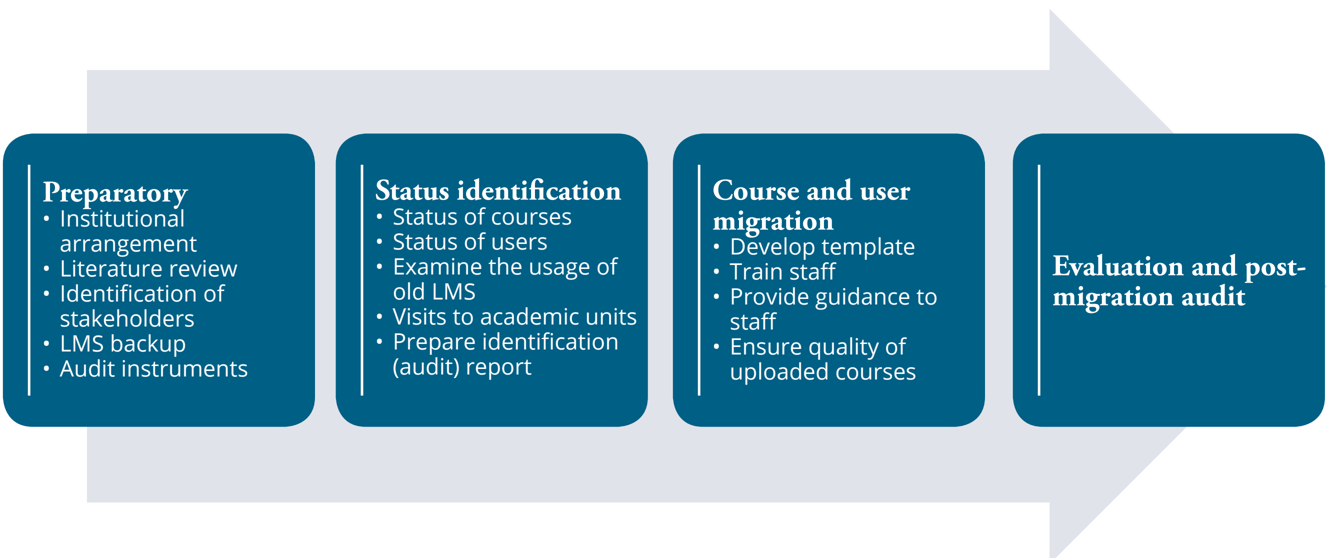
The University of Dar es Salaam (UDSM) started using the Blackboard LMS in 1998 but after ten years of use decided to switch to an OS LMS, principally due to the high costs of annual licensing for the proprietary system. Initially, the Knowledge Environment for Web-based Learning, or KEWL, was installed and tested. However, the institution realized that some of the features of KEWL were still under development and decided to opt for a more robust and stable LMS. Moodle (which has a strong international user and developer online community) was installed in 2008, and a few courses were tested before the system was fully adopted – an exercise that took advantage of, and benefited from, the Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI).

For some time, the two systems ran in parallel before a decision was made to migrate users and courses from Blackboard to Moodle. The biggest challenge was how to perform the migration in a systematic way so as to avoid negativity on the part of faculty and students towards the environment, or other unforeseen circumstances that could lead to loss of confidence in Moodle on the part of staff and students.

UDSM MIGRATION APPROACH AND PROCESSES

LMS migration requires specific planning and attention. Different institutions have approached LMS deployment and integration differently. The course migration process at UDSM involved a series of steps categorized in four different stages, namely: the preparatory stage, the status identification stage, the course and user migration stage, and the evaluation and post-migration audit stage, as shown in Figure 1. This process model was created by UDSM through consultative meetings with stakeholders as well as desktop research. The aim was to develop the most appropriate process for the context.

Figure 1: Stages used for migrating courses from Blackboard to Moodle



Preparatory stage

The preparatory stage involved listing the activities that were necessary for the course migration process. This included technical preparations that aimed at ensuring the LMS servers were up and running and accessible. Backups (online and offline) of courses available in the Blackboard LMS were made in order to guard against course loss in case of system failure. In addition, during this stage key stakeholders were identified and roles defined, as shown in Table 1.

Table 1: Key stakeholders and their roles

Key stakeholders	Relationship/role	Degree of influence	Actual influence
Deputy vice-chancellor: Academic	Decision making at institutional level, driver of the educational technology strategy	High	Instructed all heads of units to provide cooperation in the migration process
Principal, College of Information and Communication Technologies (CoICT)	Decision making at college level, and the chair of the project steering committee	High	Oversaw and steered all migration activities
Centre for Virtual Learning (CVL)	Implementation of the key projects	High	Mandated to facilitate the use of educational technologies at UDSM, hence day-to-day implementation of project activities
Deans of schools/ colleges, heads of department (academic units)	Owners of programmes in their respective units due to the fact that all courses in a programme are owned by academic units	High	Instructed academic staff to cooperate
Academic staff with courses in Blackboard	Creators/users of new educational technologies	High	Migrated and improved courses from Blackboard to Moodle
Students	Users of new educational technologies: need to be trained and registered to use the migrated courses	Medium	Used the migrated courses
PHEA	Financial assistance	High	Provided the financial resources needed for the migration process
Saide	Technical support	Medium	Developed a quality matrix and provided capacity building in instructional design and course development

A course audit instrument was created to ensure consistency in the information collected by staff involved in the audit exercise that was part of the preparatory stage. The course audit template is shown in Table 2 (below).

Table 2: Course audit template

College/school					
Department					
Course ID	Name	Instructor	Contact information	Status	Comments

Status identification stage

This stage included identification of the status of courses and users within Blackboard in order to determine 'potential courses' to migrate and 'non-potential courses' (i.e. those not considered for migration). A potential course was defined as a course that had a reasonable amount of subject content in it, seen either in course documents or, for some, in courses uploaded to the system. Moreover, other potential courses were identified by virtue of having a sizeable user enrolment and/or high number of postings on the discussion board. On the other hand, a 'non-potential course' was defined as a course with a skeleton consisting only of a course name and instructor name, yet devoid of any substantial content to facilitate learning. In some cases such courses (sometimes also referred to as incomplete courses) would have fictitious names (e.g. a course with a name like 'xyz' or 'demo').

The primary source of data was Blackboard. The audit team was supplied with an administrative password, which was used to obtain all necessary data and statistics. The username, course code and email address form a unique pattern and were the basis for tracking all users and courses in the system. The course audit template was used to document the status of courses in Blackboard. Courses were thereafter grouped into three categories: courses to be migrated without change; courses that needed improvement before migration; and courses that would not be migrated. It was found that a total of 415 courses were registered in Blackboard by March 2010, of which 146 were potential courses for migration to Moodle. However, a total of 120 (28.9%) courses were found suitable for migration after eliminating repetition of multiple copies of courses and unused courses. It was observed that 73 courses (60.8%) out of the 120 courses earmarked for migration were active, while the remaining 39.2% were inactive. Thus, the migration project at UDSM targeted 100 courses, spread across disciplines and colleges (UDSM, 2010).

This stage also involved determining the status of instructors teaching the courses. In this regard, the audit team visited various departments, schools and colleges to confirm the courses identified for migration. It was necessary to do this in order to ensure that all courses identified were still in the syllabus. Furthermore, the visits intended to determine the current instructor teaching the course versus the instructor registered in Blackboard. Some of the instructors were contacted via e-mail, using contact details obtained from Blackboard. The team also prepared a work sheet, which was distributed to all schools, to find new staff who would be interested in developing and delivering their courses via Moodle. It was observed that some instructors listed in Blackboard were no longer working for the university, some were on leave, and others were deceased.

One of the biggest challenges faced in the migration process was inaccuracy of data in Blackboard. It was difficult to obtain the exact number of registered users and the actual number of created courses in the system. For instance; the Blackboard system indicated 19,528 users (regardless of their status in terms of using the system). However, it was noted that some system users had more than one account with a different login name (in some cases, for example, an individual might have five accounts). Furthermore, it was noted that some instructors issued a common username and password to all students. An example of this was the course CS660 ('Introduction to Computers and Software

Engineering') and dp411a ('Electrical Machines and Drives II'), where all the students used the same username 'cs660'. Another challenge was that 229 courses (55.1%) were not categorized into relevant faculties, schools or colleges. Some of the courses were wrongly classified, such as the only indicated course in the Faculty of Law IS342 ('Networking'). The course belonged to Computer Science, where course codes start with the letters 'IS' , whereas Law course codes start with the letters 'LW'. This problem of categorization suggests that the majority of courses were not organized properly in Blackboard.

In addition, information in the Blackboard system had not been updated after the first registration. This resulted in the existence of invalid instructor contact details, such as e-mail addresses, in Blackboard. For example, over 50% of the e-mail addresses were no longer valid, as users had either fictitious e-mail addresses or had changed their e-mail addresses without updating the system. In some cases, instructors had not registered their e-mail addresses at all. It became evident that the nature of courses in the source LMS (i.e Blackboard in this case) could potentially simplify or complicate the migration process, as explained below.

Course and user migration stage

During this stage, the project team examined several migration options and their associated advantages and disadvantages. Four options from the Colgate University Information Technology Services (ITS) Unit (see Table 3, below) were examined. These migration options are redesign, copy – best effort, hybrid, and consultation, with the corresponding significance of technical staff and faculty involvement and responsibilities shown in the table.

Table 3: Explored migration options as adopted from Colgate University's ITS Unit

Methodology	Faculty involvement	Technical staff responsibilities	Faculty responsibilities
Redesign (starting afresh)	Significant	Extract materials from Blackboard Provide materials to faculty or upload them to Moodle Assist faculty with course design advice/Moodle orientation	Design Moodle course layout Insert transferred materials into course
Copy – best effort (use existing automated conversion tools)	Minimal	Extract materials from Blackboard Use existing conversion tools to create analogous Moodle course site, normally in the current semester's course Query the faculty when automation questions arise	Provide guidance as requested by migration staff Verify the migrated site, reviewing layout and checking course content
Hybrid	Minimal	Do both of the above	Provide guidance as requested by migration staff Verify the migrated site, reviewing layout and checking course content

Methodology	Faculty involvement	Technical staff responsibilities	Faculty responsibilities
Consultation (collaborative effort)	Some	Arrange one or more meetings with faculty to review the existing course, design a Moodle equivalent and implement the new Moodle course site	Meet with technical staff as needed to design and develop the course Optionally, assist with the course implementation

Source: Colgate Moodle (n.d.)

- The *redesign* approach involves technical staff extracting courses from Blackboard and uploading them into Moodle or giving the courses to faculty to upload, while providing orientation on Moodle. While this works, it does not result in better courses in terms of quality.
- The *copy – best effort* approach requires the use of automated conversion tools. However, since the course structures of Moodle are not fully compatible with Blackboard and since existing conversion tools are limited, this transfer process cannot be fully or simply automated (Moodle n.d.).
- The *hybrid* approach provides better content as it combines both the copy – best effort and the redesign approaches. Faculty will use the better-named, better-organized redesigned content as they update content uploaded via conversion tools.
- Finally, the *consultative* approach requires arranging one or more meetings with faculty to review existing courses, design a Moodle equivalent and implement the new Moodle course site. This is the best option due to the involvement of faculty but it requires more resources.

A *consultative* approach was adopted, and thus this third stage included the following activities:

- Sensitization seminars – The goal was to highlight the need for course migration so as to gain course instructors' acceptance of the process.
- Downloading courses from Blackboard – The technical team downloaded all courses earmarked for migration from Blackboard and made these courses available to the instructors.
- Training sessions – Instructors were given the downloaded course files and were trained on how to create and re-upload the courses in the Moodle LMS while following the created template. The purpose of the template was to ensure high quality and completeness of uploaded courses in Moodle. The information in the template included, but was not limited to, course objectives, schedules, assessment options, class activities, resources and references.
- Creation of course shells – The technical team created course shells, which together with 'course spaces' were used by the instructors for uploading their improved courses.

Automated tools for migrating users across learning platforms were not used due to the incompleteness of information in the Blackboard system. The use of such systems would have meant the importation of dummy information on users; hence fresh registration was the most appropriate option. Using this manual approach, no technical difficulties were experienced in the course of user registration. Initially 70 instructors were registered. By the end of the migration process 120 instructors and 3,419 students were registered in several courses.

In total, 96 courses were migrated, while 23 new courses of good quality were created during the migration process. This was due to the awareness created, as a result of the involvement of all key stakeholders who were identified during the preparation stage.

Evaluation and post-migration audit

An evaluation and post-migration audit of migrated courses was then performed. This is a significant stage, which enabled the university to realise the extent and success of the migration process. The audit team used the post-migration audit template; Table 4 provides examples of some of the extracted data.

Table 4: Sample data from the post-migration audit

College/school		
Department		
Course ID	EP 203	IS 273
Course name	'Educational and Career Guidance and Counselling'	'Introduction to Unix Systems'
Instructor	Luka Mkonongwa	M Munaku
Contact information	lmkonongwa@yahoo.co.uk	munaku@udsm.ac.tz
Instructor information	Available	Available
Course objective	Available	Available
Course calendar	Nil	Available
Number of users	956	86
Course modules	Modules for eight weeks uploaded	Modules for 14 weeks uploaded
Number of assignments	four	four
Number of forums	eight	three
Number of course views	505 records Highest view (Forum 8), Lowest view (0) – Discussion 2 to 6.	10,767 records Highest view (871) – Forum 2 Lowest view (41) – Forum 1
Remarks	Need improvement	There are six announcements. The course materials seem to be sufficient.

LESSONS LEARNED

Several issues were faced and lessons learned during the process of migrating courses from Blackboard to Moodle.

Motive for LMS migration

As mentioned, the university decided to switch to the Moodle LMS due to the high cost of annual licensing for the Blackboard system. The shift has been a wise one in this regard, as currently no licence costs are encountered. This does not mean, though, that the use of the Moodle LMS is cost free; there are other costs, such as customizations, upgrades, and system maintenance services. Nonetheless, the use of an OS LMS does offer savings, as noted by Drozdik, Kovács and Kochis (2005), who argue that decision makers need to find opportunities for savings through the use of OS. Gozdiskowski and Chen (2007) also state that OS systems are developing popularity in higher education 'because they have a much lower cost, can be more customized, make license management easier, and they are community-driven and community serving' (2007: 1).

Key stakeholder involvement

The engagement of key stakeholders (as identified in Table 1, above) was very important for the success of the migration process. Strategic involvement of stakeholders secured buy-in from university management and academic staff alike. For instance, once the audit team had visited the departments to determine whether the instructors as listed in Blackboard were still teaching the courses, it was found that instructors for 106 of the courses (out of 120 earmarked courses for migration) were still present and ready to shift their courses to the new LMS. However, the remaining 14 courses had no instructors because some were no longer working for the university, on leave, or deceased. In this case, alternative instructors were needed and the heads of department (identified from the outset as key stakeholders) managed to provide alternative instructors for these remaining courses. Solving this problem would have been difficult without the involvement of the heads of departments and course instructors. This finding is reinforced by the work of Doherty and Honey (2006), which emphasises the key role that lecturers/instructors play in the LMS integration and migration processes.

It is thus crucial that the course migration exercise be properly planned by identifying key stakeholders and clearly defining their roles.

Quality of courses in the LMS

The migration process revealed that creating quality courses needs to be emphasized and planned for in the design of the migration processes. This includes stipulating quality criteria and identifying mechanisms to achieve the desired quality parameters. Modalities for involvement of academic staff need to be examined because these staff have a significant contribution to make in the output of the courses. For example, given the many barriers that faculty typically encounter when working with instructional technologies (Brinthaupt, Clayton & Draude, 2009), it is not surprising that a number of faculty-related behavioural and technical issues arose during the transition process. One administrative issue noted was the lack of compensation for the time required to convert courses from one LMS (form) to another. This brought a lot of challenges as the success of the process depended so much on staff time devoted to the activity.

In many cases, the desired quality of courses could not be achieved due to time constraints. The situation was handled through providing several training sessions, which were also used by academic staff to improve their course content. As Nkonge and Gueldenzoph (2006) state, 'time can be less of an issue, we believe, if mandatory faculty training is established and made available on a continuous basis' (2006: 42).

Instructional and pedagogical issues

During the migration process most lecturers experienced a new virtual learning environment (VLE). Most were eager to know, among other things, how the system would help them deliver more effective teaching and learning processes. It is understood that LMSs offer a variety of tools to deliver course material and facilitate communication among students and between the instructor and students. Hence training sessions were provided on instructional design and how different tools of the new LMS could be used to enhance teaching and learning. The importance of this is highlighted by Vitartis, Sloan, Poh and Dunlop (2001), who state that 'offering learning programs offshore via online technologies further complicates the pedagogical issues which must be considered in adopting and adapting a LMS' (2001: 169). Kaminski (2005) highlights the fact that 'Practitioners need time to learn technology-related teaching skills, to learn how to use technology, to experiment with it and how to integrate it into the school curriculum' (2005).

During migration, training sessions on the use of the new LMS took into consideration pedagogical issues inherent in the LMS, as most systems have system-specific tools to address particular pedagogical issues. It should be noted that LMSs designed with more constructivist pedagogy in mind – and Moodle is an example of such an LMS – make it possible for novice instructors to explore pedagogical options more freely (Lane, 2008: 6). Hence, training sessions need to be designed so as to encourage ownership and impart unique pedagogical craftsmanship.

Institutional policies on the use of the LMS

Institutional policies on the use of the LMS have an impact on the migration process. For example, the absence of such enforcement policies makes the use of the LMS voluntary for staff. Indeed, at UDSM initially some users were reluctant to use the new system due to the absence of institutional directives or policies on the matter. In the end, this was handled through specific directives issued by the deputy vice-chancellor: administration to all heads of academic units, requiring the latter to ensure the migration team was given the necessary cooperation as well as the participation of lecturers for specific subjects.

Thus, there is a need to have institutional policies that enforce the deployment and use of an LMS. In addition, before the migration process starts, specific directives need to be given to all heads of units for the users to comply, as the support from top management adds value in the process. This is supported by McPherson and Nunes (2006), who argue that if LMS implementation (in this case, migration) is to be successful, the university 'must manage the change process by proposing and agreeing on goals through consensual debate, supporting strategies appropriately and then realising these through common commitment' (2006: 1). Institutionally supported e-learning implementation and institutionally supported capacity building for e-learning seemed the right approach, as suggested by Bates (1999), Davis and Fill (2007) and Aczel, Peake and Hardy (2008).

Nature of the courses in the source LMS

The nature of the courses in the source LMS (in this case, Blackboard) had a great impact on the migration process. For instance, it was found that 229 courses (55.1% of all courses in Blackboard) were not categorized, despite the fact that they belonged to faculties/schools/colleges. Also, some of the courses were wrongly classified, hence the difficulties faced in obtaining course-related information from relevant departments. Some of the information pertaining to instructors was either not registered or outdated. This presented challenges in contacting course instructors for the migration exercise.

This was alleviated for the future by disabling some features of the new LMS (Moodle) such as self-registration (Blackboard had allowed self-registration). It was further noted that there is a need to continually update the courses in the LMS as well as having some contact information as mandatory fields (e.g. e-mail, mobile phone etc.) during registration of users in the LMS. This enhances communication and speeds up processes whenever course migration takes place.

Support mechanisms and handling technical issues

Support mechanisms for LMS users are essential for building positive user attitudes towards the use of the LMS in teaching and learning. Tallent-Runnels et al. (2006) reviewed several studies and concluded that all instructors and students need training and support during an LMS transition process; such support would be technical and/or pedagogical. During the UDSM migration process it became evident that some instructors did not want to migrate their courses due to lack of end-user support experienced while using Blackboard. In addition, in 2005 the Blackboard LMS at UDSM had become corrupted and most lecturers had lost their course materials. At that time, the support structures at UDSM were not well established. Such experiences impacted negatively on users' attitudes towards the LMS and thus had ramifications for the process of course migration.

Furthermore, technical difficulties such as connectivity problems arose during the process of course migration. Offline facilities (e.g. Poodle) were used to address connectivity issues. In this respect, there is a need to establish good support structures that will assist in helping system users before, during and after the course migration process. The technical support team needs to ensure the system is available and the necessary backups are performed from time to time.

Institutional reforms

LMS maintenance and updating processes need to respond promptly to institutional reforms as they may affect the process of course migration. At the time of the course migration, there were several institutional reforms – such as course modularization and institutional structural changes – taking place. The former led to new curricula for some programmes, while the latter brought about changes by replacing faculties with schools and departments. These structural changes had implications for course categorisation in the LMS. Despite the fact that these changes had been introduced in 2008, they were still not reflected in the LMS two years later, and the courses in Blackboard were still grouped under faculties that no longer existed.

Thus, the study revealed that there is a need to continually update institutional data in LMSs deployed within our situations as this may affect any migration process that must be conducted.

CONCLUSION

Like many higher education institutions, UDSM has successfully migrated courses from the Blackboard to the Moodle LMS. The institution's experience in this regard shows that course migration needs to focus not only on the technological aspects of the process but also on the pedagogical dimension. This is mainly because there is nothing significantly different about teaching through an OS LMS compared to a commercial one. What is different is the tool itself, and the support, adaptability and ease of use offered by the competing systems.

The literature reviewed revealed a variety of options for migrating courses from one LMS to another. What is important, however, is for an institution to choose an approach that is most appropriate for its context. Such an approach should take into account institutional legacies and the resources available. Whatever approach is adopted, the current study showed that key issues that need to be considered include stakeholder involvement, levels of commitment by institutional leadership, and sound support mechanisms. It is hoped that other institutions may find this case study useful in their quest for a systematic approach to LMS migration.

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NOTES:

Using the Moodle Learning Management System for Teaching and Learning at the University of Education, Winneba

Issifu Yidana
Department of ICT Education, Faculty of Science
University of Education, Winneba, Ghana
iyidana@uew.edu.gh; yyidana@yahoo.com

Frederick Kwaku Sarfo
Department of Educational Leadership
Faculty of Education and Communication Sciences
College of Technology Education
University of Education, Winneba, Ghana
sarfofredk2001@yahoo.com

Alexander Kyei Edwards
Center for Educational Policy Studies
University of Education, Winneba, Ghana
aedwards@uew.edu.gh

Raymond Boison
Management Information System Department
University of Education, Winneba, Ghana
rayboison@yahoo.com

Osafo Apeanti Wilson
Faculty of Science
University of Education, Winneba, Ghana
osafoapeanti@googlemail.com

ABSTRACT

Higher education institutions in Africa face many challenges, including large class sizes, shortage of high quality learning materials, lack of experienced professors, and rigid/inflexible lecture timetables. The current case study recounts the experiences of Ghana's University of Education, Winneba (UEW) in implementing the Moodle virtual learning environment as a strategy for addressing some of these problems and improving the quality of teaching and learning. This initiative, implemented between 2009 and 2013, was sponsored by the Partnership for Higher Education in Africa Educational Technology Initiative, with technical support from the South African Institute for Distance Education. Using various qualitative data-gathering techniques the study revealed that use of the Moodle learning management system impacted positively on instructors and students alike in terms of the teaching and learning processes. The availability of learning resources promoted independent learning by students and provided opportunities for students to be in control of their learning processes – important pedagogical benefits. The study also highlighted, though, the many challenges faced by students and lecturers in using education technology at the university, including regular power blackouts, poor Internet connectivity, inadequate computer facilities for students, and lack of recognition for academic staff who take the initiative to use educational technologies in teaching and learning. The study recommends that the university make more investments in improving campus facilities in order to enhance easy access by students. More training interventions should also be introduced in order to acquaint staff and students with relevant skills in using Moodle.

Keywords: learning management systems (LMS), Moodle, collaboration, University of Education, Winneba case study, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

INTRODUCTION

Higher education institutions in Africa face many challenges, including large class sizes, shortage of high quality learning materials, lack of experienced professors, and rigid/inflexible lecture timetables. Many institutions are harnessing the affordances of educational technologies in order to address some of these challenges. This case study recounts the experiences of the University of Education, Winneba (UEW) in implementing educational technologies under the Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI) as a way of addressing some of the aforementioned challenges, with a view to enhancing the quality of teaching and learning. The PHEA ETI involved implementing educational technologies with support from the South African Institute for Distance Education (Saide). This case study report explains the processes that were followed in deploying pilot courses on Moodle, the challenges that were faced, and lessons drawn from the experience.

BACKGROUND TO THE PROJECT

The University of Education, Winneba is a multi-campus teacher education institution in Ghana. It has six residential campuses, three of which (North, South and Central campuses) are located in Winneba, and the other three in Kumasi, Ashanti Mampong and Ajumako respectively, all in Ghana. The total student population is currently 50,012: 23,746 distance education students; 8,636 'sandwich'/part-time students; and 17,630 regular on-campus students.[1] The university also runs the largest distance education programme in Ghana, with 23 learning centres located in all ten of the geographic regions. The university has eight faculties, two schools and an institute.

A recent survey (2010/11 academic year) on selected courses at the university showed that class sizes range from 150 to over 400 students in languages, physical education and social studies/science. For instance, enrolment for the GPD 113 course (an ICT course) is over 3,000 each year. Most UEW academics use teacher-centred instructional delivery strategies such as lecture expositions, which have not been effective in the development of critical thinking, reflective thinking and problem-solving skills. This approach is also not effective in dealing with large classes. The university's distance education programme has also relied mainly on printed textbooks and monthly meetings with tutors for delivery of instruction and remediation. This does not adequately engage students in their interaction with instructors, with course content or with one another.

In line with the university's ICT Strategic Plan (2003–2008), which sought to encourage the uptake of information and communication technologies (ICTs) by improving infrastructure on campus, a number of initiatives had been introduced at the university prior to the PHEA ETI project. Since the 2003/04 academic year, the university has attempted to raise the awareness of academics about the importance of the pedagogical integration of ICTs. For instance, during the period 2003–2005 the university benefited from the services of an American Fulbright Scholar (the late Professor Emeritas Sandra Vogel Turner), who helped academics to develop basic technological competencies and use of ICT for teaching and learning (use of multimedia tools, PowerPoint and word processing) through a series of workshops and demonstration sessions. During this preliminary stage of the educational technology initiative, academics were assisted in purchasing personal computers on hire-purchase agreements with local ICT vendors. Academic departments were also encouraged to set up departmental computer laboratories. The purpose was to increase access to computing facilities by academics and students for teaching and learning.

However, these mass workshops failed to address discipline-specific educational technology needs and pedagogical integration of ICT. The consequence of these shortcomings is that academics relapsed in their use of educational technology after the training workshops. Furthermore, subsequent to August 2005, when Professor Turner

1 Institutional data provided by the UEW Publication Unit, 2011.

completed her UEW tour, there were no follow-up workshops to address academics' educational technology needs and concerns.

In the past, UEW had also been assisted in mounting three courses for online delivery on the Moodle learning management system. These courses were developed externally by a South African organization, eDegree. Lecturers of the university were not involved in the design and development of these courses, however, and were only involved in facilitating the courses after their development. The distinguishing features of the courses were their pacing, assessment, and interactive nature; students learned at their own pace, had immediate feedback on exercises they completed, and could collaborate with one another using blogs and forums. An evaluation of the use of Moodle in these courses was conducted after the semester, through questionnaire administration to the 21 student participants who submitted themselves for the end-of-semester examination. The 21 students consisted of 17 second-year students and four first-year students. The findings of this evaluation revealed that:

- While facilitators did post assignments and use the discussion boards, they did not appropriately respond to student challenges and queries;
- Academics did not feel a part of the process (i.e. they did not own the design and delivery process of the courses);
- Facilitators found the technology challenging, despite their self-professed confidence with technology in a survey of interested academics that was conducted to assess their competence in technology prior to course delivery on Moodle; and
- eDegree hosted the Moodle server in South Africa; therefore, technical support was not readily available at UEW. This also meant that capacity was not built within the institution.

These findings indicate that one of the challenges with regard to the eDegree intervention at UEW has to do with the extent to which academics involved were outsiders to the process of design and development, and were only involved in implementing what an external designer had developed. In this sense, the academics did not exercise agency – their ownership of the project was limited because they were not part of the design and development process.

Previous attempts by the university to equip academics with expertise in ICTs to support teaching and learning were not successful. This was mainly due to the ad hoc nature of the training interventions, lack of local expertise and poor ICT infrastructure on campus. The PHEA ETI project therefore came in at an opportune time, offering the university the opportunity to address poor uptake of educational technologies in teaching and learning.

CHALLENGES TO BE ADDRESSED BY THE PROJECT

Prior to the implementation of the PHEA ETI, the learning environment of UEW was characterized by:

- Overcrowding in lecture rooms, which adversely affected the quality of teaching and learning;
- Teacher-centred pedagogical practices and instructional academic strategies, which do not adequately address diversity of learning styles/needs;
- Overload on the part of instructors, which made it difficult for them to innovate and create enabling learning experiences for students; and
- The inability of the majority of the academics to use the available educational technology resources.

The PHEA ETI at UEW was designed to address some of these shortcomings in the institution's teaching and learning environment. By supporting the use of educational technology in teaching and learning, the PHEA ETI aimed to improve interactions between student and instructor, between student and content, and among the students. In planning the implementation of the PHEA ETI, the over-riding goals of the university's Educational

Technology Strategy were to:

- Address the challenges posed by large class sizes and inadequate teaching and learning facilities through the adoption of: hybrid instructional delivery modes for residential programmes; online learning strategies for distance education students; and pedagogical practices and instructional strategies that would meet the diverse learning needs and styles of 21st century students; and
- Make optimal use of ICT to enhance management information systems.

The PHEA ETI plan was to assist the UEW in achieving these goals by supporting three interventions at the institution: (i) a baseline study on the status of educational technology at UEW; (ii) the development and deployment of hybrid courses on the Moodle learning management system (LMS); and (iii) an investigation into how academics and students use Moodle for teaching and learning. The Moodle LMS project was conceived as part of the strategy to help build the capacities of academics and students to purposefully use ICTs for teaching and learning.

The current case study focuses on the second intervention ('Project 2'), involving the development and deployment of courses on Moodle. The specific objectives of the second intervention were to deploy Moodle in order to augment face-to-face instruction and to enhance the quality of purely online support for distance education students.

The main research question that guided this investigation was: How does the use of Moodle impact academics' pedagogical practices and students' experiences of learning and assessment?

LITERATURE REVIEW

Online learning and course/learning management systems

An LMS, which can also be referred to as a course management system, is software that automates the administrative tasks of education/training, such as registering users, tracking courses in a catalogue, recording data, charting a user's progress toward certification, and providing reports to managers. Such systems also serve as a platform for delivering e-learning to students (Left Brain Media, 2010/11). Hall (2004) states that the LMS ultimately provides an interface that automates the administration and facilitation of online interactions and the distribution of learning materials. In other words, when used effectively an LMS can help instructors provide their students with learning materials and instructional activities, while keeping track of student participation and progress through data management systems and assessment modules. Ullman and Rabinowitz (2004) propose that LMSs are becoming critical to education, being used mainly to supplement the traditional learning experience in a course and to organize the course experience.

LMSs are available in two forms: proprietary/closed source and open source. Open source software (OSS) can be defined as software distributed under a licensing agreement that allows the source code (computer code) to be shared, viewed and modified by other users and organizations (coreDNA, 2009). Some examples of open source learning management systems are Manhattan Virtual Classroom, Moodle and Sakai (coreDNA, 2009).

Closed source software is proprietary software that is distributed under a licensing agreement to authorized users with private modification, copying and republishing restrictions (coreDNA, 2009). The cost of proprietary software usually varies from thousands to hundreds of thousands of dollars, depending on the complexity of the software and other customizations or services that come with it. Proprietary software providers do not allow users to alter or view the source code of their software products. Examples of closed source/proprietary course management systems are Blackboard, WebCT, Desire2Learn and Joomla LMS (coreDNA, 2009).

Horton (2000) states that LMSs can be used in one of three scenarios: in a completely online environment without any physical face-to-face interaction; in a hybrid course environment where the class frequently meets face-to-face as well as conducting online meetings and activities; and in a face-to-face course environment with the provision of web-based support materials and activities. UEW currently uses the hybrid or blended model, since academics have inadequate capacity for effective facilitation of full online courses, and the ICT infrastructures/facilities, particularly Internet connectivity, are not yet developed sufficiently to support exclusive online course delivery.

The adoption of LMSs for web-based instruction continues to increase in today's higher education institutions (Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007) and studies have shown that students have a positive perception of LMSs. A study by Erah and Dairo (2008) to evaluate pharmacy students' perception of the application of an LMS in a doctor of pharmacy programme at the University of Benin, Nigeria, revealed that over 92% of the students sampled felt that the use of an LMS will make teaching and learning more exciting and effective, especially when combined with face-to-face teaching. The study also concluded that the use of an LMS would improve the learning of pharmacy students, as the LMS enables students to collaborate online. A 2012 study by Zhu on student satisfaction, performance, and knowledge construction in online collaborative learning concluded:

> *Learning with peers may benefit not only the overall individual performance; it may also enhance team performance by increasing the quality of team product. Students can learn to formulate ideas and opinions more effectively through group discussions. Based on social constructivism and activity theory, the online learning system can enrich collaborative learning activities for knowledge construction. Results of this study confirm that online learning systems can enrich students' collaborative learning activities and their knowledge construction via group interaction. (2012: 134)*

Liaw (2004) makes the same observations in an earlier study and adds that web-based systems, cross-platform environments, hyperlinked networks and synchronous or/and asynchronous communication are all appropriate functions that provide students with more equal opportunities for retrieving information and active interaction with other students and teachers.

A study by Greyling, Kara, Makka, and Van Niekerk (2008), which reported on teaching and learning and assessment strategies for classes made up of approximately 600 first-year students in business management at the University of South Africa, concluded that the blended learning strategy resulted in enhanced student perceptions of the quality of teaching and learning and a significant improvement in student throughput. This conclusion confirmed an earlier study by Bongey, Cizadlo, and Kalnbach (2005), which found that 'the use of these expert-system-like self-tests, grade books, and other LMS features has the potential to improve teaching and learning in all manner of courses, including those that are on-ground, blended, and fully online' (2005: 252). Zhang, Zhao, Zhou, and Numamaker's (2004) findings support this in their assertion that students on blended learning courses can be more engaged as they can move at their own pace through the course materials, and determine their personal needs.

According to Morgan (2003), the EDUCAUSE Centre for Applied Research studied the faculty use of LMSs in 2003, the extent and purpose of use – including the factors on which instructors' decisions to use an LMS were based – and whether the use of the LMS resulted in 'pedagogical gains'. The study results show that use of LMSs is increasing at a rapid rate. It is remarkable however that the use is not focused on the interactive features of the LMS but on the content creation tools (Morgan, 2003). The study results also indicated that although instructors claimed they had adopted the LMS in order to meet pedagogical needs, the actual use of the system seemed to be in meeting class management needs.

A 2010 survey by Unwin et al., based on 358 respondents across 25 African countries, explored LMS usage and reported familiarity with LMSs. In total, 174 respondents (49% of the total sample) affirmed they had used an LMS for teaching in the previous twelve months and 185 (52% of the total sample) had used one for learning. In that study two LMS environments dominated: Blackboard and Moodle.

It is worth noting that even though the World Wide Web (www) contains a vast amount of information and countless resources, the inefficient use of these resources can be a major limiting factor to instructors who are unfamiliar with how to use them. What this means is that courses modelled to be delivered online should include a lesson on effective use of the www to enable students to use web-based platforms effectively and optimally. That said, the delivery of online courses is for the most part enhanced by the advent of LMSs.

The UEW is thus fortunate to have had the PHEA ETI project, which has not only supported the acquisition of a dedicated server for the installation of Moodle but has also included training academics in online courseware deployment and delivery on the LMS.

Using Moodle as an instructional tool

While traditional teaching environments have tended to be teacher-centred, there are some recognized advantages that blended learning or hybrid learning has over traditional, face-to-face learning. Blended instruction caters to a range of different learning styles and maintains quality lecturer–student interaction in the classroom at the same time (Dukes, Waring, & Koorland, 2006). When instructors replace in-class time with online components – such as uploading reading materials for students to download and engage with prior to class, and discussion forums, quizzes and so on – it frees up time for the lecturer to address students' learning problems or areas that students may find particularly confusing. For example, in the case of UEW where large class sizes are a norm, it gives students the chance to interact on a personal basis with the content, resources, activities and assessments, and it gives the lecturer the time and opportunity to address particular learning problems or areas of confusion for students. Also, in courses that offer practical experiences or hands-on practice, a hybrid approach frees up class time for the lecturer to provide hands-on instruction and demonstrations.

METHODOLOGY

Research design

The current study adopted a qualitative approach to evaluating and documenting the processes and activities carried out in the UEW PHEA ETI to develop and deploy hybrid courses on the Moodle LMS. A qualitative approach was identified as being the most suitable for gathering data from the social environment of the university. The opinions and views of the various actors were analysed in order to frame the issues and formulate emerging themes (Owen & Demb, 2004).The current case study is thus an evaluative one, seeking to investigate how academics and students used the Moodle LMS to enhance teaching and learning at the university. The evaluation used a number of qualitative instruments and strategies, including documentation of processes and activities, observation of academics' and students' use of Moodle, and interviews and focus group discussions. According to Owen and Demb (2004),

> *a research strategy based on individual interviews and focus group discussions allows for the inclusion of a broad range of perspectives from a variety of individuals who [are] intimately immersed in the innovative changes on campus as developers, implementers, and/or end users. (2004: 640)*

Sample description

Two ICT lecturers were the main participants in this qualitative study. Initially, there were two main considerations that informed their selection. The first reason for using these particular academics in the research was that they were already using ICT for pedagogical purposes and were therefore more inclined to adopt Moodle at the pilot stage without much difficulty. The second reason was that these academics were directly involved in the UEW PHEA ETI projects and were responsible for training and assisting other academics in the development and deployment of courseware on Moodle. The research team for this study included two other senior academics as researchers and two research assistants, who were chosen because of their expertise in educational and instructional technology and research. Their responsibility was to assist the main ICT lecturers to conduct the evaluative research.

Two sets of students consisting of six members each participated in the student focus group discussions. They were chosen by virtue of their participation in courses run on Moodle under the PHEA ETI. Focus group discussion was preferred over self-completed surveys because the use of Moodle was not yet widely experienced at UEW and because the researchers wanted to delve deeply into participants' experiences with Moodle in order to gain insights into how the intervention could be rolled out to the wider university academic programmes.

Data collection

The following data collection methods were used:

- The two lecturers involved in the research kept *reflective journals* on all the processes that were carried out towards the implementation of Moodle. Journal input included classroom practice, the courseware development process, and engagement with Moodle during the implementation stages. These journals documented lectures' experiences working with other academics and in Moodle;
- *Moodle user logs* for each of the two courses provided evidence of how academics and students used the Moodle platform for teaching and learning. Data obtained from the logs included frequency of use, the type of activity, and students' interactions with facilitators as well as peers on Moodle. These logs also provided useful information about students' reflections on the influence of Moodle on their learning;
- *Focus groups with selected students* offered an opportunity to obtain qualitative data from students about a range of issues concerning how their use of Moodle impacted on their learning experiences; and
- *Focus groups with selected instructors* who had previously implemented educational technologies offered the researchers an opportunity to obtain qualitative data from their peers about a range of issues concerning how their use of Moodle impacted on their instructional experiences using a hybrid mode of delivery. These discussions with colleagues helped the participating academics to undertake self-reflections on what worked and did not work during the Moodle implementation. These also provided useful insights into the challenges and prospects of rolling out this intervention across all academic programmes in the university.

RESEARCH FINDINGS AND DISCUSSION

Data from the processes and sources outlined above were analysed and the findings are presented and discussed below.

Background information on the observation of academics' and students' use of Moodle

The UEW Moodle site was set up and configured at the Network Operations Centre (NOC) by the university's network administrator with help from facilitators from Saide (from South Africa). The GPD 113 ('Introduction to ICT') course was run on a pilot basis during the second semester of the 2010/11 academic year. The EDI 502 course ('Computer Applications in Education') was piloted in the 2011 sandwich session (June to August). Users (faculty and students) were registered by the NOC system, using official UEW network accounts. On 21 February 2011 a hybrid mode of the online learning environment using Moodle was set up to supplement face-to-face lectures and practical classes. Students accessed Moodle content from March to July 2012 using their UEW official password-protected user accounts.

The central issues of interest on the use of Moodle were explored according to the following broad questions:

- Does the curricular revision adequately include Moodle use by students?
- How was Moodle introduced to students?
- How did students participate in class using the Moodle platform?
- What kinds of activity are carried out on Moodle by (a) instructors and (b) students?
- What kinds of issues do students bring to face-to-face class discussions?
- What is the quality of Moodle lesson presentation?

A checklist was designed for observing and monitoring activities being carried out by instructors and students on the UEW Moodle LMS in the EDI 502 and GPD 113 ('Introduction to ICT') courses. The strategy was to compare instructors' and students' use of the features of Moodle in both phases with a view to observing improvement in instructional practices and quality of learning. The logs showed that some students continued to visit the course site after the semester had ended.

Moodle environment lesson observation

The Moodle design follows the standard Moodle features layout, though in Phase 2 a few more features – such as a survey to evaluate the course, navigation pane for easy movement across the course, and academic and technical support information – were added, and information on how students would get feedback was given. In Phase 2, improvements were also made in consistency of course layout in terms of font type, colour, and use of labels and pictures. The modules used by instructors included resources, assignments, chats, quizzes, forums, wikis, surveys, glossaries, journals, and choices. The expected activities under each feature as outlined in the in-house Moodle user manual were matched against actual activities carried out on Moodle during the implementation period. The closer these two sets of activities were, the more optimal the use of these features, and vice versa.

Lecturers revised the curricula to include Moodle use and during the first lesson instructors demonstrated to students how to login and update their user profiles. Instructors also explained the tracking features of Moodle that would be used to monitor students' online activities. This was done in both Phases 1 and 2 of the Moodle implementation.

Good practices of instructors in the first round of implementation of Moodle

The following were good practices observed during the Phase 1 implementation of Project 2:

- Moodle content file sizes were not large; they were kept small for easy uploading and downloading;
- Documents were well labelled;
- Students were encouraged to save work during their work online e.g. during postings on forums, journals etc.;
- Discussions during face-to-face and online sessions were dominated by students, while instructors guided and facilitated them;
- A variety of reading resources was provided online for the students; and
- Students were encouraged to keep journals of their learning experiences and bring issues to class for discussion.

Resources used on Moodle

For content delivery the lecturers used the following:

- Text labels;
- File uploads comprising:
    - PowerPoint presentations for lessons;
    - PDF files of relevant reading material; and
    - Microsoft Word documents of lecture notes.
- Links to external resources on the web.

The availability of resources supported independent learning by students and provided opportunities for them to develop a sense of ownership of the learning process. Students proactively interacted with the content, and the resources included online text, videos, interactive exercises such as quizzes, and assignments that provided instant feedback. It was discovered that for the EDI 502 course the resources were not adequately aligned with the curriculum content (computer applications in education). There was more emphasis on ICT and socio-economic development issues and learning theories than on applications for ICTs in education. This anomaly was detected during the internal course review and addressed appropriately by linking the theories with pedagogical integration of ICTs. Activities were created to match learning theories with technological tools and a set of learning tasks.

Ensuring the quality of Moodle courses

Producing quality courses has been the focus of the PHEA programme at UEW. The training workshops on pedagogy, instructional design and the technical aspects of Moodle ensured that high quality courses were developed in Moodle. Saide also facilitated capacity-building workshops aimed at addressing quality and evaluation aspects of the online courses. Participants were introduced to instructional design by first viewing a video titled *The Big Mistake,* which critiqued a range of e-learning courses. Thereafter the participants used a Moodle forum to share an evaluation of their own e-learning courses. Participants reviewed a ten-point instructional design checklist available on the Internet and then use the Moodle journal tool to comment on the appropriateness of the items identified. Working in pairs the participants used a number of sources to develop 15 criteria to assess e-learning courseware. Participants used their criteria sets to evaluate three external e-learning courses: Open University, BBC and Johns Hopkins School of Public Health. The participants reported back on their experiences and various design issues were discussed. Participants then used the same criteria to provide the facilitator with feedback on the Moodle course he had designed for the workshop.

A general course evaluation checklist was developed based on synthesizing the various groups' evaluation criteria prepared during the workshop. The general course evaluation checklist was distributed to all courseware developers and courseware developers' assistants to serve as a guide for courses being developed. The courseware assistants served as the first point of contact (as outlined in their job descriptions); they were expected to use a quality assurance checklist to formatively evaluate the quality of the courses mounted on Moodle.

The courseware was internally reviewed by a review team that was locally constituted. The team members' comments were then passed on to the courseware developers to address identified deficiencies and suggested changes to their courses. The identified deficiencies included the following:

- *Etiquette expectations*: Authors were advised to include an item on etiquette in their course manuals/outlines.
- *Prerequisite knowledge*: The courses needed to stipulate the prior knowledge required by students wishing to do the course.
- *Course components*: The courses had to provide instructions on how to find the course components; authors were required to include this as part of the introduction to the navigation tool.
- *Technical skills expectation*: Authors were advised to create a paragraph in their course manuals/outlines to include this expectation. The following sample paragraph was provided: 'Computer literacy is a required skill for this course. This includes user's ability to go online; use of an Internet browser; and experience with Moodle.'
- *A range of student support issues*: There were two types of feedback: technical support and academic support. The technical support team (network administrator and educational technologists) gave feedback on issues such as assisting students with log-in problems, downloading resources, uploading assignments and embedding multimedia resources in assignments. Academic feedback took the form of advice to instructors on using the various Moodle tools, including journals, forums, assignments and quizzes.

Students also evaluated some of the courses, using the Moodle survey tool to do a formal summative evaluation and giving feedback to lecturers for improved instructional delivery.

In response to the feedback from the review team, the researchers of the current case study developed a Moodle course structure and learning pathway that guided course developers. This helped considerably to standardize all courses mounted or being mounted on the Moodle platform.

Finally, as part of the ongoing evaluation process, a visiting Saide Moodle facilitator undertook a preliminary external review of courses during a workshop in April 2012. The facilitator noted that quite a number of the courses under development had escaped the usual trap of poor pedagogy. He surmised that this was because UEW is, after all, a university of education.

However, a shortcoming of the evaluation process observed by the researchers was that due to time constraints there was no chance for peer review of courses before they were deployed for use by the students. Although the checklist used to evaluate the courses was extensive, peer review of courses would also have helped to verify the accuracy of content, pedagogy and learning evaluation. Furthermore, course developers would have collaborated more effectively and had the opportunity to share their experiences and challenges. These observations will guide future roll out of the gains of the PHEA ETI across all faculties of the university.

Communication and interaction

The Moodle collaborative tools (chats, forums and wikis) and self-paced activities such as the journal, quizzes and assignments were used to enhance interaction between instructors and students, between students and the content, and among students. The discussion forums were based on contemporary issues related to the impact of ICT on socio-economic development and learning theories. In the first pilot, collaboration within both courses was not very effective; students simply posted their views without reading or responding to those of their colleagues. Instructors failed to give clear instructions requiring students not only to post their contributions but also to read their colleagues' postings and respond to at least two of them. Students used these collaborative tools as if they were meant for individualized activities. Preliminary investigation of the first pilot identified this shortcoming, which was corrected in Phase 2.

In the Phase 2 implementation, lecturers used the discussion forum to promote social interaction that got students to debate and react to issues. Lecturers put up questions/statements in the discussion forum and students posted their thoughts or opinions and commented on the postings or thoughts of their classmates. Lecturers then commented on the students' replies. Comments by lecturers during a focus group interview support this point:

> *I used the forum a lot. Because we would come to a stage in class during the face-to-face discussion where they would have to give their views on issues and comment on what their friends had also written.*
>
> *We did forums too where the students were able to comment on other students' input.*
>
> *I used the forums to talk about issues that I really want to pick their brains on.*

Lecturers used journals for interaction on an individual level with the students. In their journals, students posted reflections about the lesson, the course and their learning, and the instructors commented on the students' reflections without the comments being seen by other students. The following comments of some lecturers corroborate this point:

> *I used journals to get their [students'] feedback of what they have studied or their expectations on an individual basis.*
>
> *I used journals for assessing the students.*

E-mails were another feature used by instructors to communicate/interact with students. Students who experienced problems sent e-mail messages to the lecturer in question, who replied to the messages with possible solutions. A lecturer commented in support of the use of e-mails: 'Some students too had problems with registration and we taught them how to use the message; so they used to send e-mail messages to us, requesting for help from us.'

Pedagogical practices of the instructors on Moodle

Academics' approaches to teaching were changed as they incorporated multimedia and web-based resources to support learning. Lecturers uploaded resources that were accurate and up to date for students to interact with, and made updates to the course as and when necessary during reviews and notified students. Lecturers developed detailed course manuals that guided the course structure. Each topic in the course had an introduction. The learning objectives of the course described the measurable outcomes of the course. The learning objectives addressed content mastery, critical thinking skills and core learning skills. The lecturers gave instructions to students on how to meet the learning objectives and these instructions were adequate and easy to understand.

Academics also identified assessment as one of the most beneficial areas of the Moodle LMS. Their approaches to assessment changed as they made use of the assessment management tools in Moodle. One of the ICT instructors used quizzes for assessment, while the other used practical assignments and projects. Some of the forums were also graded as part of the assessment. The quizzes consisted of multiple choice type questions in Phase 1, but short answer questions and matching type questions were added in the Phase 2 implementation. These were suitable for undergraduate level. For postgraduate level, assignments and forum discussions were the dominant instruments used for assessment.

The types of assessment the instructors selected and used measured the stated learning objectives and were consistent with the course activities and resources. The grading policy for the course was transparent and easy to understand, as specified in the course manuals. Scores per assessment activity were also stated upfront, so that students knew what to expect in this regard. The types of assessment selected and the methods used for submitting the assessment were appropriate for the hybrid learning environment. The assessment comprised the following: quizzes that provided instant feedback, discussion forums and journals that also provided feedback but not immediately, and uploading of assignments via a web link. However, one deficiency identified was that the use of rubrics was limited or entirely absent for some courses. The use of rubrics allows the instructor to specify standards that students should meet in their assignments and projects, and thus rubrics help to enhance the quality of students' work.

Academics stated that there was an increase in their workload, associated with using Moodle for instructional delivery. They reported that the major time-consuming aspects of Moodle use were the initial development of courses and the grading of forums, journals and assignments. They also indicated that the online courseware development was time consuming and there was a need for the online courses developed to be recognized among the criteria for staff promotion, to serve as an added incentive for online courseware development.

It was observed during the course development workshops that academics preferred one-on-one, on-site, needs-based and timely training – compared to the mass-organized workshops. Academics' support remained mostly local, with assistance from courseware developers' assistants and occasional facilitation from the external and internal facilitators during workshops.

The current case study research found that these academics clearly perceive Moodle to be an effective tool for developing courses and for extending learning resources to students outside of face-to-face classroom settings.

Students' use of Moodle for learning

The areas of focus in the analysis of data for student use of Moodle were resource availability and access to students, how students use these resources on Moodle, and the impact of the use of Moodle on the quality of their learning. As already highlighted, Moodle in this project was used to supplement the face-to-face classroom session interactions in a hybrid mode. Students' use of Moodle was observed to occur in two settings: in-class face-to-face interactions with Moodle, and virtual/online interactions for independent and collaborative learning. In class, students used Moodle to access presentation material and participate in synchronous chats and other forms of interaction with the content, colleagues, and the instructor. They used the Moodle platform for independent learning outside of the classroom. On average, students indicated they spent about six hours a week accessing course resources and performing activities. The Moodle platform also helped them to collaborate with their colleagues and undertake quizzes and assignments online.

Students participated in online forums, journals, chats and wikis, which promoted collaboration among students. They used forums to contribute and share their views on topical issues as directed by the instructor. Chats and e-mails were used to communicate among themselves and with their instructor on course issues. They also used journals to document their reflections on various topics on Moodle. However, the use of journals to document their personal experiences and challenges in the use of Moodle was not emphasized.

Students had unrestricted access to the course and course materials, including reading materials, lecture notes, articles, slide presentations and video clips. According to the students, access was occasionally interrupted by power outages that affected Internet connectivity. Access to campus computer laboratories was also limited to scheduled lecture periods only. Consequently, most students used Internet cafés or the campus Wi-Fi connectivity and mobile modems with their laptops to access Moodle resources and activities. It would therefore appear that students' main concerns focused on access and availability of computing and Internet facilities rather than technological competencies.

Students were also able to obtain academic and technical support via chat and e-mails. As already mentioned, students were able to send e-mails to the instructors or chat with them online for support related to academic issues. When students experienced technical difficulties they were able to contact the technical support staff via e-mail and chat, to help them resolve these problems. Students had access to important updates on the course as and when new materials were added to the course or when certain changes were made.

Students stated they had positive experiences doing assessment online as this provided instant feedback. Students also observed that the quality of teaching and learning resources uploaded to Moodle was high. They experienced both teacher-centred and learner-centred approaches to teaching. Students' levels of ICT competence also increased as they learned at their own pace using Moodle courses, in the process adopting other skills such as chatting, exchanging e-mails, researching, social collaboration, and improving their typing skills. Students received important updates via Moodle, including to their notes, and regarding revisions to assignment due dates, and that helped them in their time management.

Overall, students were unanimous in their view that Moodle was very useful in their learning and said they would encourage others to use Moodle. Their main concern was with the unreliability of and inadequate access to computing facilities and the Internet.

CHALLENGES AND BARRIERS TO EFFECTIVE USE OF MOODLE AT UEW

Although the Moodle implementation project was a success at UEW, a number of challenges were encountered, including in relation to the following: institutional culture, inadequate infrastructure, time constraints, workloads of academics, large class sizes, and low levels of technological competence among academics and students (particularly the older students in the postgraduate course). Due to the fairly large scale of implementation, the project required planning, logistics, teamwork, and support from various people.

During the planning stage, the programme management team initially had difficulty in getting all team members to meet regularly, as a result of other institutional assignments. This problem was exacerbated by the multi-campus nature of UEW, from where the distributed team members participated. The team had to agree to meet whenever at least three of the five team members were present for a scheduled meeting. The workload of some team members was such that carrying out their responsibilities in a timely manner was almost impossible. At a later stage of the implementation, the management team had to be expanded by adding four members, with the hope that this would speed up the work. There was also reorganization at the Externally Funded Projects Office and this brought about some positive changes to drive the implementation forward. For instance, the inclusion of the course developers' assistants and the organization of the writing retreat for both Projects 1 and 2 helped speed up the implementation process and also increased academics' participation in the course development processes.

The project management team also faced certain administrative challenges from the procurement laws of Ghana, which delayed the acquisition of equipment and software, including the Moodle server, the Adobe CS5 Suite software and the antivirus software. This consequently delayed the start of Project 2, and the project lost a whole semester of implementation, though ultimately most of its target outputs and deliverables were achieved. There were administrative delays in issuing appointment letters to various members of the implementation team (courseware developers, technical support staff, and multimedia experts).

Technical problems were experienced during the initial setup. The stand-alone computer on which the initial version of Moodle was set up crashed and data was lost. This resulted in delays in starting the initial piloting. Unfortunately, no provision for backup equipment had been made in the project budget. However, after the crash of the standalone computer, the network administrator took steps to perform regular backups of the data on the Moodle platform.

Online course development places an additional burden on the academics involved. Most of the academics indicated that failure to provide incentives/motivation to academics for the development of online courses was one of the barriers to their uptake of educational technology, particularly in a situation where large class sizes resulted in increased workloads for academics.

LESSONS LEARNED FROM COURSE DELIVERY THROUGH MOODLE

Ensure collaboration among staff, and coordination among all players and processes

Teamwork is essential for the success of projects, even at the planning stage, as shared responsibility pushes the plan forward. Too much bureaucracy and too many formalities can slow progress, as experienced in the initial stages of Project 2. If proper planning and projection are not done, institutional culture and government policies can negatively affect project progress; a good example of this has already been mentioned, where convoluted procurement processes delayed the start of the project.

Obtain buy-in from academics

It is important to get those who will carry out the processes directly involved in the project (i.e. adopting a bottom-up approach). The PHEA ETI was more successful than previous attempts at technological innovation because the academics were involved from the outset. If academics' concerns and needs are factored into their training, they are more likely to benefit from the training and apply skills and knowledge learned (Palak, 2004).

University academics are overloaded with work and responsibilities, so if workshops are not properly timed there is low participation. The courseware writing retreat organised in Kumasi is a good example of a workshop that was properly timed and thus well attended by faculty, as compared to participation in the previous and later workshops. Time constraints are the cause of low participation among academics. Thus, in order to ensure active involvement of academics in innovations of this nature, advocacy is not enough; scheduling training workshops for times when academics are less occupied with other university activities such as teaching and intern supervision would help.

Set realistic targets based on team competence

Project 1's slow pace affected the implementation of Projects 2 and 3. The plan was that Project 1, a baseline study of educational technology at UEW, would provide empirical evidence about academics' competence in technology, access to resources, needs, and concerns. This would have helped with customising the content of the Project 2 training workshops to meet the needs and concerns of these academics. Project 3 also needed the baseline data and information to measure the immediate impact of the PHEA ETI programme on the university learning environment; the data would have helped to validate the findings of the Project 3 study. Unfortunately, the three projects were running in parallel. In assigning responsibilities for project implementation, administrative and academic leadership should assign timeframes for project completion based on realistic evaluation of the skills and competencies of the concerned staff for each project. Adequate capacity-building support has to be built into projects where staff skills need to be developed for optimum project implementation.

Avoid one-off, generic workshops

For purposes of designing courses, one-off workshops attended by large groups of lecturers do not appropriately address individual needs and concerns. Smaller groups or one-on-one mentorship is needed as a follow up to large-group workshops in order to enhance academics' technology integration training.

The problem of lack of follow-up support after large-group workshops was partly resolved when the management team decided to recruit the Ohio University-trained instructional technologists to assist course developers onsite and on a one-on-one basis. These six educational technologists were among UEW staff who had educational technology training from a collaborative programme between UEW and Ohio University. The collaboration involved a two-year MEd programme in computer education and technology, which was certified by Ohio University.

Address poor connectivity and power cuts

Online teaching and learning is only effective where Internet connectivity and power are reliable. At UEW poor connectivity and power cuts have slowed progress or disrupted activities in various ways during workshops, in class and outside class when students and academics want to use the Internet to access Moodle. Consequently, to ensure effective implementation at UEW of educational technology innovation, including Moodle, the university must improve the connectivity and power supply situation.

Improve infrastructure

Access to computing facilities is still a concern for students despite the improvement of network infrastructure and setting up of computer labs for student training. The consequence is that students were able to access Moodle during the face-to-face interactions in the lab settings but had no access outside of lecture periods. This was confirmed by one of the students during a focus group interview.

Students were highly motivated to use Moodle for learning and most of them had to rely on Internet cafés or buying mobile modems in order to access Moodle on their laptops. This incurred extra costs to the students. Despite the huge investment in ICT labs there is still room to improve students' access to computing facilities, without which the online activities would be jeopardized.

RECOMMENDATIONS

Based on the findings of this project the following recommendations are made:

- The university should continue to invest in building computer laboratories and improving network infrastructure to provide easy and reliable access to the Internet for academics and students alike. The current case study results showed that access time for continuing students (second-, third- and fourth-year undergraduate students) was limited, as only first-year students had access to the instructional labs. Continuing students relied on their personal laptops and Internet cafés in order to access the Moodle course sites outside of the campus. This increased the cost of learning to them;
- There should be formal recognition of staff that adopt and use educational technologies to improve the quality of teaching and learning in the university. Such recognition could be in the form of promotion, salary merit increases and/or other tangible benefits. This would go a long way towards motivating more academics to adopt the use of ICTs for pedagogical purposes;
- Regular and timely workshops should be organized for academics engaged in online course development on an ongoing basis. The experiences from the PHEA ETI showed that academics' participation in training workshops and the speed of development of their courses depend on the appropriate timing and location/venues for such workshops;
- Facilitation in the form of one-on-one technical support and assistance should be provided for academics involved in online courseware development. The trained instructional technologists should be empowered, challenged and encouraged to provide technical support through one-on-one mentorship relationships with academics;
- The university should incorporate online courseware development as an item in the strategic plan of the university, to ensure that the success of the project is sustained well beyond its life span. Where the adoption of online instructional delivery is institutionalized, academics will be motivated and encouraged to use available ICTs for teaching and learning;
- A young and vibrant Moodle management team should be put in place, to manage and research new developments that will enhance the Moodle LMS. The six instructional technologists trained could form the pool of expertise in this regard;
- Special orientation courses should be developed and organized for students in the use of the Moodle LMS. The findings of the current case study showed that postgraduate students were not sufficiently technologically competent to explore the essential tools of Moodle for their learning and research work. Instructors should therefore spend some time bringing such students up to speed with the Moodle platform before commencing actual academic use of the system; and
- Special Moodle user guides and manuals should be developed and distributed to academics and students. Academics were given a PDF version of the Moodle user manual, and they should be encouraged to use this resource independently during the deployment of their courses on Moodle.

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NOTES:

Designing and Developing e-Content in Higher Education: The University of Ibadan model

Ayotola Aremu
Faculty of Education
University of Ibadan, Nigeria
ayotk2001@yahoo.com

Olaosebikan Fakolujo
Faculty of Technology
University of Ibadan, Nigeria
ola@fakolujo.com

Ayodeji Oluleye
Faculty of Technology
University of Ibadan, Nigeria
aoluleye@gmail.com

ABSTRACT

This case study presents a systematic model of technology integration, which could be adapted in any higher education institution across the African continent. Based on the experiences of 55 content developers at the University of Ibadan, in Nigeria, the three-phase model for e-content development captures the details of the planning, training and development, and pilot and deployment phases of educational technology integration in teaching and learning that can ensure both the effectiveness of educational technology use and the sustainability of educational technology projects.

Keywords: technology integration, educational technology, three-phase model for e-content development, University of Ibadan case study, distance education, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

INTRODUCTION

The value of using educational technology to support improvement of teaching and learning has been documented extensively, with the various supporting hardware devices having evolved from large and immovable mainframe devices, through personal desktop computers, and now encompassing the use of handheld mobile devices giving users the ability to access the Internet from anywhere in the world. Higher education institutions are increasingly harnessing the affordances of educational technology as a way of enhancing the quality of teaching and learning.

A significant affordance of online teaching and learning is that it provides a platform for collaboration, social networking, and information creation, sharing and retrieval by teachers and learners at any time or place. Whether it is used to interact with distance education or 'regular' learners, online learning can encompass creating interactive web pages, synchronous and asynchronous discussions with peers and lecturers, video and teleconferencing, and so on.

The University of Ibadan (UI), founded in 1948, is the oldest university in Nigeria. A major strategic shift for the university in the past five years has been the emphasis on postgraduate education and a rejuvenation of the system to achieve excellence in teaching, research, and community service. The university considers the use of educational technology to be supportive of its vision of being a world-class institution for academic excellence, geared towards meeting societal needs. In achieving the university's mission of 'expanding the frontiers of knowledge through provision of excellent conditions for learning and research', information and communication technology (ICT) has played a major role. The Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI) has assisted the university in deploying modern ICT tools and methodologies in support of the development of educational materials that can be used to enhance the teaching and learning process.

Among the reasons for investing in educational technology at UI were the following:

- Implementing discipline-specific pedagogical strategies that require students' active engagement and that encourage in students the development of problem-solving and problem-posing skills, supported by technology-enabled learning environments;
- Creating learning environments that challenge students to become actively engaged, independent lifelong learners inside and outside of formal learning spaces;
- Creating interactive learning supported by a variety of digital media;
- Offering flexible and cost-effective quality learning to time-constrained and economically deprived students; and
- Alleviating staff and space capacity constraints in the institution.

This case study focuses on two of the PHEA ETI projects that the university embarked on to achieve these objectives: the Capacity Building and Digital Content Development project; and the Open Courseware Development for Science and Technology project.

The Capacity Building and Digital Content Development project aimed to equip staff with appropriate teaching and learning methods that would respond to the following kinds of challenges: overcrowding in lecture rooms; obsolete tools and equipment; inadequate knowledge of new teaching techniques; and lack of skills in developing appropriate materials for teaching. The major goal of the project was to develop the capacity of faculty staff to develop e-content and overall materials for 12 identified courses. The participants were drawn from the faculties of Education and Pharmacy respectively, as well as from the university's General Studies Unit and the College of Medicine.

The Open Courseware Development for Science and Technology project aimed to develop open courseware for a small selection of existing UI science and technology courses. Open courseware was developed by adapting existing course content where possible and developing new content where necessary. The aim of the project was to improve staff and student awareness of open courseware and the possibilities it offers. Ten courses were selected for development based on key criteria such as large class size and a record of poor performance by students.

The purpose of this case study is to generate, evolve and recommend a model for e-content design and development in higher education institutions in Nigeria based on the experiences at UI with the PHEA ETI. This was to be achieved by documenting and analysing the steps that led to the design of e-content for some of the university courses, highlighting the successes and failures in the process.

CASE STUDY QUESTIONS

A number of questions were posed in order to guide the study:

Question 1: Faculty development model

How appropriate was the faculty development model?
Were e-content trainers appropriately identified?

Was the process of course and e-content development team selection appropriate?

Question 2: Successes
What successes have been achieved?

Question 3: Challenges
What where the limitations in the development process?

Question 4: Providing explanations
What are the plausible reasons for the successes/failures encountered?

Question 5: Suggestions for improvement
What could have been done better?

THEORETICAL FRAMEWORK

The following four theories were used to generate constructs for successful integration of technology and were used as a guide in analysing responses from the participants in the study: the Combined Technology Acceptance Model and Theory of Planned Behaviour (C-TAM & TPB); the Motivational Model; and innovation diffusion theory.

The inclusion of 'Combined' in the name C-TAM & TPB refers to the fact that the model combines the predictors of TPB with the construct 'perceived usefulness' from the TAM to provide a hybrid model (Taylor & Todd, 1995). The core constructs that could determine whether a technology is accepted and used according to this theory are: i) attitude towards behaviour, ii) subjective norm, iii) perceived behavioural control, and iv) perceived usefulness. In this research, these constructs have been investigated as a way to provide explanations for the observations that would be documented. The TPB explains adoption issues and predicts intention to use and actual use of workplace technology (Umarji & Seaman, 2005). One of the additional constructs included in the TPB (Ajzen, 2006) is 'perceived behavioural control', which represents the ease or difficulty of performing the target behaviour.

In the Motivational Model, Davis, Bagozzi and Warshaw (1992) applied Motivational theory to understand new technology adoption and use (Venkatesh & Speier, 1999; Venkatesh, Morris, Davis & Davis, 2003). The two constructs – extrinsic motivation and intrinsic motivation – are particularly relevant to the current research, where the success of e-content development was largely affected by the motivation of staff.

Innovation diffusion theory (Rogers, 1995) has been used since the 1960s to study a variety of innovations. It was adapted by Moore and Benbasat (1991) to investigate individual acceptance of innovations within information systems. The core constructs of this theory, which would be relevant for providing explanations for the current research, include the following: relative advantage; image; results demonstrability; and voluntariness of use.

These theories provided the guidelines for designing the questionnaire for collecting data, and aligning focus group discussion (FGD) questions, which elicited information about the process of the e-content development in the university. This was a great input into the UI evolutionary model because it provided information about what was workable, realistic and efficient.

METHODOLOGY

The current study was purely qualitative in approach, and made use of a questionnaire, structured interviews and FGDs designed to collect information. The bi-annual PHEA ETI reports were also used as a source of primary data about the project activities. The questionnaire focused on the process of the development of e-content in order to answer the questions about challenges faced as well as successes recorded.

Each course development team was asked to complete a questionnaire. In total, 13 of the 20 questionnaires distributed were returned. The FGDs lasted between 45 and 60 minutes. Six FGDs were conducted, with between five and ten developers in each discussion group. Notes were taken on responses based on the items in the FGD guide. The same personnel facilitated the FGDs across the groups.

The sample used for validating the study comprised all 55 e-content courseware developers across the faculties who were involved in the phases of design and development of the e-content. This involved the following faculties and units: Education, Basic Medical Sciences, Clinical Science, Pharmacy, Technology, Science, the General Studies Unit, and the African Regional Centre for Information Studies (ARCIS). The FGDs were conducted in groups of developers, based on their faculties.

Information provided from the questionnaire and the FGDs was analysed based on the themes identified in the theories. This information was used to answer the questions about successes and challenges in the development process. Plausible reasons for successes achieved and failures encountered were considered using the variables of the models and theories. Suggestions for improvement were then outlined.

FINDINGS

Study question 1: Faculty development model

How appropriate was the faculty development model?

The Workshop Model (Yilmazel-Sahin & Oxford, 2010; Teclehaimanot & Lamb, 2005) was used in this project. It comprised the following stages:

- An awareness workshop on what technologies could help to enhance the quality of teaching and learning;
- Training workshops on using Moodle, offered via a Moodle platform;
- A three-day retreat for development of the e-content;
- Review workshops to present courses developed in-house; and
- A quality assurance workshop.

The awareness workshop was seen as a necessary process and vital to ensuring a focus for the project. At this workshop, various technologies that could be used for teaching and learning were showcased. The training sessions were well handled according to the developers, and using the Moodle platform for training on how to use Moodle was seen as a good strategy. However, two of the faculty groups felt it would have been better to train developers on instructional design and pedagogy before training them on the Moodle platform or any technology. This is because most of the developers had their first contact with pedagogical issues at this training.

According to the developers, the turning point for this project was the three-day development retreat, which was held outside the university. Developers spent concentrated time away from their routine schedules, and this yielded the best results in the process of this project. One of the reasons for the success of the retreat, as identified by a developer, was that from the outset 'goals were set'. These goals were revisited and reviewed during the course of the retreat. The review workshops, according to some of the developers, helped to stimulate more positive action. Seeing what others had accomplished, as explained during one of the FGDs, motivated others to work harder and improve their work. Unfortunately, these workshops were few and far between.

Were e-content trainers appropriately identified?

The trainers were identified by the PHEA ETI team and included those who provided support for the development of the projects. This meant the trainers were familiar with the development groups and their expectations, which helped the process of development. Arising from this is the recommendation that for future similar exercises, the trainers and experts be identified upfront and involved in the project development process.

Was the process of course and e-content development team selection appropriate?

In all, 22 courses were selected for the project. These courses were selected based on predetermined criteria. The courses chosen were all characterized by one or more of the following features:

- Offered to a large class.
- Dependent on conventional chalk and talk method.
- Inadequate time to cover the course content.
- Insufficient learning materials for the course.
- A record of poor performance by students.
- Non-interactive classes.
- Need for practical work support in terms of videos, animations and visuals, which were not being provided in laboratories.

Due to tight work schedules of some staff, only 20 of the 22 courses selected were developed.

The course development teams comprised course lecturers and graduate assistants. From the proposal stage, each faculty involved at the university was asked to nominate staff already using ICT in some way; these people then formed the core faculty team. After courses had been selected, more faculty members who were either teaching the courses or teaching related courses were nominated to join the development teams. Graduate assistants (postgraduate students) were also selected based on their ICT experience.

What characterized these groups of people, according to one FGD, was 'commitment, integrity, and the fact that they were finishers'. FGDs revealed that these teams were effective because the departments nominated them and developers would not want to undermine the confidence placed in them. According to one of the groups (the ARCIS group): 'Participation was a departmental mandate because the team leader for the group was the head of ARCIS.' 'Team leaders", according to another group (General Studies group), 'should be more experienced in group management and dynamics and lead by involvement'. This, they said, would enhance the process of development.

One important suggestion that came out of the FGDs was that team members nominated by the department should be allowed to teach the courses developed for some time, before those courses are reallocated to other lecturers in the department. According to the FGDs, the process of team selection was deemed to be adequate.

Study question 2: Successes

The successes achieved have been grouped according to the following:

- *Number of courses completed*: The 20 courses developed were seen as great achievements;
- *Skills of developers*: Faculty members attested that the e-content development project helped to improve the following skills:
  - Pedagogical (instructional design) skills. Some of the faculty members confirmed that exposure to these newer forms of technology exposed them to greater and better possibilities in the world of teaching and learning, some of which they had adopted in the classroom situation. One of the developers acknowledged that he had learned about pedagogy for the first time through this project;

- ◦ Skills to develop activities in Moodle (this was the first Moodle experience for 80% of the project team); and
- ◦ Curriculum development skills, especially pertaining to the design of new curricula. A member of the Pharmacy group attested that she had carried the learning from this experience to another curriculum development project.
- *Enhanced understanding of teaching*: During the FGDs, content developers said they had developed a better appreciation of teaching and its various complications. Some had never previously considered pedagogical training to be necessary, believing that anybody could teach without any form of training. For most, this perspective had changed. This enabled developers to begin to explore the use of other educational technologies such as authoring tools and also the use of data projectors;
- *Increased self-efficacy*: A success of the project was enhanced self-efficacy in using computers, especially for research assistants associated with the Education group. This enhanced other areas of collaboration among staff and students outside the PHEA ETI group in terms of discovering new technology skills; and
- *Fostered relationships*: Participation in the project enhanced inter-faculty relationships and opportunities for multidisciplinary research. The Pharmacy group was excited to explore opportunities for research in collaboration with the Education group. It is highly likely that such relationships would lead to a blending of skills across faculties.

Study question 3: Challenges

The following challenges were identified:

Time

A constant challenge during the course of the project was time. Scheduling time for the workshops was difficult, because this had to be balanced with other, competing schedules. During the training sessions held on campus, developers kept going in and out of meetings to attend to matters requiring their attention in their departments or faculties. Most groups indicated that if a faculty member was nominated for courseware development, his/her administrative schedule should be reduced in order to provide more time to devote to this work. It was noted that the time allotted to the course-writing process was inadequate because of other competing responsibilities such as teaching workload, administrative duties, and other special assignments from the university. In the case of this round of development, there were also unexpected delays due to industrial strike action at the university.

Skills

Most of the developers already had basic word processing, presentation and spread sheet skills. Working in teams was beneficial because members of each team brought their expertise into the process. However, all group members had to develop Moodle skills. The training approach was that developers had to learn the functionality of the technology tools and then use them immediately in the design and development of their own courses. This had its positive and negative sides: the positive aspect was that developers began to practise what they had just learned; the negative aspect was that they seemed unsure that they had gained sufficient competence to be able to use the various features. However, for subsequent course development training, some groups suggested that the two processes could be separated. The consensus was that each development team should have a technology expert attached to it.

Pedagogy

With the exception of the developers from the Faculty of Education, all of the developers experienced challenges in terms of instructional design. Developing specific objectives that go beyond the level of recall and understanding, recommending strategies that suit different content, and suggesting assessment techniques were all new activities for many of the participants. This limitation in pedagogical skills was reflected in the nature of activities initially provided for learners in the courses.

However, as explained by one of the technology groups, the provision of a completed template for one of the courses, which was presented as a guide for others, proved helpful. The ARCIS group suggested it would have been better to ensure that instructional design skills were acquired and that developers designed their courses, before proceeding to train participants in technology tools design. It was suggested (by the General Studies and Science groups) that the university should invest in providing pedagogical training for its staff. Where this was not possible, it was suggested, each development team should have at least one pedagogy expert attached to the team.

Faculty support

Developers experienced faculty support at different levels. The Technology group enjoyed the support of its dean, because he was the university coordinator for the project. The Pharmacy group explained that its members were able to attend the e-content development retreat because they were given official exemption from attending a faculty board meeting during that period. This suggests that if people in key positions are informed and supportive, the process is more likely to succeed.

Motivation

While all the groups stated that a level of extrinsic motivation, especially monetary, should be integrated into courseware development, they said that they were not initially motivated by money, because many of them did not even know there was any reward attached to the process. However, they said the monetary rewards encouraged them to continue. With respect to the reward received, the Science group explained that it could never be commensurate with the time and effort expended on the project. Thus, rather than seeing this as a motivator, one member of the Technology group felt that it acted as a source of distraction. In future, it was suggested that resources be released as and when due, to facilitate work progression.

The major motivation for participation, according to one of the Technology and ARCIS groups, was interest in using technology. For the Education and College of Medicine groups, the excitement related to the possibilities technology presented in terms of supporting their large classes and the fact that, through technology, they could cater for skills development of their students – in terms of conducting experiments (for the College of Medicine group) and teaching skills (for the Education group).

The need for a conducive environment for development was greatly emphasized. This applies both to Internet access and regular power supply. Other environmental factors include providing hardware such as laptops and modems to promote access to the online course materials.

The fact that participation in the e-content development process did not currently count as part of the criteria used for staff promotion purposes was identified as a major constraint. For most of the developers it took self-discipline to ensure that this did not undermine the process of development. The university should be committed to a reward system that integrates time and effort in e-content development into promotion criteria. An institutional setting where teaching is greatly undervalued will never yield the best in terms of learning materials and this will subsequently be reflected in the quality of graduates produced.

Technical support

The work experienced several constraints related to technical support. This included slow and irregular connectivity, and limited support from the ICT Technical Unit, whose members were constrained by their existing university schedules, which they had to combine with providing support for the e-content development process. The initial proposal of the project, to appoint a technical staff person per team of developers, was not achievable. Furthermore, most of the technical support personnel were also experimenting with the Moodle platform for the first time during this process. However, according to one group, getting the required technical support for Moodle was easy for them, because they scheduled time with the technical staff.

Project communication

Communicating goals in each phase of development and timeline was below expectation. There were times when developers were not sure of what was happening and where exactly they were on the project timetable. For many this proved quite frustrating.

Study question 4: Providing explanations

Explanations for the successes or failures experienced were based on the constructs identified in the models used for this study.

Attitude

The construct 'attitude', as found in both the TAM and TPB, is an assessment of the desirability of performing a behaviour by an individual. Fenton and Hall (1997) cited in Umarji and Seaman (2005: 4) discuss practitioner attitude in detail and claim, 'if you fail to generate positive feelings towards a software program, you seriously undermine your likelihood of success' (2005: 4). At the inception of the project, most of the developers had a very positive and enthusiastic attitude towards technology and high self-efficacy towards the use of computers. However, enthusiasm dwindled slightly as the project continued, as was observed in the response to meetings. Many of the developers felt constrained by having several roles to fulfil at the same time, while the reward system failed to confer any advantage within the wider university system. Many wondered how their activities would contribute to their career progression. One of the factors revealed in the FGDs is that the content developers nominated from the various departments/faculties were faculty staff that already had a level of use of technology in teaching and learning. Most likely this was the reason for the high levels of enthusiasm regarding courseware development.

Subjective norm

'Subjective norm' is a construct in the TPB, and explains that social pressure can influence an individual's intention to use a system. To a large extent, this had a positive effect on the developers. For example, as already mentioned, one of the groups received approval from the dean of the faculty to be absent from a faculty board meeting in order to attend the e-content development retreat. This approval went a long way towards positively influencing the attitude of the group members in terms of working hard and being effective.

Subjective norm also concerns the significant role that the attitudes of a group of co-developers play in e-content development and use. If one developer feels that the e-content project is not effective or worthwhile, s/he may negatively influence people and this attitude might begin to spread through the group. This would potentially cause a reduction in general energy and interest. Although some of the developers stated that peer (co-developers') attitudes did not have an influence on them, others explained that the presence of good team leaders enhanced their attitude towards the project. Others explained that they put in their best effort because they did not want to disappoint their departmental head who had selected them.

Perceived behavioural control

The 'perceived behavioural control' construct is from the TPB. Ajzen (2002) explains that it addresses a situation where performance may depend on non-motivational factors such as availability of requisite opportunities and resources. At different stages, the developers were motivated or discouraged, depending on the presence or absence of external factors, such as inadequate Internet facilities that affected the output at times and the rate of delivery. One of the developers explained that although they were advised to use a designated location in the university where there was constant Internet access, he found it difficult to move all his resources from his office to the location. The issue of erratic power supply was mentioned by virtually every developer. Most of them had a high level of self-efficacy, which ensured that internal factors (personal ease or difficulty of performing the behaviour) were not an issue. Some of the developers said that they were confident in their use of the Moodle platform after some experience, and were able to navigate easily around the platform.

Perceived usefulness

The 'perceived usefulness' construct from the TAM in this study is the developers' perception of how their involvement with e-content will directly benefit themselves and the university. Many of the groups identified technology as a tool to help them teach better, enhance delivery, make the teaching and learning experience more exciting, and make it easier to share knowledge. Knowing that the materials would be reusable was part of the usefulness developers referred to when talking about the technology. On more personal grounds, one faculty member explained: 'If by any chance, I am not around, my course would still go on.' Furthermore, the developers were willing to work on the Moodle platform because they saw the potential it has for assessment, which had been a challenge for most of the teachers. The perceived usefulness of e-learning by developers could be one of the major reasons accounting for the project successes.

Motivation

The results of the current study show that motivation (intrinsic and extrinsic) largely influenced the developers' attitude towards the development of e-content. During this study, motivation for the developers was mostly extrinsic. The extrinsic motivation came from factors such as the group leaders and the fact that there was a monetary reward. Some of the teams said the strength of their group leaders played a significant role in motivating them to work, while others complained about the attitude of their team leaders towards the work being done, which was discouraging. The developers also emphasised that the availability of team leaders to answer questions was encouraging. One developer, a graduate assistant, commented that providing lecturers and research assistants with the same monetary reward seemed fair, and served as a motivation to work hard. While some of the faculty members remarked that extrinsic motivation was a positive force, others noted that for them it was the intrinsic motivation that mattered most. They explained that the desire for self-improvement was the positive force, and the desire to help students and the desire to move the university forward were key considerations.

Relative advantage

Developers commented that, when compared with the long-standing forms of instruction, the new pedagogical and technological knowledge spurred them into active engagement in the development process. Others remarked that reusability of the material after development served to encourage developers.

Image

Some faculty members mentioned that being part of the project boosted their image in the eyes of their colleagues, both within and outside the university. They further explained that their association with such an innovative project and being part of a pioneering group were motivation enough for them to participate. For most of the developers, it was the interest and not the image that was the major driving factor.

Results demonstrability

The ability of the Moodle platform to produce immediate feedback on the work in progress encouraged people to work harder. One of the developers noted that *it was quite encouraging seeing your handiwork and the progress made at every point. It felt like building a house and putting one block after the other and finally the joy of seeing a complete building even though it may still need a bit of furnishing here and there.*

For another of the developers, opportunities to give a presentation of the work done and receiving favourable acceptance by external quality auditors went a long way in encouraging her during the entire process. Yet another developer said that seeing the courses developed by other people and what they had done, and how far they had gone, spurred her on to work on her course.

Study question 5: Suggestions for improvement from lessons learned

Course selection

Based on the developers' experiences with deploying some modules of their courseware, it was agreed by most of the FGD groups that it would be better to start with higher-level courses and then work downwards towards lower levels. This would ensure that students coming from lower level would not be disappointed if, after becoming familiar with e-learning at lower levels, such facilities were not yet available at a higher level. Also there is lower risk of non-compliance at higher levels; mature students at a higher level will more easily adapt to 'forced' changes and challenges during delivery.

Development team

Experiences during the PHEA ETI project indicated that the team leader should act as a leader and motivator. Also, the team members should consistently teach the courses during their tenure of working on the project. Furthermore, it was seen as important to have a blend of pedagogy experts and technical staff in each team.

It is suggested that, for maximum effectiveness, the IT policy of the university, which will mandate the development of courses, should also ensure a system where the selection of courses and development teams goes through the university line of authority. This would ensure that deans work with their heads of department, and the latter with the lecturers, to ensure completion of the development of the courses identified in the scheduled timeline. In recommending a development team, it would be wise to ascertain the willingness to participate on the part of the proposed members, rather than participation being forced on individuals.

Courseware needs considerable time to evolve and mature. There should thus be a form of time release in the institution or reduction of the administrative load of the developers within that period.

Faculty model

An incremental model of courseware development has been suggested. This is a case where one or two modules are developed and pilot tested, and the pedagogy, usability and content are quality assured, before going on to the next module. Such a review process, which would involve experts, faculty members, faculty quality assurance members, and students, would assist in ensuring that mistakes can be corrected right from the outset rather than waiting until the end to do so. It is suggested that, since many students are technology savvy and are the end users, it would help the developers to seek their opinions on usability and ease of use, as well as harnessing their development skills. It is also proposed that the model integrate a couple of development retreats, which would take place outside the university, as well as awareness workshops at various management levels of the university.

The peculiarities of each department/course should be taken into account when determining the technology tools to be used. One of the Science groups felt that there was some content that could not be fitted effectively into Moodle. However, this may reveal more about the pedagogical knowledge of the developers than anything else.

It underscores the point though that pedagogical training for academic staff is necessary. Furthermore, content-specific technology tools should be provided and capacity-building programmes conducted based on this.

Motivation

The following forms of motivation were recommended:

- Courseware development should be allocated points as part of the research component of the university staff promotion criteria, having the status of textbook development or higher. This is because the time and effort committed to e-content development could just as well have been used for other research work. However, it would be necessary to develop guidelines for assessing the relative value and ensuring the quality of the courseware developed;
- The provision of facilities such as mini computers, faster connectivity and modems should be considered;
- Appointing more quality assurance assessors would allow for prompt assessment and responses to issues germane to the development;
- Monetary motivation should be provided when promised;
- Participation in the development could be officially recognized via a letter from the vice-chancellor and/or via the university bulletin;
- Creating and funding a unit to support and train lecturers in technologies for courseware and e-content would make sense, as would providing pedagogical support for academics; and
- Sponsoring developers to participate in e-learning conferences and workshops should be considered.

CONCLUSION AND MODEL

Based on the information gathered and analysed, a model (see the Appendix) is proposed for the development of e-content in higher education institutions in Africa. The model comprises three phases: planning; training and development; and pilot and deployment.

Planning: This first phase addresses the issues of policy and other groundwork that should be in place to ensure the effectiveness of the process. In developing the policy, three main issues should be addressed.

- *Facilities and infrastructure*: Getting fast and reliable Internet facilities working in all locations in the university is a must. Computer laboratories and maintenance structures should be put in place to support the use of the courseware. Technical staff should be able to handle all challenges that would arise from the use of the platform.
- *Institutional support*: This focuses on reward system, pedagogical training, and time release. The policy must stipulate what types of reward system would be put in place for the efforts of developers, with input in this regard being elicited from the faculty staff. Furthermore, modalities for mandatory pedagogical training of staff should be given great consideration. The policy should address what form of time release would be given to members of staff who had been nominated by the faculty to develop their courseware.
- *Involvement of all stakeholders*: It is recommended that each faculty management in conjunction with lecturers and students should decide what courses would be developed, when, and who the content development team members would be. This would ensure that the faculties and students take ownership of the outcomes and thus give their full support, especially to the deployment at the appropriate time.

Training and development: The second phase relates to sensitization (awareness), and training and development. The wider university audience should be made aware of what possibilities exist for using technology to support teaching and learning, and what is proposed in each faculty. This would give the wider stakeholders the opportunity to express their concerns and have them addressed at an early stage. It would also provide opportunities for inputs to be made into the process, for increased effectiveness. Along with this would be training on course template design and the technology tools to be used. The course template is a framework for the design of instruction, enabling developers to smoothly translate their ideas through technology to the learning platform. The training on technology tools would also enable developers to have a degree of independence in designing their courses, without needing to depend on the technical experts.

The design of the courseware should adopt an incremental model. This involves developing small portions of the content, showcasing it, and doing a mini trial, testing and evaluation, before moving on to the next chunk of content. The evaluation would address both technology and pedagogy, evaluating the content and the usability, and would be carried out by technology and pedagogy experts, faculty course reviewers, and students. The evaluation reports would feed back into the development phase, until a level of acceptability was attained. This incremental nature is captured in the model as S_1 - S_n – that is, the first cycle is represented by S_1, the next S, and so on, until the end of the process (as S_n).

The third phase, **pilot and deployment**, involves evaluation of the courseware on a larger scale. This should be with the full involvement of the faculty staff and students. After remediation, based on the pilot testing, full deployment should commence. All these must be carried out with a significant number of awareness programmes, to enable faculty staff and students to be aware of the development process and its results.

It is expected that the piloting and use of this model (see the Appendix), both at UI and by other higher education institutions, would not only provide guidance for developing e-content, but also contribute important feedback and input for improving this process.

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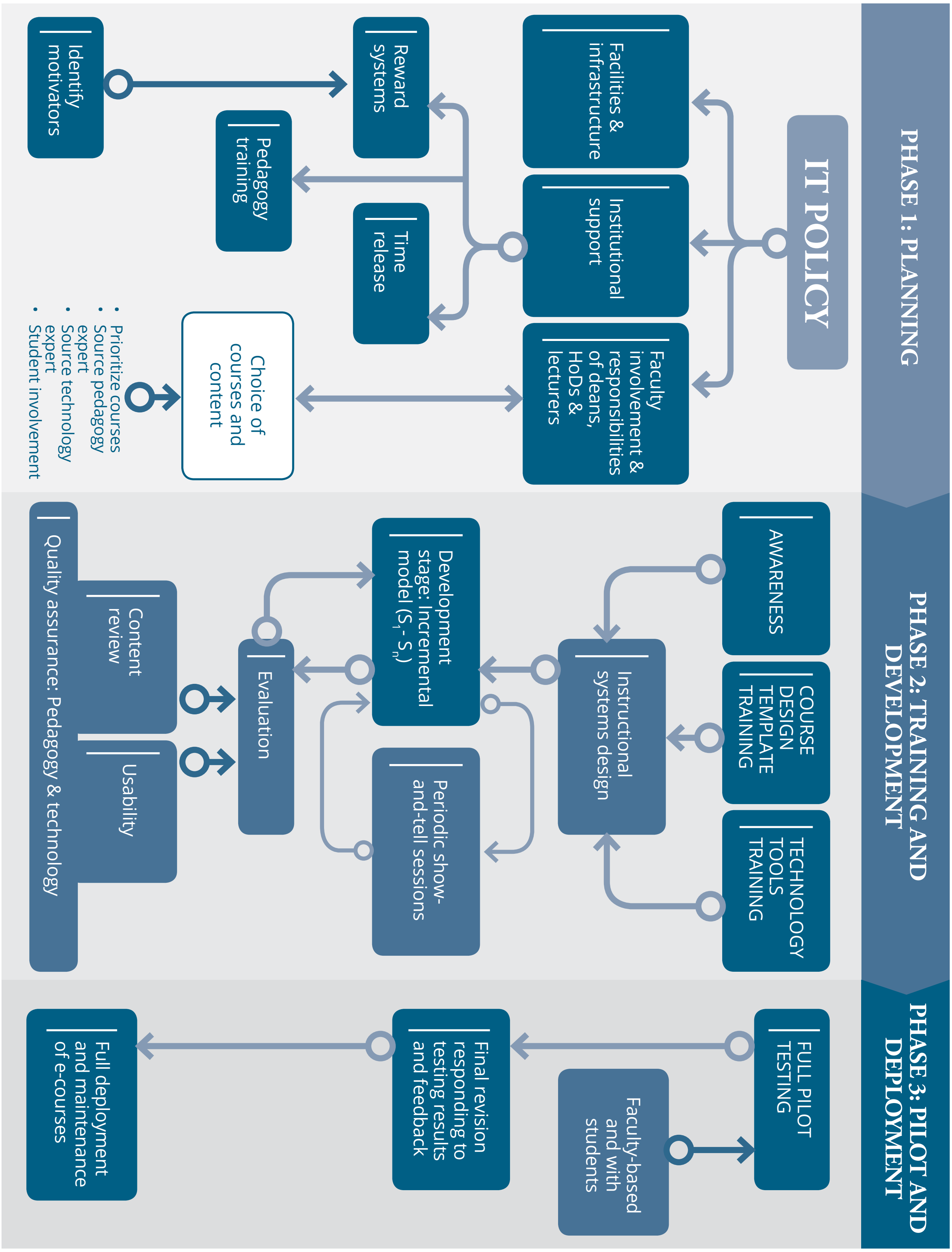
APPENDIX: THE THREE-PHASE MODEL FOR E-CONTENT DEVELOPMENT



Students' Acceptance of Mobile Phones for Distance Learning Tutorials: A case study of the University of Ibadan

Gloria Adedoja
Department of Teacher Education
Faculty of Education
University of Ibadan, Nigeria
sadedoja@yahoo.com

Francis Egbokhare
Department of Linguistics
Faculty of Arts
University of Ibadan, Nigeria
foegbokhare@yahoo.com

Omobola Adelore
Department of Adult Education
Faculty of Education
University of Ibadan, Nigeria
omobola.adelore@yahoo.com

Ayodeji Oluleye
Department of Industrial Engineering
Faculty of Technology
University of Ibadan, Nigeria
aoluleye@yahoo.com

ABSTRACT

This case study focuses on students' acceptance of mobile phones for learning purposes within a project that seeks to go beyond merely communicating information and creating access to learning resources, and aims to support and engage distance education students by using mobile phones for distance education tutorials. The research design is based on Davis' Technology Acceptance Model of 1986 and tests multiple hypotheses concerning the effects of perceived usefulness, perceived ease of use, interest in the technology, and technology self-efficacy on the use of the mobile tutorials. The evidence gathered confirms that the mobile tutorials enhanced teaching and learning. However, the evidence also highlights several preconditions for successful implementation, including providing technical support to students, having a well-designed interface, improving student information and communication technology literacies, controlling messaging and data costs faced by students, and improving the capacity of course developers and technical staff.

Keywords: mobile learning (m-learning), learning design, Technology Acceptance Model (TAM), University of Ibadan case study, distance education, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

INTRODUCTION

Over the past 12 years, the University of Ibadan (UI) has striven to improve the teaching and learning experience of staff and students. In order to support this process, the initial focus was on building a campus information and communication technology (ICT) infrastructure. The focus has now shifted to using this infrastructure to support the teaching and learning process, underscoring the importance of the interaction between staff and students in achieving an effective teaching and learning environment.

A number of educational technology initiatives are being pursued. Among others, key reasons for investing in educational technology at the UI are to achieve the following:

- Implement discipline-specific pedagogical strategies that require students' active engagement and help to develop problem-solving and problem-posing skills;
- Create a learning environment that challenges students to become actively engaged, independent lifelong learners, in and outside of formal learning spaces;
- Enrich learning experiences through enhanced, interactive learning;
- Offer flexible and cost-effective quality learning to time-constrained and economically deprived students;
- Alleviate staff and space capacity constraints within the institution;
- Achieve learner-centred education, and enable open and distance learning; and
- Develop teachers who can be supported to make learning relevant, exciting and effective, while achieving efficiencies beneficial to their multi-faceted academic responsibilities.

The Distance Learning Centre (DLC) of UI is a very strong arm of the university, and was established in 2002 to cater for the needs of distance education students (both adult and young, whether employed or job seekers). This responded to one of the major objectives of the Nigerian national policy on education: the provision of equal educational opportunities to all citizens at different levels of education, thus widening participation.

The National Universities Commission (NUC) policy guidelines (NUC, 2009) for open and distance learning in Nigerian universities encourage the use of technology in deploying distance education programmes. In this regard, content delivery should be based on resource-based pedagogies, and the management of assessment processes should be automated. In line with the NUC policy guidelines, and funded by the Educational Technology Initiative (ETI) of the Partnership for Higher Education in Africa (PHEA), the project conceived in this case study explored the use of mobile phones in supporting distance education students. This case study focuses on the acceptance of mobile phones for tutorial delivery in distance education.

PROJECT RATIONALE

The integration of mobile phones to support distance education has three clear rationales. Firstly, distance education students are in diverse geographical locations, which means they are learning in isolation. Affordable technology is desirable and appropriate to sustain communication with the institution and other students. The mobile phone can be used to provide academic and administrative support for such students and therefore reduce what Moore in Keegan (1997: 22–38) refers to as 'transactional distance' – one of the major constraints faced by distance education students. Secondly, students can conveniently carry the device with them, meaning that they can learn 'on the go'. Thirdly, mobile phone penetration in Africa is high, and mobile devices such as phones and personal digital assistants (PDAs) attract much lower prices than desktop computers and therefore offer a less expensive method of communicating. In Nigeria, the evidence of mobile penetration and adoption is pervasive and irrefutable: mobile phones, PDAs, MP3 players, portable gaming devices and laptops all abound. From toddlers to seniors, people are increasingly communicating in ways that would have been impossible to imagine only a few years ago. Simultaneously, many claims about the potential and benefits of mobile learning (m-learning) to make learning possible anywhere, anytime, in any way and for any reason have been reported (Adedoja & Oyekola, 2008; Adedoja, Omotunde & Adelore, 2010; Young, 2002; and Salmon, 2000).

Improving our understanding of this support for education using mobile phones is therefore crucial. There is a growing body of evidence (Green, 2002; Campbell, 2004, 2006; and Hooper, Fitzpatrick & Weal, 2009) that current hardware in the form of PDAs and mobile phones can indeed help to increase communication and interaction and enhance the quality of learning, particularly in distance education. Hooper et al. (2009) argue that mobile technologies are increasingly being used to create innovative m-learning experiences for students, and a key benefit has been students' collaboration with the use of PDAs and mobile phones.

In pursuit of the stated reasons for investing in educational technology at the UI, four groups have been working on capacity building, development of open courseware resources, use of radio and mobile phone resources, and the development of tele-classrooms, respectively. In particular, the mobile phone project entails exploring the use of mobile phones for distance education tutorials. The project seeks to go beyond merely communicating information and creating access to learning resources, and aims to support and engage distance education students. This case study focuses on students' acceptance of mobile phones for learning purposes.

OBJECTIVES OF THE STUDY

The objectives of the study on the use of mobile phones are to:

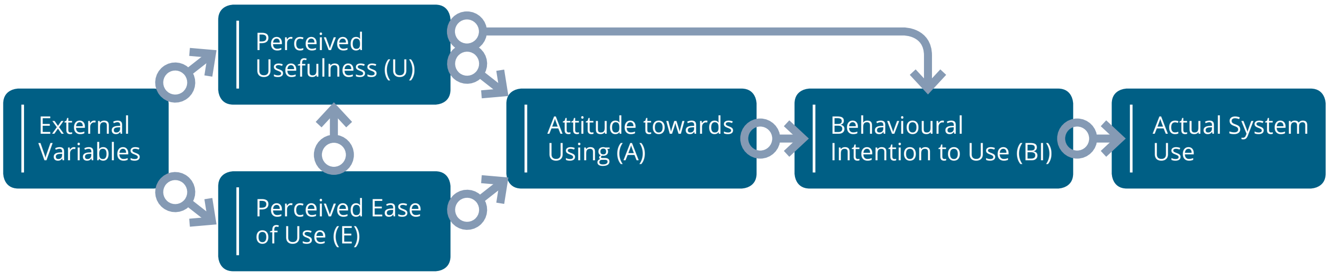
- Determine the level of acceptance, among students, of mobile delivery modes;
- Create opportunities for users to contribute to the final product, under the following variables: external factors, perceived usefulness, perceived ease of use, intention to use, attitude to using, and action (Davis, 1986);
- Determine which cultural and environmental factors are predominant in influencing acceptability of the courseware;
- Determine preference for a particular delivery format and reasons for choice;
- Ascertain the type of support students need for effective use of mobile delivery modes; and
- Based on challenges faced during use, make appropriate recommendations for adoption.

THEORETICAL FRAMEWORK

The study's framework is based on Davis' (1986) Technology Acceptance Model (TAM), which made use of the Theory of Reasoned Action (TRA). TRA postulates that an individual's attitude towards behaviour is influenced by his/her beliefs. Notably, the model deals with the acceptability of an information system/tool, predicting acceptability of the system/tool and modifications to be made, if necessary, for acceptability. The model assumes that acceptability is for the most part determined by two factors: perceived usefulness and perceived ease of use.

Perceived usefulness can be described as the degree to which an individual believes that the use of a system/tool will improve his/her performance, while perceived ease of use refers to the degree to which an individual believes the use of a tool/system will be effortless or require minimum effort. The model postulates that use of a system/tool is determined by 'behavioural intention', an individual's 'attitude towards using', and perception of its utility. Davis (1986) posits that the attitude of an individual is not the only factor that determines his/her use of new technology, as the impact the tool or system is expected to have on the individual's performance is also significant. The key factors in the TAM are illustrated in Figure 1.

Figure 1: The TAM relationship between perceived usefulness, perceived ease of use, and actual use (Davis, 1986)

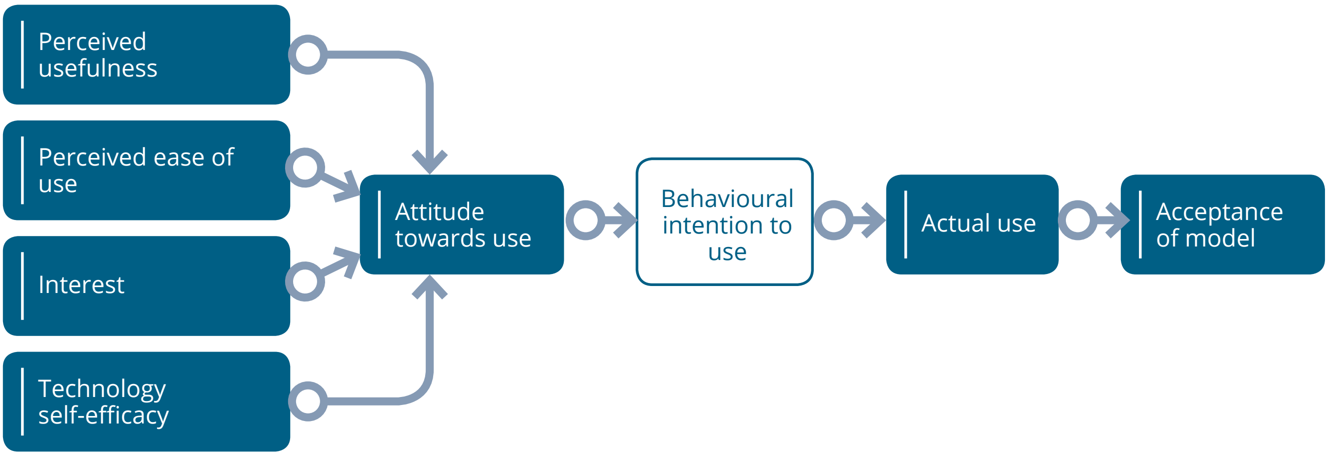


Many studies have been carried out using Davis' (1986) TAM. Most conclude that the model is incomplete because it fails to account for social influence in the acceptance, adoption and use of a new tool/system (Misiolek, Zakaria & Zhang, 2002; Malhotra & Galletta, 1999). It is important to take this into account because human beings are largely influenced by their social environments. Nonetheless, many studies have used the constructs of perceived usefulness, perceived ease of use, and subjective norms to explain technology acceptance and use for a variety of instructional systems, including online learning.

Mun and Yujong (2003) exposed students to Microsoft end-user applications for a period of eight weeks. After a two-week trial period, it was found that students' self-efficacy, enjoyment and learning goal-orientation determined the actual use and acceptance of the system. Shen, Laffey, Lin and Luang (2006) explored the extent to which subjective norms (the influence of instructors, mentors and peers) influence and shape the perception of students towards the use of course delivery modes. Results showed that instructors' influence makes a significant contribution to perceived usefulness on the part of students, while mentors' influence is significant to perceived ease of use. This suggests the importance of instructors' and mentors' roles in shaping students' impressions of the value of using course delivery systems. Miller, Rainer and Corley (2003) found that perceived ease of use and perceived usefulness had a significant positive relationship with the amount of time students spent on a course, and they note that both are significant factors for predicting intention to use. Sumak et al. (2011) show that the use of Moodle by students depends on 'behavioural intentions' and 'attitude'; and perceived usefulness is found to be the strongest and most important predictor of attitude.

The current study used Davis' (1986) TAM as a framework for analysing how distance education students at UI perceive the use of mobile technology for learning purposes. Figure 2 shows the adapted model used in the study.

Figure 2: Proposed TAM (adapted from Davis, 1986)



PROPOSED MODEL

In the proposed model (Figure 2) based on the TAM, it is assumed that perceived usefulness, perceived ease of use, interest, and technology self-efficacy will exert an important direct effect on attitude towards use and behavioural intention to use. According to Farah (2011), technology self-efficacy refers to teachers' belief in their ability to achieve successful integration of technology into their classrooms. All the aforementioned variables will exert an important direct effect on attitude towards use and behavioural intention to use, which in combination with actual use are the most important antecedents of acceptance of the proposed model. Looking at e-learning use as similar to students' lecture delivery modes, the model predicts students' acceptance of using e-learning systems. In the light of this, additional factors derived from literature (e.g. interest, technology, and self-efficacy) and constructs from the TAM are explained in the study.

Hypotheses

In this study, the following hypotheses were tested:
H_1: Perceived usefulness is positively related to improving attitude towards use of mobile technology;
H_2: Perceived ease of use has a positive effect on attitude towards use of mobile technology;
H_3: Perceived ease of use has a positive effect on perceived usefulness of mobile technology.
H_4: Interest is positively related to the use of mobile technology;
H_5: Technology self-efficacy is positively related to attitude, hence affecting students' acceptance of mobile technology use;
H_6: Perceived usefulness will be associated with actual use of mobile technology;
H_7: Behavioural intention to use is positively associated with students' acceptance of mobile technology use; and
H_8: There is a significant relationship between attitudes of students and their behavioural intention to use mobile technology.

Methodology

A multi-method (both quantitative and qualitative) approach was used in order to triangulate data, as well as to solicit rich data from respondents. Use of a survey enabled the researchers to draw on a good-sized sample (201 students) of the total population. The questionnaire items were structured on a four-point Likert scale ranging from 'strongly agree' to 'strongly disagree'. Open-ended questions were also included, in order to obtain responses from the participants regarding skills developed in the course of the m-learning activities, as well as challenges encountered. To complement the survey data, focus group discussions (FGDs) were held with respondents. Items in the questionnaire and FGDs centred on constructs that were perceived to be predictive of students' acceptance of the proposed technology. These constructs were: perceived usefulness, perceived ease of use, interest, technology self-efficacy, attitude, behavioural intention to use, actual use, and acceptance of the model. Each respondent was also asked to indicate specific skills gained in the course of the programme, as described in the paragraph (below) on procedures for data collection.

Population and sample

The population of this study comprised 201 students of the DLC at UI. A census of students from the Faculties of Arts, Social Science and Education was taken. Three courses designed with m-learning as the key student-support strategy were used. Using the purposive sampling method, students taking the courses who were willing to participate, and who had the required technology tools and applications such as Internet-enabled (GPRS, 3G) mobile phones, were selected. Students were introduced to common technological gadgets (GSM phones) available and within the reach of everyone, so as to prepare the students to use their phones in a learning situation.

Reliability and validity

The instruments were validated and Cronbach alpha reliability coefficients were used for construct reliability.

Procedures for data collection

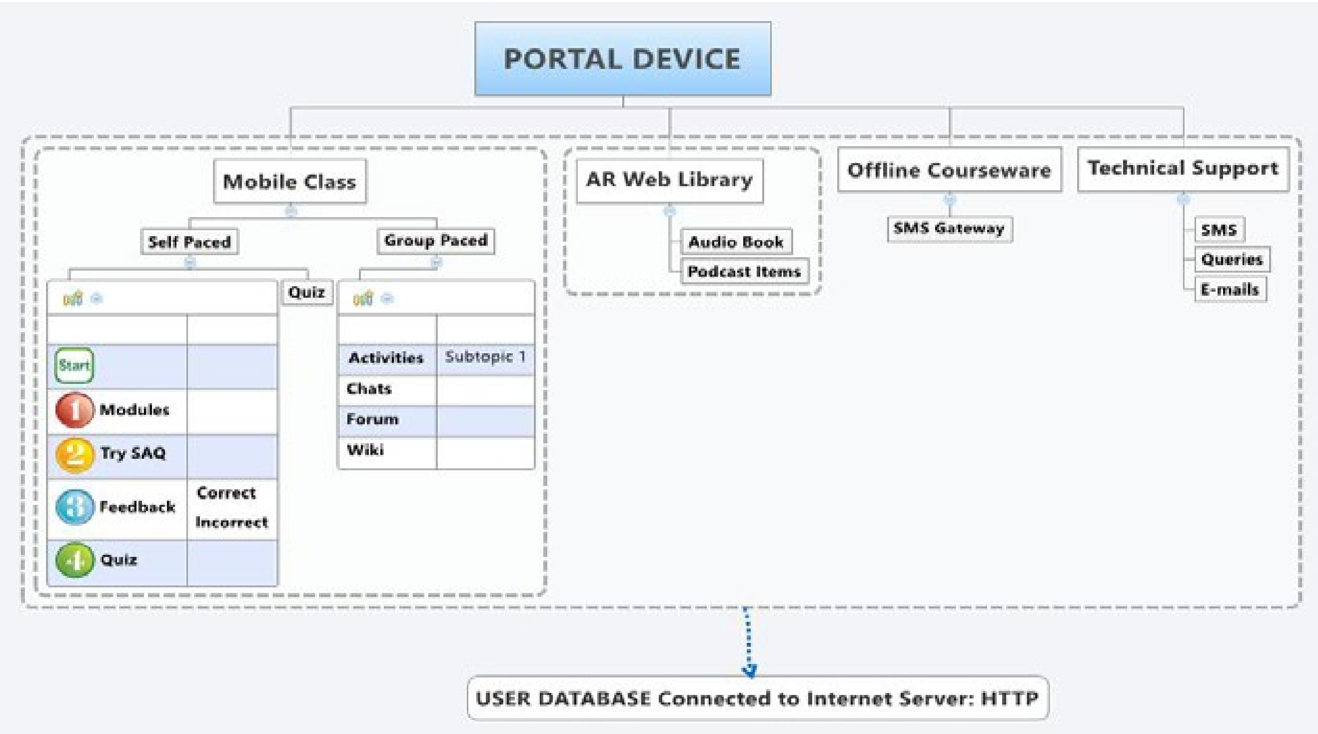
The questionnaires were administered personally to respondents in the respective departments and faculties by the researchers and research assistants over the course of ten days. The researchers ensured that all copies of administered questionnaires were retrieved.

FGDs were carried out at different times in the Faculties of Arts and Education among students enrolled on LIN 241 (Linguistics), ADE 205 (Adult Education), and TEE 353 (Instructional Technology). Given that the respondents were distance education students, a bulk SMS service was used to inform students of the FGD date, time and venue. For the TEE 353 FGD, the students gathered at the scheduled venue where they were divided into groups of not more than ten and not fewer than five people per group. After an informal welcoming and a quick overview of the FGD by the facilitator, each group was asked to choose a group leader and a recorder. The group leader's task was to facilitate group discussion and the task of the recorder was to take down notes as each question was discussed.

Description of the project

Figure 3 illustrates the framework for m-learning that was used in the study, designed for the DLC at UI.

Figure 3: Framework for the m-learning platform



The m-learning platform was officially opened to students on 21 February, 2012. To bring the students together and inform them of the new mode of instructional delivery, the project team went out to obtain information and data of students from the Management Information System (MIS) Unit of the DLC. These personal details were required for purposes of identification, registration and communication.

During the course of the project, group e-mail accounts were created for the different courses. These e-mail accounts were used to contact students at the inception of the use of the new delivery mode using the e-mail addresses collected from the MIS Unit of the DLC. Students were sent information regarding the day on which they were expected to assemble for orientation on the new instructional delivery mode.

A bulk SMS account was opened in order to reach students. SMS is considered one of the quickest ways to reach students on the spot via their mobile phones without their having to visit a cyber café to get information. Sending SMS alerts ensures that students got prompt information wherever they are.

On resumption of the semester, the students, on starting the courses, received formal orientation regarding the new instructional delivery formats. They were divided into groups and connected to online support referred to as 'online tutors'. The course TEE 353 had five tutors due to the large number of students taking the course. Each course tutor had a maximum of 60 students to attend to and the e-mail addresses and telephone numbers of the online tutors could be viewed on the m-learning platform page. This enabled students to have easy contact with tutors and facilitated maximum support. The online tutors had the following roles: assisting course lecturers in the design and delivery of course content, providing student support, facilitating online discussions, facilitating the FGDs, assisting with student assessment, and communication. Course lecturers had the responsibility of providing expert knowledge during the design of the course, giving support to the online tutors, and monitoring the activities of the students and tutors. They also had sole rights to make changes in their courses on the m-learning platform.

In the first week, students were exposed to the first three modules of each course. A module on the platform is made up of frames, which comprise a small piece of information a student is exposed to at a particular time. After each frame comes a practice question designed to stimulate students to ascertain if they properly understood the small unit of instruction to which they were previously exposed. These practice questions were of different types, mostly comprising multiple choice and short answers. If a student answered correctly, s/he then moved on to the next frame.

These modules also contained chat sessions and forums. Students were encouraged through SMS to log onto chat forums with their mobile phones and make comments on a discussion topic started by the online tutor or by another student. An obstacle that became apparent was that only students with smart phones were able to participate fully in these sessions. After a few weeks, some of the other students purchased smart phones to facilitate participation. Through the chat sessions, students were able to discuss aspects of the content and also technical difficulties they might encounter. After the students had successfully gone through the three modules, they were exposed to their first quiz on the m-learning platform. The quiz was open between 6.00pm and 8.00pm of the same day. One attempt was allowed per student, with the time limit set at ten minutes. At the end of the quiz period, 95 attempts were recorded.

Challenges encountered

In the course of the project, the following challenges were encountered with respect to students using the m-learning platform:

Logging in problem: Student difficulties included the fact that some names for logging in were not written correctly (e.g. student's name: JOSHUA, registered name: JOSUA), which caused confusion and frustration for the students.

Network problem: Some students complained about unreliable Internet connectivity. For example, a student complained of not being able to log in because of rain. This is frequently the case with some mobile network infrastructure.

Special needs: Blind students were not catered for in the project as they were not able to interact with content that was wholly text-based. Students requested that their physical challenge be factored into the design and implementation of the m-learning project.

Inadequate ICT skills: During quizzes, some complained about not being able to initiate the quiz (this complaint was made about the TEE course quiz). Some students also complained about answering the quiz questions but then not being able to submit their response because of having limited IT skills.

User interface: Students commented that the m-learning platform was not simple to navigate, and most of them expressed difficulty in using the platform. This could be due to the design of the interface and poor IT skills at the beginning of the project. Students need to be sufficiently oriented to how the m-learning platform works, and it should not be assumed that general mobile phone skills are easily transferable to a learning situation. Also, the design of the interface should be such as to facilitate ease of navigation even by the novice student.

Students also asked questions, made comments, and registered complaints during chat sessions. Some of these are listed below:

- 'Are we to answer all questions in Module 1 before proceeding to another module?'
- 'Please: I can't access Module 4 now – help me.'
- 'The time given for the quiz was short. I want to plead that more time be given to us when next you give us such quiz. Thank you, Sir.'
- 'The lecture is well understood.'
- 'The online quiz is good but why is the network so unfavourable during the attempt?'
- 'Modern technology cannot operate itself, it definitely needs an operator...a teacher.'
- 'Without a lecturer or a teacher, the technology is useless.'
- 'The time allocated for the quiz session was too small; what do you think?'
- 'I did my first quiz today; am I supposed to take the next one?'

As already indicated, only students with smart phones could benefit from the chat forums. Apart from that, the design of an m-learning platform must take into consideration several factors: language competence, technology reliability, ICT expertise, and the nature of devices. It is perhaps advisable that students participate actively in the choice and evaluation of options at the design, technology and evaluation strategy stages. In tackling these challenges, online tutors were able to help students to log in to and navigate the m-learning platform. In future, the audio web library will be activated to help blind/sight-impaired students.

SUMMARY OF FINDINGS FROM THE DATA

The result of the following questions asked during the FGD sessions are presented below:

1. What are the benefits of using mobile phones for learning?

Most students stated their belief that the use of mobile phones for learning will enhance accessibility of information. Other students agreed that mobility and easy accessibility of their lecture notes will save time and make learning interesting because learning can take place at any time and wherever they may be.

2. What are the problems you are likely to encounter when using mobile phones for learning?

Students believed that network failure and the poor supply of electricity could be major constraints in terms of using mobile phones for learning. Poor supply of electricity, which usually leads to low mobile phone batteries and network failure, could make the use of instant messaging and generally accessing content very difficult. Sometimes, electricity supply is unavailable for several days, thereby making charging of batteries impossible. This is usually taken care of by the use of generators used in many homes and institutions, irrespective of geographical location.

Students also concluded that small screen sizes would lead to small text sizes, which can make information viewing from the m-learning platform a tiring experience. Respondents said this may cause fatigue, especially if they stare at the screen for too long.

3. Can you imagine learning on mobile phones?

In total, 90% of the students in each group saw m-learning as a welcome innovation in their course and advancement in their learning process. Their overall response to using the technology for learning was positive.

4. What forms of learning do you consider feasible for mobile phone use?

Three of the nine focus groups agreed that quizzes would be the most feasible form of activity on the m-learning platform. Four groups agreed that reading short texts and lecture notes would be the most feasible form of activity. One group agreed that reading texts and lecture notes, and taking quizzes and tests, would all be feasible forms of activity on the m-learning platform. One group did not respond to the question.

5. Have you ever tried using your mobile phone for an assignment?

Five groups indicated that they had never used their mobile devices for assignments – although, during the FGD, it was discovered that a few students had attempted to use their mobile devices to surf the web for information. Some of the information they sought was to carry out class assignments. Four other groups indicated that they had at one time or another used their mobile phones for assignments.

The complaints included in the feedback cited above suggest the need for a more elastic access for evaluation, rather than the time-constrained window for access to quizzes. They also suggest the need to offer multiple attempts instead of only one attempt per student. The responses from the FGDs confirmed the findings from the quantitative data. Students' responses were positive and this confirmed at least 75% acceptance of using mobile technology for learning purposes.

ANALYSING THE QUANTITATIVE DATA

The study employed three closely related multivariate techniques: cross-correlation matrix, which examined the relationship between the constructs; multiple regression analysis, also used to determine the prediction of students' acceptance among the constructs; and analysis of variance. The use of the above multivariate approach was preferred because all seven predictor variables – perceived usefulness, perceived ease of use, interest, attitude, behavioural intention, actual use, and self-efficacy – act simultaneously with one another, as well as with the dependent variable. Correlation was used to examine the relationships between the constructs, while regression analysis was used to predict acceptance of the TAM for the delivery of lectures through the mobile phone for distance education tutorials.

DISCUSSION

The descriptive analysis for the constructs and items in the questionnaire shows the means of the following constructs as having high agreement with the items on attitude (6.87): perceived usefulness (6.32), perceived ease of use (6.11), acceptance (5.62) and interest (5.29) (see Table 1 in the Appendix). These means indicate positive and high interest of students in using mobile technology, and that the students also perceive mobile technology as being easy to use and useful. Students' responses suggest that they consider the mobile mode flexible. They also believe it reduces fatigue to the barest minimum, and they find it exciting. The high interest and positive attitude the students showed in using the m-learning platform could be attributed to the way in which learning activities were structured. Shen et al. (2006) indicate that instructor and mentor influence are significant factors that impact on students' perceived usefulness of the course delivery system, while only mentor influence is significantly associated with perceived ease of use of the system.

Analysis of the quantitative data showed significant positive correlation between perceived usefulness and perceived ease of use, on the one hand, and students' attitude towards use of mobile technology, on the other (see Table 2 in the Appendix). This suggests that perceived usefulness and perceived ease of use of delivery mode can actually determine the attitude towards use. In essence, the benefits or value that students see in the system could determine their attitudes towards the system. In the same vein, the convenience and fewer restrictions experienced by students when the mobile mode was used to support learning could also influence students' attitude towards it. This confirms Porter and Donthu's (2006) perception that ease of use and perceived usefulness are related more strongly to attitude towards Internet usage. Although Lee, Cheung, and Chen (2005) reveal that perceived usefulness and perceived enjoyment had an impact both on students' attitude to and intention to use an Internet-based learning medium (ILM), they found that perceived ease of use is unrelated to attitude. By contrast, Davis et al. (1989), cited in Venkatesh (2000), explain that there is a weak direct link between perceived usefulness and attitude, and a strong direct link between perceived usefulness and intention. This was explained as originating from people intending to use a technology because it was useful, even though they did not have a positive affect (attitude) towards using it. However, the current study of the m-learning platform found a strong positive connection between perceived usefulness, perceived ease of use, and attitude.

The analysis also showed that there is a positive correlation between perceived ease of use and perceived usefulness, which indicates that the perceived ease of using the mode can actually determine its usefulness. Analysis also revealed that perceived usefulness can effectively determine actual use of the mode of tutorial delivery. The model shows that perceived ease of use is significantly correlated with perceived usefulness, while perceived usefulness is significantly correlated to intention to use and self-reported use. This means that if the system is easy to use, a user may find the system more useful, and hence has sufficient motivation to use it. Thus, actual use (behaviour) is an indirect result of ease of use. This important finding shows that users are motivated to adopt an application in the first instance because of the functions it performs for them, and only in the second instance based on how easy it is to get the system to perform those functions. The current study also confirmed Davis' (1986) TAM in the context of mobile technology use for learning. Hence the findings validate the TAM as the basis for this deployment and support the value of attitude in students' acceptance of mobile delivery modes for learning.

The seven factors (predictor variables) examined in the current study – perceived usefulness, perceived ease of use, interest, attitude, behavioural intention, actual use, and self-efficacy – jointly influence the behavioural intention to use, and the acceptability of the modes as perceived by students. Each of the independent variables proved to be a significant predictor of acceptance of mobile modes for tutorial delivery. In terms of the magnitude of the prediction, interest in using the mode emerged as the most significant predictor of acceptance. The next predicting value was actual use, followed by attitude to use. The factors with significant value as predictors of acceptance are: behavioural intention, perceived ease of use, technology self-efficacy, perceived usefulness, and acceptability of the m-learning platform. This suggests that all seven of the factors are good predictors of student acceptance of mobile phones as a mode of tutorial delivery.

The study also showed that self-efficacy can determine the actual use of the mode. This explains the sustained effort students showed in the actual use of the platform. Analysis showed significant positive correlation between attitude to use and acceptance of using the mobile technologies for tutorial delivery. This suggests that attitude towards using the mode can actually determine acceptance of using the mode.

Finally, the study showed a significant positive correlation between behavioural intention to use and acceptance of the mode. This suggests that behavioural intention to use the mode can actually determine acceptance of using the mode.

LESSONS LEARNED

In summary, this case study provides evidence to support an assertion that mobile technology is effective and efficient in enhancing the teaching and learning process, and hence can be used for academic support. However, for this to be achieved effectively, the study yielded the following insights:

1. *Student support* is a major contributory factor to the successful implementation of m-learning. Students using mobile devices for learning are in great need of both technical and academic support. In the current study, students called in frantically because they were frustrated with matters ranging from inability to log in to other technical issues such as having trouble navigating the web, problems with network connectivity, and inability to participate in the quizzes. Therefore, there is a need for massive support facilitated through tutorial assistants who provide timely assistance to students.
2. *ICT literacy* is imperative for prospective distance education students to have acquired prior to the course, in order that they can participate successfully.
3. *Navigation* difficulties can be alleviated by receiving a demo of the m-learning platform on the centre's website, and the platform could also be demonstrated at the orientation programmes since the mobile phone is an integral tool for learning in this mode.
4. *Cost* continues to be a constraint. Although students were advised to subscribe to a cellular network provider plan, not all the students did so. To alleviate this problem, it is advisable that a plan that uses as leverage the large population of students and institutional advantage be negotiated with cellular network providers.
5. *Capacity building* is required for course developers and technical staff. It was noted that course development for m-learning requires some technicality and rigour beyond what is required in print or online materials.
6. As good as the outcome of this study is, this result cannot be generalized because the *sample population* is too small. Hence, further studies would need to draw on a population of at least 1,000 in size, in order for assumptions about the efficacy of m-learning, as made in the current study, to be generalized.

CONCLUSION

The adaptation of Davis' (1986) TAM for use as an analytical framework for the study proved to be highly relevant and useful in this context.

The project was novel in that it demonstrated the potential for using the medium of delivery of the mobile phone for academic support rather than simply for sending students SMSs for administrative purposes. Faculties and educational technologists need training and incentives to further explore opportunities for enhancing the quality of student support through mobile phones. This also brings to the fore the issue of teaching and instruction via this medium, requiring substantial initial support. Adopting a simple, linear and user-friendly interface for the design of the m-learning platform is of paramount importance if students are to enjoy the time they spend in the learning experience.

It is clear that there is a need to test this model with students before deployment, taking into consideration the realities and constraints of the environment. In addition, information on preferred model and type of device should inform design of m-learning systems.

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APPENDIX: STUDY RESULTS

Table 1: Descriptive analysis

Construct	Mean	Standard Deviation
Perceived usefulness	6.32	0.72
Perceived ease of use	6.11	0.70
Interest	5.29	0.52
Self-efficacy	3.63	0.64
Attitude	6.87	0.64
Actual use	3.45	0.54
Acceptance	5.62	0.69

Note: N=201

Table 2: Cross-correlation matrix among the constructs

Variable/ construct	Perceived usefulness	Perceived ease of use	Interest	Self-efficacy	Attitude	Actual use	Acceptance
Perceived usefulness							
Perceived ease of use	0.72						
Interest	0.56	0.76					
Self-efficacy	0.58	0.67	0.62				
Attitude	0.54	0.51	0.58	0.85			
Actual use	0.77	0.59	0.78	0.41	0.46		
Acceptance	0.68	0.52	0.58	0.65	0.48	0.59	

The Design and Feasibility of Adoption of a Special Purpose e-Portfolio in an African University: The case of Makerere University

Andrew Mwanika
School of Health Sciences
College of Health Sciences
Makerere University, Uganda
amwanika@chs.mak.ac.ug

Ian Munabi
School of Biomedical Sciences
College of Health Sciences
Makerere University, Uganda
imunabi@chs.mak.ac.ug

Tito Okumu
School of Education
Makerere University, Uganda
tokumu@iace.mak.ac.ug

ABSTRACT

This case study used constructs underlying innovation acceptance and adoption to gauge the feasibility of the acceptance and adoption of e-portfolios at Makerere University in Uganda. Ten years ago the university made a strategic decision to move from teacher- to learner-centred teaching and learning. Information and communication technologies (ICTs) – including such innovations as e-portfolios – are regarded as central to this change. The case study was largely quantitative, surveying 293 respondents consisting of undergraduates, postgraduates and lecturers randomly selected from the university's nine colleges and the School of Law. Quantitative data was analysed using SPSS version 17. The study found that the key person-agency predictors of 'acceptance' and 'adoption' were positive for technology adoption in the university. The majority of respondents indicated that educational technologies are relevant, and make teaching and learning deeper and more meaningful. It is surmised that these findings are a result of the university's investments in creating an enabling campus environment. Based on these findings, the study concludes that there is sufficient e-readiness at Makerere University for the adoption of the e-portfolio.

Keywords: e-portfolios, e-readiness, Makerere University case study, distance education, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

BACKGROUND TO THE STUDY

Acceptance, adoption, use and diffusion are components of a complex continuum of user behaviour that affect successful implementation of innovations such as educational technologies. A number of studies suggest that educational technologies have not had the expected impact on teaching and learning and have not transformed higher education primarily because stakeholders have not paid attention to the adoption theories and how they affect uptake of innovations (Collis & Van der Wende, 2002; Zemsky & Massy, 2004). Technology exists in a social context and is very often designed to serve a social function (Sahin & Thompson, 2007). Technology and society interact and influence each other, and therefore the design, adoption and diffusion of technology should be viewed as a social process influenced by person agency and socio-environmental factors, which need to be thoroughly understood for successful implementation (Surry & Farquhar, 1996).

A number of adoption theories have been propounded and used by different researchers in different fields to predict and/or evaluate technology adoption and diffusion. The earliest of these is Rogers' (1962) Diffusion of Innovations Theory. Others include the Technology Acceptance Model (TAM) of Davis (1986), the Cognitive Model of Oliver (1980), and the Expectation-confirmation Model (ECM) of Bhattacherjee (2001).

These theories make particular assumptions about the underlying constructs that influence the decisions of the potential adopters and users of technology. Generally one can categorise these theories in one of two ways: those that measure the intention to use an innovation; and those that predict loyalty towards, and continued use of the innovation. The former propose constructs such as 'knowledge of and attitude towards' the technology, 'perceived benefit', and 'perceived ease of use', as predictors of the initial acceptance and adoption (Rogers, 1962; Davis, 1986). These constructs are mainly internal psychological variables, which are regarded as antecedents of acceptance and adoption of technology. They do not, however, necessarily predict or confirm continued loyalty and use of the technology.

Other theories such as the Cognitive Mode (Liao & Chen, 2009) predict continuance of use using constructs such as 'user satisfaction', which are mediated by socio-environmental and institutional factors such as information and communication technology (ICT) infrastructure, division of labour, reward systems, training, and technical support. These variables can be used to predict diffusion, roll out, loyalty and continued use.

In the TAM, Davis (1986) contends that the initial acceptance and adoption of the innovation are determined by intention to use. This is a measure of the degree of willingness to exert oneself when performing an activity (Ajzen, 1991). This predictor of acceptance and adoption is predicated on the individual`s attitude towards technology, and the individual's perceptions regarding the benefits and ease of use of the technology. Therefore, surveying potential technology adopters in terms of their attitude and their perceptions of ease of use and benefits of the technology can be an important part of predicting acceptance and adoption of the technological innovation.

In the Diffusion of Innovations Theory, Rogers (1983) suggests that initial acceptance is predicated on knowledge of the technology and persuasion to use. Knowledge involves a basic understanding and a level of familiarity with the technology, while persuasion is about forming a positive or negative impression of the technology. According to Rogers' theory, it is useful to survey potential technology adopters for knowledge of, familiarity with and attitude towards the technology, as a measure of the likelihood of adoption.

User satisfaction and continued use are mediated by a number of contextual issues, which various adoption models express as enablers or barriers to use. These include the following: ICT infrastructure, ICT policy, division of labour, training, technical support, and reward mechanisms. These are seen as the key determinants of loyalty and continued use, once acceptance and adoption have kicked in (Bhattacherjee, 2001). These contextual issues will differ from situation to situation, requiring those who are implementing technology innovations to study and understand their effect in each institutional context.

The current study is not an evaluation of the various theories of adoption behaviour; rather, it uses the constructs proposed by the above theories to design a tool with which to gauge the feasibility of adoption of the e-portfolio as an educational technology innovation at Makerere University.

The authors surveyed lecturers, students and the institutional environment, using a questionnaire that was informed by the adoption theories reviewed above. The tool was designed to survey lecturers' and students' attitude towards, and perceptions of educational technologies. It also surveyed institutional contextual issues such as access to ICTs, Internet speeds, availability of technical support and training.

INTRODUCTION

In the 2001–2004 planning cycle, Makerere made a strategic decision to shift from teacher- to learner-centred teaching and learning (Makerere University, 2004). ICT and other educational technologies were to play a central role in this transition. At the same time, an ICT policy was put in place and a Directorate of ICT Support (DICTS) was started to oversee the infrastructural development based on a master plan for the university. The master plan provides for increased access to computers by students and staff, training of end users, and provision of an electronic learning management system. In addition, a Directorate of e-Learning was established to oversee the digitisation of instructional materials and the design of e-courses (Tusubira, Mulira, Kahiigi & Kivunike, 2007).

As part of the efforts to move the university towards learner-centred learning, the current authors involved a group of lecturers and students in designing an e-portfolio for Makerere. The e-portfolio has been designed to promote reflective learning, formative assessment, and mentorship, among other things. It is web based and integrated into the Makerere University Electronic Learning Environment (MUELE).[1]

The e-portfolio is an emerging Web 2.0 technology, which is seen as an appropriate tool for helping students to construct, monitor and manage their own learning. The e-portfolio also facilitates systematic and frequent online interactions between the lecturers, students and their peers, which makes it suitable for both academic and pastoral mentorship of the students (Alexiou & Paraskeva, 2010).

Uganda's Makerere University is one of the seven higher education institutions that participated in the Partnership for Higher Education in Africa (PHEA) through its Educational Technology Initiative (ETI), and is currently undertaking three projects, including the use of e-portfolios, focused on promoting the use of educational technologies to enhance teaching and learning in Africa.

This case study focuses on the feasibility of the adoption of the e-portfolio for teaching and learning at Makerere. It describes the study that was conducted at the university to establish the extent to which staff and students were prepared to adopt educational technology in general, and extrapolates the findings to preparedness to adopt the designed e-portfolio. The value of such feasibility studies lies in their ability to shed light on both enabling and constraining factors in an institution before educational technology initiatives are rolled out.

AIM AND OBJECTIVES OF THE STUDY

The aim of this study was to determine the feasibility of the adoption, by lecturers and students, of the e-portfolio as an educational technology at Makerere University – the oldest public university in East Africa – with particular focus on gauging the feasibility of adoption based on:

- Person-agency issues; and
- Contextual institutional factors.

METHODOLOGY

This was a cross-sectional descriptive study. The university is organised into nine colleges and a School of Law, from which the study population was drawn. Respondents comprised 227 undergraduates, 17 postgraduates and 49 lecturers (293 respondents in total), randomly selected from the colleges and the law school. The study sample size of 293 was calculated using the formula for calculating sample sizes based on proportions available online at OpenEpi (Open Source Epidemiologic Statistics for Public Health).[2] Data was collected by means of

1 See www.e-portfolio.mak.ac.ug

2 See www.openepi.com

a questionnaire that was based on the predictive factors advanced by the theories of adoption behaviour. The questionnaire contained a mixture of closed- and open-ended questions.

Quantitative data was collected from the lecturers and students on their knowledge of educational technologies, and their views on the relevance of educational technologies to teaching and learning. The study investigated attitude towards educational technologies, the perceived benefits of educational technologies, capacity to use educational technologies, familiarity with the MUELE, and involvement in e-courses. Data was also collected on contextual issues such as access to computers, access to the Internet, and reliability of the Internet in terms of speed, availability of training and technical support.

The quantitative data from the closed-ended questionnaires was entered directly into SPSS version 17 for analysis and interpretation. The findings are presented in the form of frequency tables and histograms. Qualitative data from the open-ended questionnaires was manually analysed according to the identified themes. This qualitative data was used to triangulate the quantitative data.

FINDINGS OF THE STUDY

This sub-section presents the study data, which is discussed in the following sub-section.

Table 1: Key variables defining 'attitude' towards educational technologies (ETs)

	ETs are relevant to teaching and learning (%)	ETs do not improve teaching and learning (%)	Using ETs is extra work-load (%)	ETs make teaching and learning deeper and meaningful (%)	I am willing to use ETs for teaching and learning (%)	I have sufficient time to use ETs for teaching and learning (%)
Yes	96	2.7	30	87.8	94.0	54
No	3	90.0	66	7.1	2.7	28

Table 2: Data on technology access issues

Group	Own a computer (%)	Own a mobile phone (%)	Direct Internet at office/hostel (%)
Lecturer	77	98	78
Undergraduate	58	95	45
Postgraduate	88	98	47
Average	74	97	57

Table 3: Responses to questions on practice-related factors

Factor	Findings (%)
Have been trained in ICT	54
Self-trained in ICT	69
Have participated in online courses	43
Have taught online courses	12
Internet is constant and reliable	43
Technician is readily available	29
Technician is important and useful	94

DISCUSSION

The 227 undergraduates, 17 postgraduate students and 49 lecturers from the nine colleges and the School of Law at Makerere University were surveyed for their knowledge, attitude, familiarity with and actual practice of educational technologies. The respondents also provided views on factors affecting access to and use of technology, such as: the reliability of the technology, the availability of training, and technical support.

The results show that students and lecturers alike are knowledgeable, have positive attitudes, and are familiar with educational technologies. These factors and those affecting access are among the main issues responsible for technology adoption behaviour and have been used to predict the feasibility of technology adoption (Charness & Czaja, 2006).

Attitude towards educational technologies

An overwhelming 96% of the respondents agreed that educational technologies are relevant to teaching and learning, while 90% affirmed that educational technologies improve and deepen learning. In total, 94% expressed a willingness to use educational technologies; and, more significantly, 54% indicated that they have sufficient time to commit to the use of educational technologies.

Commitment of time by teachers is considered central to the adoption of educational technologies. It is influenced by and at the same time influences the person-agency factors such as attitude, values, competence development, willingness, and innovativeness (Moser, 2007; Ngambi & Rambe, 2008). The pre-intervention person-agency adoption factors, as established by the current study at Makerere University, are good and suggest good feasibility for the adoption of educational technologies including the e-portfolio.

The activities of e-portfolio construction and review are time- and labour-intensive for both the students and their mentors, the lecturers. Furthermore, most of the conditions for the successful use of e-portfolios – for example, user ownership and empowerment – relate to commitment of time by the users (Driessen, Tartwijk, Vermunt & Van der Vleuten, 2003).

While time commitment is mediated by the person-agency factors above, these have to be augmented by a strong institutional incentive structure that recognizes and invests in the time of users. The absence of such a structure has been linked to poor investment in time by faculty and therefore poor uptake of educational technologies

(Moser, 2007).

Knowledge, awareness and familiarity with technologies

Technology anxiety and self-efficacy have been cited as good indicators of adoption. Both are attitudinal variables that affect confidence levels and the perceived ability to perform a task. They are mainly shaped and influenced by knowledge, awareness, and familiarity with technology (Charness & Czaja, 2006).

In all, 71% of the undergraduates and 59% of the lecturers were found to be knowledgeable about and familiar with the MUELE. Since the e-portfolio will be part of this learning management system, these findings indicate that there will be low levels of technology anxiety but good self-efficacy among students and lecturers alike towards its adoption.

Access factors

Access to technology is affected both by person-agency and institutional context factors. Among the context issues covered by the study were the availability of technology in the form of computers, Internet and mobile phones, and a learning management system. Also covered were reliability of the Internet, electricity supply, opportunities for training, and availability of technical support.

The study found that, on average, 74% of the respondents own computers. Postgraduate students lead in computer ownership (88%), followed by lecturers (77%), with undergraduates coming in at 58%. These are good levels of computer ownership on the part of students and lecturers.

The majority of the lecturers (78%) have direct access to the Internet in their offices; however, only 43% indicated that the Internet is reliable. Of the students, 47% of the postgraduates and 45% of the undergraduates said they have direct Internet access in their hostels. At the same time, 58% of the undergraduates said they can access the Internet within 30 minutes of their classrooms. While availability of technology is an important first step, adoption, integration and sustained use require that the available technology is reliable.

Of those surveyed, 54% had training in ICT; training or capacity building of teachers is key to the transformation of teaching and learning in schools (Darling-Hammond, 1995). It seems the training is ad hoc and not systematized or properly structured into the staff development activities of the university. Of the 54% who acknowledged training in ICT, 69% said they were self-trained.

Practice issues

Okumu (2011), in a paper on e-learning at Makerere, advised that the 'ubiquity of mobile devices' creates real opportunities for their use in teaching and learning at the university. Indeed the ownership of mobile phones by students and lecturers is high, at 97% (in 2013). Of the respondents, 72% agreed that mobile devices such as phones can be used for teaching and learning.

Competition in the communication sector has led to lower costs and better connectivity (Okumu, 2011). However, in spite of the improved connectivity and access, reliability of the Internet and electricity remain huge challenges. Only 43% of the respondents indicated that the Internet was constant and reliable. Availability and reliability of technology and training of the users encourage the adoption and sustained use of technology (Charness & Czaja, 2006; Moser, 2007).

Only 12% of the lecturers admitted to teaching online courses. This rather low uptake and integration of online teaching by the university was also noted by Okumu, who attributed it to the 'restrictive budgetary allocations and fixed mindset'. These fixed mindsets would be the same 'pedagogical beliefs' that Ertmer (2005) blames for the inability by lecturers to adopt technology and that Pelgrum (2001) associates with the traditional, industrial age teacher.

Makerere needs to address the issue of restrictive budgets, as part of a comprehensive incentive structure that includes training for both technological awareness and a shift from industrial age to information age mindsets. Pelgrum (2001) links the industrial age mindset with teacher-centred learning and the information age mindset with learner-centred learning, and suggest that the latter is more aligned to the use of educational technology. As mentioned, Makerere University has adopted a new strategic plan (Makerere University, 2004), which among other things calls for a shift from teacher- to learner-centred learning. Given the close link between learner-centred learning and use of educational technology the university needs to address technology adoption issues within the spirit of this strategic plan.

Part of the institutional incentive structure is provision of technicians and ensuring that they are available when needed to lend support to students and lecturers. While 94% of the respondents said the availability of a technician was important, only 29% reported technicians were available when needed. Technical support is one of the factors that affect competence development, which in turn feeds into reducing technology anxiety while increasing self-efficacy (Charness & Czaja, 2006, Moser, 2007).

CONCLUSION

The adoption and roll out of an innovation is not a single act, but rather a process that occurs over time. This cross-sectional study offered a scan of person-agency and contextual institutional factors that can predict the feasibility of adoption. Positive person-agency attributes such as positive attitude, knowledge of and familiarity with technology, and willingness to use technology, were found to exist among students and faculty. In addition, the university has provided an institutional environment that is conducive to educational technology adoption, including introducing an ICT policy, establishing an ICT support directorate, and improving access to computers and the Internet. Based on these findings it is feasible to imagine that the e-portfolio, an educational technology innovation, will be accepted and adopted by users at Makerere University.

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Developing and Using Animations and Simulations to Teach Computer Science Courses: The case of the University of Dar es Salaam

Joel S. Mtebe
Centre for Virtual Learning
University of Dar es Salaam, Tanzania
jmtebe@gmail.com

Hashim M. Twaakyondo
Department of Computer Science
University of Dar es Salaam,Tanzania
hmtwaaky@yahoo.com

ABSTRACT

Concepts in computer science are among the most complicated to teach in developing country higher education institutions. This is because in most cases such institutions are faced with large class sizes, while teaching facilities are few. Although strategies such as increasing the computer-student ratio, improving teaching pedagogy and increasing the number of teaching staff have been proposed to alleviate these problems, they persist. Therefore, the University of Dar es Salaam's Centre for Virtual Learning and its Department of Computer Science conducted a pilot study to determine if the use of animations and simulations could help students to learn difficult concepts and master course content. The study revealed that 67% of the respondents (of a total of 108 students) indicated that animations and simulations in courses enabled them to grasp difficult concepts more easily. The study also found that the process of developing animations and simulations improved the quality of course design. However, for the benefits and usefulness of the developed animations and simulations to be realized, it is crucial that the pedagogical and instructional design principles be incorporated into the whole process of course development.

Keywords: animations, simulations, computer science, e-learning, animated courses, distance education, University of Dar es Salaam case study, Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI)

INTRODUCTION

Concepts in computer science are among the most complicated to teach. In order to enable students to grasp these concepts, lecturers need to provide demonstrations, practical exercises, and several assignments. This becomes more difficult for institutions in developing countries, which are faced with increased student enrolments (i.e. large classes), limited teaching facilities, and massive shortages of teaching staff, particularly in science courses. These and other challenges result in poor quality of graduates and discourage students from proceeding to further (e.g. postgraduate) studies. Several strategies have been proposed to address these challenges, such as increasing computer-student ratios, improving teaching pedagogy, and increasing the number of teaching staff. Although much of the literature indicates that effective application of information and communication technologies (ICTs) has the potential to alleviate some of these challenges, the benefits of using such technology remain an issue for further research. Moreover, while the current generation of students tends to be very technologically literate and to see technology as an important tool in their daily activities (Corriveau & Shi, 2010), unfortunately many lecturers in African universities are not making full use of technology in teaching and learning.

In responding to such challenges, the University of Dar es Salaam (UDSM), through its Centre for Virtual Learning (CVL), decided to implement a pilot project focused on developing and integrating animations and simulations into computer science courses. This two-year project was funded by the Partnership for Higher Education in Africa (PHEA) Educational Technology Initiative (ETI) and implemented in partnership with the South African Institute for Distance Education (Saide). The pilot project aimed to investigate if the use of animated course materials can improve course design and enhance students' mastery of difficult computer science concepts. To achieve this, the project supported lecturers to redesign their course blueprints by identifying areas where animations and simulations might assist by simplifying the presentation of difficult concepts. Moreover, the project developed animation learning objects, which were integrated into course blueprints, converted into an e-learning format and made available via the Moodle learning management system (LMS) and on CDs for students' access.

To assess the effectiveness of the intervention, the current study was conducted to provide a critical analysis of whether and how the use of animations and simulations in computer science courses had enhanced subject matter concept mastery and improved course design at UDSM. More specifically, the main objectives of the study were to:

- Determine if the inclusion of animations and simulations in science courses enhances concept mastery of complex subject matter; and
- Show how the integration of animations and simulations in science courses had in this case improved the quality of the design of the courses.

BACKGROUND TO THE STUDY

UDSM has made tremendous investment in ICT infrastructure to enhance the quality of teaching and learning. Notable achievements in this regard include the increase in bandwidth to 1/155 Mb, deployment of a wireless LAN (hotspot) at the main campus, and establishment of public access rooms (PARs). Other achievements include the deployment of various information systems such as the human resource information system (HURIS), the financial information system (FIS), the academic register information system (ARIS), the library information system (LIBIS) and various e-learning systems. In terms of educational technologies, UDSM started e-learning implementation in 1998. Initiatives include the introduction of the Blackboard LMS (1998–2008), the WebCT LMS (2003–2006) and the Advanced Level End User Competence Upgrading Project (2004–2007) (Mtebe, Dachi & Raphael, 2011).

Most of the above investments and initiatives focused on installation of network infrastructure and capacity building for core staff, in order to provide technical support to academic staff and students. Through these initiatives, more than 2,000 staff members were trained on how to use the Blackboard LMS and 415 courses were created and uploaded (UDSM, 2010: 36). These initiatives did not result in improved students learning, however, due to the fact that effective integration of ICT in teaching and learning lies beyond mere access and ICT literacy, as pointed out by Peeraer and Van Petegem (2010). According to Mtebe et al. (2011), little was done beyond improving the technological environment of the institution and equipping a few of the academic staff with educational technology skills. This is evident from the fact that most of the 415 courses that were uploaded in the Blackboard LMS consisted of skeletal course guides or course handouts, with minimum content, summarized in the form of Microsoft PowerPoint or Microsoft Word documents (USDM, 2010). Lecturers uploaded into the LMS handouts and notes they were using in face-to-face teaching and expected students to learn independently. In addition, these courses lacked interactivity and were designed without considering e-learning pedagogical approaches. The problems highlighted above regarding poor quality of course design have impacted directly on the mastery of course concepts for students, and ultimately affect the quality of the university's graduates.

In the light of the above problems, CVL decided to implement a pilot project focused on creating interactive course materials (courses integrated with animations and simulations) for computer science and other courses. This project coincided with an institutional migration from the Blackboard LMS to Moodle, an open source LMS. The pilot project was implemented in partnership with Saide and funded by the PHEA.

THEORETICAL FRAMEWORK

There is a growing interest, among those involved in the teaching of computing, in using computer animations or simulations to help present difficult concepts in the subject (Peeraer & Van Petegem, 2010). This is because studies have shown that using animations and simulations in teaching science courses offers many benefits with regard to improving students' learning. These benefits include enhancing understanding of abstract concepts, which are otherwise considered to be 'invisible' (Steinke, Huk & Floto, 2003), and of complex processes (Stoffa & Slovakia, 2004) that are very difficult to grasp from words alone (Woodcock, Burns, Mount, Newman & Gaura, 2005). Moreover, by presenting content in multimedia (video, audio and sound), animations are thought to support students with different learning styles. In this case, animations have the potential to give students different ways of learning concepts, in the process potentially attracting increased numbers of novices, especially women and minorities, to studying computer science (Blank, Roy, Sahasrabudhe, Pottenger & Kessler, 2003).

These potential benefits sparked the interest of several researchers in conducting studies and pilots to determine suitable roles for animations and simulations in teaching science courses. In this regard, studies worth noting include the development and use of animations for teaching courses such as cell biology (Stith, 2004), operating systems (English & Rainwater, 2006), discrete structures (Zhang, 2000), histology (Brisbourne, Chin, Melnyk & Begg, 2002), molecular chemistry (Falvo, 2008) and mathematical concepts (Taylor, Pountneya & Malabara, 2007). The majority of these studies appear to indicate that animated learning materials are more useful than equivalent static learning materials in presenting difficult concepts. While most of these studies have focused on a single subject or discipline, the current study focused on more than one course in the specific domain of computer science.

Animations and simulations can be used in various ways in a given educational setting. For example, they can be used to liven up a lecture, where lecturers can use interactive animations to better demonstrate and explain difficult concepts in face-to-face teaching (Lanzilotti et al., 2006). They can also be used to improve online versions of lectures notes, where interactive animations presented in a lecture can also be offered on the web. In either case, they must be integrated into the instructional design, making them part of the overall pedagogical framework of the course, in order to meet the intended didactic objectives.

Developing quality animations is a complex task that requires highly qualified staff with both technical and pedagogical skills so that the desired learning experiences can be realized. Two factors are essential during the design and development of animations and simulations for educational purposes. Firstly, they must be attractive, engaging and 'intuitive', while enabling students to navigate easily to the learning content. This is because if animations are not user-friendly, students spend more time learning how to use them than learning the course content (Lanzilotti et al., 2006). In addition, such animations (i.e. those that are not user-friendly) are often cognitively demanding and can result in decreased learning outcomes (De Koning, Tabbers, Rikers & Paas, 2011). Thus intuitive interfaces and clear information design allow students to focus on the learning content. Secondly, the need for attractiveness aside, animations and simulations must adequately meet the needs of the instructional process and support students' behaviours and actions (Rentróia-Bonito, Guerreiro, Martins, Fernandes & Jorge, 2008). It should be noted that 'when the users of the technology are students we don't need interfaces that support "doing tasks" but interfaces that support "learning while doing" tasks' (Zaharias, Vassilopoulou & Poulymenakou, 2002). These therefore are among the important issues CVL must address during the development of animations and simulations in order to derive the intended learning benefits – for computer science students, in the case of the current study.

CVL recognized that developing useful animations required technical staff to strike a balance between technological usability and pedagogical objectives. To ensure that animations and simulations met their intended didactic objectives, the learning outcomes were designed based on sound principles of learning (Falvo, 2008). Learning theories such as Gagné's (1985) Nine Levels of Learning and Bloom's Taxonomy of Educational Objectives (Bloom, 1956) were incorporated into the design of the course blueprints. This was done through the course development template. These theories play a significant role in helping lecturers to construct measurable learning objectives and ultimately to ensure that the developed courses cater for different learning styles while meeting the intended course objectives.

RESEARCH DESIGN IMPLEMENTATION

Methodology

The current case study employed both qualitative and quantitative research methods to collect data. Questionnaires were prepared and distributed to students and lecturers. Qualitative data collection methods included one-on-one interviews with the lecturers who were involved in developing the course blueprints. In addition, documentary evidence in the form of the developed animations and integrated courses was used to assess the quality of the developed courses based on the proposed course design quality rubrics (see the Appendix). Questionnaires were analysed using Google doc tools. Further details on specific research methods are presented below.

Findings

The study findings are reported here in terms of two categories:

- Animations and simulations in enhancing concept mastery of subject content; and
- Improvement in the quality of course design based on the process of course development.

Finding 1: Animations and simulations in enhancing concept mastery of subject content

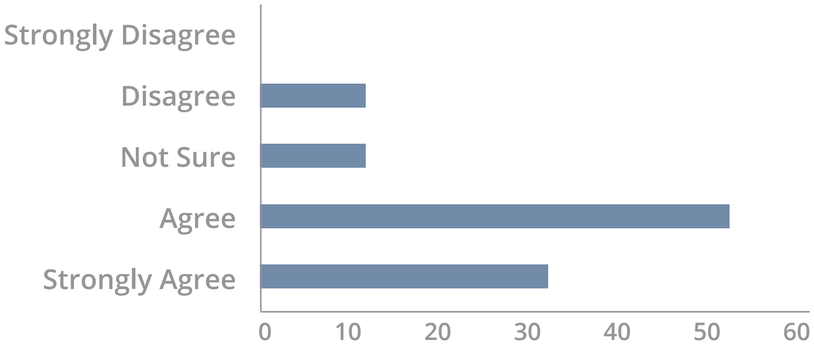
To determine if the use of animations and simulations helped students understand difficult concepts, we developed questionnaires and distributed these to students at the end of the second semester (May) of 2012.

Through these questionnaires, we were interested in finding out (a) about students' perceptions of interface design and content arrangement and if courses were appropriately designed for independent learning; (b) about students' perceptions of the usefulness of animations and simulations in making difficult concepts easier to understand; (c) examples from students of concepts that were made easier to understand as a result of animations and simulations; and (d) students' overall opinions on the usefulness (in terms of assisting course mastery) of animations and simulations in science courses.

The questionnaires were completed by 108 students, of whom 86 were male (80%) and 22 female (20%). Of these respondents, 27 were in their first year of study, 46 were in their second year, and 35 were in their third year.

When respondents were asked to provide feedback on a five-point scale ('strongly agree', 'agree', 'not sure', 'disagree', 'strongly disagree') about their perception of interface design and content arrangement presented in courses and whether they were appropriately designed for independent learning, 78% indicated that the animations were well designed, with content properly arranged to foster independent learning (see Figure 1).

Figure 1: Perceptions of students regarding interface design and content arrangement helping to foster independent learning



When respondents were asked to provide feedback on a five-point scale about their perception of the usefulness of animations and simulations in making difficult concepts easier to understand, 67% agreed that animations and simulations made difficult concepts easier to grasp.

Asked for specific examples of animations and simulations that made some of the course concepts easier to grasp, respondents mentioned the following animated concepts:

- The concept of deadlock in operating systems;
- In networking, the flow of traffic from one device to another; and
- In networking, the flow of data from sender to receiver by the OSI seven layers: according to respondents this was made easier to understand through the simulation used because it showed how data changes from the top layer to the bottom layer.

Other concepts mentioned included:

- E-R Diagram;
- Boyles law;
- B-+ trees (insertion and deletion) (as shown in Figure 2);
- K-map process (Figure 3);
- Data encryption and decryption using the DES algorithm;
- Data structure (recursion, concept of Towers of Hanoi); and
- Application of gates in digital circuits.

Figure 2: Snapshot of the animation for insertion of B+ tree, in a database implementation course

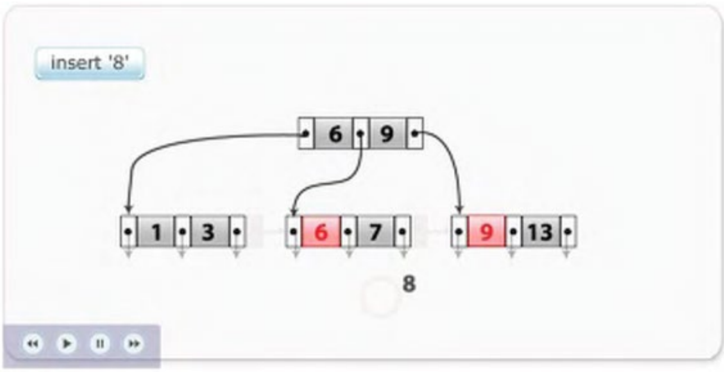
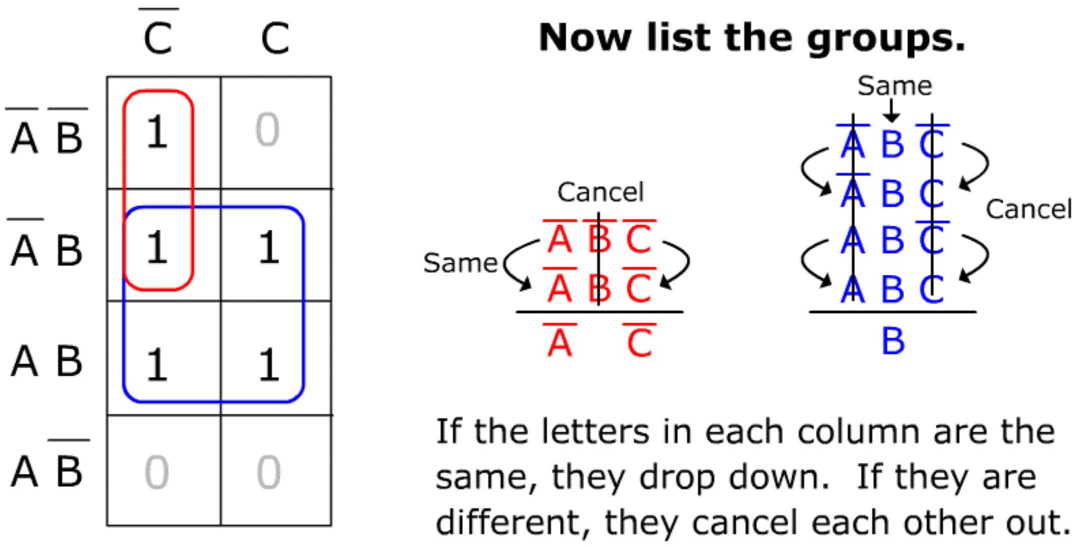
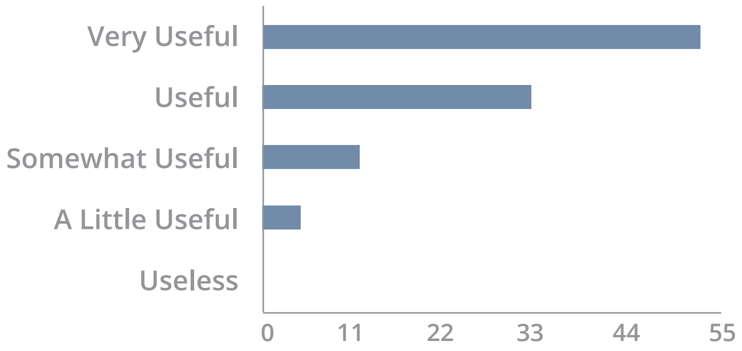


Figure 3: Snapshot of the animation for simplification by K-map process, in the digital circuits course



Finally, we requested respondents' opinion expressed on a five-point scale on the overall usefulness – in terms of assisting course mastery – of animations and simulations in science courses. In response, 84% (91) of the respondents indicated that animations and simulations are useful or very useful in science courses; 11% (12) indicated they are somewhat useful; 5% (5) indicated they are a little useful; and no respondent said they are not useful at all (see Figure 4).

Figure 4: Perceptions of students of the usefulness of animations and simulations in science courses



Finding 2: Improvement in the quality of course design based on the process of course development

In order to determine if the process of developing animations and simulations had an impact on improving the quality of the course design, we conducted two tasks to collect information. Firstly, we developed course design quality metrics (see the Appendix), which provided guidelines on how the quality of a course's design should be judged. These metrics were adapted from the course development template (given to lecturers during course development) and from Quality Matters Rubric Standards 2011–2013 (QMRS, 2012). Secondly, we distributed questionnaires to lecturers to obtain their opinion on the usefulness of the use of animations and simulations in improving the quality of course design and enhancing concept mastery.

Task 1 results

From the table in the Appendix, it can be seen that, in most of the courses, the overall course information was made transparent to students at the beginning of the course. The information that was provided included titles of modules, course objectives or outcomes, prerequisites, list of assignments, lecturer contact information, student evaluation, and grading criteria. Using the course development template, lecturers were able to provide all the required and relevant course information.

Moreover, a course calendar was developed and provided in the case of almost all of the courses. The course calendar is very important because it helps students to learn at their own pace and plan their learning time accordingly. Students learn better when they control the pace of their learning (Mayer & Chandler, 2001). With the presence of the calendar, students can plan when to submit assignments and when to undertake tests or examinations.

The challenging part was the development and integration of learning objectives into various modules in order to enable students to achieve the stated learning objectives. CVL staff had to ensure that animations achieved specific outcomes related to skills or acquired knowledge for intended students, as insisted by Taylor et al. (2007). From the developed quality metrics (see the Appendix), it can be seen that integrated animations complemented text materials by presenting difficult concepts using multimedia elements. Also, most lecturers were able to develop learning activities/practical exercises that encourage reflection.

Task 2 results

The second task involved eliciting lecturers' opinions on the use of animations and simulations to improve the quality of course design and to enhance concept mastery in their courses. In all, 71% 'strongly agreed' that animations and simulations are useful in enhancing students' mastery of difficult course concepts, while 29% 'agreed' that the approach was useful. Respondents also indicated that the use of animations and simulations in their courses helped them easily explain difficult concepts.

When asked about the usefulness of the project and the use of the animations and simulations in general, the respondents suggested the following:

- CVL and departments need to look at how this process can be a continual one; it should not end with these few courses. Other departments within the university should follow this example and make use of CVL, which is well equipped with facilities for and skills in developing such animations;
- More courses should be integrated with multimedia, in the interests of improving mastery of difficult concepts; and
- The exercise is time consuming; in particular, more time is needed to work with CVL instructional designers in developing storyboards for animations.

DISCUSSION, AND LESSONS LEARNED

This study has shown that the process of developing animations and simulations can improve the quality of course design. Lecturers strongly agreed that this process ensured that course goals, course content and methods of assessment were well planned and integrated into the courses, which was not previously the case. However, the study also revealed that it is essential for pedagogy and instructional design principles to be incorporated into the whole process of course development, if the benefit and usefulness of the developed animations are to be realized. To ensure this, CVL developed a course template that incorporated all pedagogical considerations. As already stated, the template included important instructional principles such as Gagné's Nine Levels of Learning (1985), Bloom's (1956) Taxonomy of Educational Objectives, and other related learning theories and principles.

The study included a focus on the effect of animations and simulations in enabling students to master course content and in making difficult concepts easier to grasp. The study revealed that 'animations can serve as effective multimedia tools to engage students while facilitating and enhancing the student learning experience by explaining difficult concepts through visual means instead of the traditional way of heavy textual based presentation' (Aravinthan & Worden, 2010). This conclusion comes from the fact that 67% of the respondents indicated that animations and simulations in courses enabled them to grasp difficult concepts more easily. This finding is in line with what other researchers have found, including Stith (2004), Taylor et al. (2007), Taylor, Duffy and Hughes (2007), and Brisbourne et al. (2002), regarding the benefits of animations and simulations with regard to helping students grasp difficult concepts.

The study also revealed that some lecturers were using animations and simulations to complement their face-to-face teaching. This indicates that animations and simulations are not only useful in online or independent learning, but also have a use in more traditional or face-to-face classroom settings.

CONCLUSION

This study has shown that the use of animations and simulations can assist students to understand complex concepts in various computer science courses. Although the project focused on the computer science discipline, the same benefits could be attained in other science courses. In addition, the process of developing animations and simulations enabled quality course materials to be made available to students and improved course design, while also ensuring the availability of teaching resources – even when experienced staff members retire or leave the institution. The challenge remains how to ensure that animated courses are reviewed and updated regularly.

Despite these benefits, many lecturers hesitate to incorporate animations and simulations into their courses (English & Rainwater, 2006). They do not place the same value on course development as they do on conducting research or teaching. We argue though that lecturers in universities need to realize that developing quality course notes for their students is as important as teaching and doing research. Therefore, there is a need for institutional management to sensitize lecturers on the value of incorporating animations and simulations in their educational materials. In addition, institutions should create motivational mechanisms, such as staff promotion and/or provision of facilities for lecturers who use educational technologies in teaching.

Thanks to technological advancements and the availability of modern equipment, the possibilities for educational animations and simulations are endless. We recommend, for example, that research be conducted into how animations and simulations might assist students with disabilities. Existing animations are mostly web based, with some audio and video complementing the text-based course notes.

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APPENDIX: PROPOSED COURSE DESIGN QUALITY METRICS

A: General Course Information	CH 240	IS 263	IS 273	IS 353	IS 364
Course title	Yes	Yes	Yes	Yes	Yes
Course code	Yes	Yes	Yes	Yes	Yes
Lecturer(s) introduction	Yes	Yes	Yes	Yes	Yes
Course overview	Yes	Yes	Yes	Yes	Yes
Course outcomes/objectives	Yes	Yes	Yes	Yes	Yes
Prerequisites	Yes	Yes	Yes	Yes	Yes
Course assessment and grading options	Yes	Yes	Yes	Yes	Yes
Course calendar	Yes	Yes	Yes	Yes	Yes
B: Instructional Materials					

A: General Course Information	CH 240	IS 263	IS 273	IS 353	IS 364
Course title	Yes	Yes	Yes	Yes	Yes
Clearly stated course outcomes	Yes	Yes	Yes	Yes	Yes
Objectives are stated clearly and written from the students' perspective	Yes	No	Yes	Yes	Yes
The instructional materials contribute to the achievement of the stated module/unit learning objectives	Yes	Yes	Yes	Yes	Yes
Content pitched at level matching course outcomes	No	No	Yes	Yes	Yes
Animations and simulations present a variety of perspectives on the course content	Yes	Yes	Yes	Yes	Yes
There are learning activities/practical exercises that encourage reflection	Yes	Yes	Yes	No	No
The learning activities promote the achievement of the stated learning objectives	Yes	No	Yes	Yes	Yes

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Saide South African Institute for Distance Education

14th Floor, Rennie House, 19 Ameshof Street
Braamfontein, Johannesburg
Tel: + 27 11 403 2813 | info@saide.org.za
www.saide.org.za