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E-Learning Eco-system for Mobility and Effective Learning: A Case of JKUAT IT Students

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Abstract: This paper presents the end results of a project conducted to study the effectiveness of e-learning through the use of handheld electronic gadgets. The study utilized an experimental study design in which sampled students were divided into two groups: control and treatment. The treatment group was facilitated and supported to ensure that all the content was available and accessible on a Learning Management System (LMS). The lesson module of MOODLE LMS was utilized to ensure weekly release of content. Navigation to the following week's content was conditioned on accumulated score based on learners' responses to presentation-related questions which appeared on every page.

From the analysis of project results and particularly the performance of the students, it is demonstrated that m-learning addressed the alarming cramming problem of examinations. In addition, m-learning allowed for location shifting with students able to learn from diverse physical locations using different portable gadgets, time shifting with students being able to access course materials any- time and on demand as well as interactivity with students being able to track their learning progress as well as the management of the learning environment with ability to provide online assessments, assignments, goals and expectations.

Continuous interaction with the learning materials ensured that the learner was always ready for learning evaluation. The significant differences in CAT marks and overall examination score is a major finding that leads to the conclusion that m-learning is superior to the face-to-face mode because besides passing examinations, the learner is able to master content as the semester progresses. With the current trends in adoption m-learning, learning institutions can use the results of this study to implement effective Technology supported Distance Learning programmes.

Key Words: Mobility, Control and Treatment, Learning Management System, T-test, m-learning.

1. Introduction

Traditional educational settings are often teacher-centered where students acquire information by reading texts and listening to lectures and assessments which are based on the retention of facts but e-learning encourages restructuring this setting into student-centered learning in which learning is extended beyond fact retention through challenging learning activities that require critical thinking and the development of contextualized knowledge. In the e-learning design, student achievement is assessed using a combination of practical applications and rigorous examinations which are normally accessed through electronic gadgets. When these gadgets are portable, the mobility of the learner is guaranteed but the challenge of the non-compliant Learning Management Systems may

pose access challenges to the learner. Mobile Learning (m-learning) focuses on the mobility of the learner and interacting with portable technologies such as hand held computers, notebooks and mobile phones with the aim of accommodating and supporting an increasingly mobile population. Ambient Insight Comprehensive Report [1] has painted a bright future and it is believed the scenario could have a great impact in Africa.

In Kenya for mobile learning, there has been encouraging m-learning case studies documented [2]. In their report, m-learning has been identified as a catalyst for building more flexible programmes. Recently, the Aga Khan University-Institute for Educational Development, Eastern Africa made a bold venture and included mobile learning component certificate courses, a step that reflected quick institutional change for learner benefit [3]. This innovation has led to recognition of the need to utilize locally available technologies in delivery of programs by the university. Mobile technologies also support learning in personal and informal setups [4] this potential can be tapped to reinforce [5].

In 2009 an e-readiness survey by Kenya Education Network (KENET) placed Jomo Kenyatta University of Agriculture & Technology (JKUAT) as one of the top-ranked universities in East Africa based on staging of the 17 indicators of e-readiness survey framework used. A JKUAT team was granted research funds under the KENET East African Universities Accession Project to undertake a project entitled E-LEARNING ECO-SYSTEM FOR IMPLEMENTATION OF MOBILE LEARNING (A Case of JKUAT IT Students). This paper is part of a final project report presented to KENET in October 2012.

2. Objectives

The following were the study objectives as derived from the main project.

Main objective:

- To test the efficacy of m-learning in a university setup.

Specific Objectives:

- To design and implement an e-learning eco-system based on an LMS and portable devices.
- To compare e-learning and face-to-face learners in terms of their learning experiences and performances.

3. Methodology

The artificial Intelligence unit taught to Bachelor of Science in Information Technology students was purposively selected for the study. The course was to be offered to eighty (80) students. A sample of twenty (20) students was targeted due to the cost implications. The twenty students were selected using probability sampling [6]. Previous year's performance score were used in the selection of the participants to ensure that there was no significant difference between the active and control group in performance score. To obtain the sample of twenty (20) students, out of a class of eighty (80), all the students were ranked in descending order based on the examinations of end of year two average marks. In the ranked list, twenty cohorts each consisting of four students were created and a single student was picked randomly from each cohort. Whenever a cohort contained a female, some preference was made to ensure that the criteria picked at least 4 females from a class consisting of 64 males and 16 females.

Portable devices namely IDEOS phones, mini laptops and tablets were allocated to the active group. Airtime was allocated to the sampled students for internet access to the learning management system. Personal devices were also enlisted for the treatment group.

All the teaching and learning for the sample of twenty (20) students was done through the learning management system, Moodle 2.1, accessible through portable gadgets

including mobile phones, laptops and tablets. Using Lime Survey online data collection/feedback tool, a number of questionnaires were administered at different stage. Two continuous assessment tests were administered on the learning management. The final examination was administered in the normal examination environment for both the sample and the control group.

To compare the two groups in terms of academic performance in the selected unit, t-test [7] was conducted on the CAT marks and Examination Marks. Before the actual implementation of the study project, three tasks were undertaken as described below.

3.1 Configuration of LMS Interface for Portable Devices

The main objective of this interface was to allow learners to access content from Moodle LMS using hand held electronic gadgets such as mobile phones, tablets etc. The team engaged a research assistant to investigate how such an interface could be designed and implemented. The relevant servers were installed before the configurations.
Initial attempt to configure Moodle 1.9* proved challenging and the team had to switch to Moodle version 2.1 for which the online plug-ins were easily configured enabling appropriately formatted content to be accessible using different phones, tablets and laptops.

3.2 E-Content Development

The unit BIT 2319 Artificial Intelligence had been purposively identified for the pilot project. The first task was to organize all the notes for the unit into a comprehensive compilation as per the approved syllabus. After Review by subject expert, the content was packaged as a reference manual which was uploaded into MOODLE LMS (elearn.jkuat.ac.ke hosted at KENET) both as a HTML file and PDF file to allow for offline use. The reference manual was broken down into 11 weekly lessons [8] and implemented in the lesson module of MOODLE. This allowed online tracking of learners progress where they were required to read and understand sections of the content in order to respond correctly to lesson questions. Navigation to the next lesson was conditioned on getting a score of at least 80% of the lesson questions.

4. Case Description

4.1 Launch

The M-learning project officially kicked off with an official Launch by the University Management which was an indication of the commitment to the implementation of new technologies towards the improvement service delivery to the students and staff community. The university was investing in massive network upgrading and wireless connectivity which would find immediate use in extending learning beyond the walls of the lecture halls and improving learning outcomes.

The active and the control group were adequately informed and equipped on what they required to be part of the project.

4.2 Learning Activities and Progression

After the official launch of the second phase and e-orientation of the students, a number of activities were planned and executed as described below.

4.2.1 Tracking of Students

It was found necessary to track students both offline and online. A research assistant was engaged to physically trace the whereabouts of at least one (1) active student during the

scheduled online sessions and ascertain that the student was doing the right thing. This was a form of monitoring which was done on weekly basis. Evidence of the students' online m-learning activities was gathered in form of personal interviews, comments and photos in some of the sessions.

Online activities for all students were tracked. Students' issues including failed logins, browser problems were responded to by a dedicated system administrator. All the communications were posted on the LMS feedback forum.

4.2.2 Interaction Sessions of Students with the Online Facilitator/Lecturer

Online interaction between the students and the lecturer was done every Monday from 12.00 pm to 3.00 pm. The lecturer and the students had synchronous sessions which were also confirmed from time to time by other researchers.

4.2.3 Additional Data Collection Exercise

Throughout the project period, three (3) data collection exercises were carried out through an online survey tool (elearn.jkuat.ac.ke/lime survey). The first exercise was to gather information on potential participants' perceptions and readiness. The second was to gather baseline information from participants for use with the final performance data and the third was to determine the participants' preparedness to face the end of semester examinations.

4.2.4 Online CATS

Three (3) Continuous Assessment Tests (CATs) were in a designated Lab. Two (2) were conducted online. One (1) of the CATs could not be done online because the internet connection became too slow and it was felt that the expected results would not be achieved.

4.3 Findings

In this section, we present the findings of the project.

4.3.1 Pre-Project Perceptions

An online questionnaire was administered just before the students were selected. About 40% of the BIT 2319 class responded to the questionnaire. Of those who responded, 72% said that they were using their phones to access internet, 60% had modems and 72% had laptops. All the respondents expressed interest to participate in the m-learning project. While 88% were willing to use their own laptops or phones in the project, 40% said the greatest challenge in accessing the content was lack of reliable internet connection. This justified provision of internet bundles to active participants.

4.3.2 Student Retention and Progression

Out of the class of eighty (80) students, only sixty six (66) went through the semester and only forty eight (48) sat for the final examination for the Artificial Intelligence unit. Out of the forty eight (48) students, twenty (20) were in the sample and the rest were in the control group. How retention of 100% for treatment group:

4.3.3 Access to Content

Location shifting - The students were able to access the content from within and out with the University. The average distance from JKUAT Main Campus was 2.2 kilometers, presumably in the hostels in and around the University. Some students were accessing from 20 kilometers. The students were also able to access the content from a distance of over 600 kilometers while on an academic trip in Mombasa and Malindi along the Kenya's Indian Ocean coastline.

Time shifting - The students indicated that access was generally successful 89.6% of the time and 83.1% after 6.00 p.m. Learning was therefore possible beyond the normal daytime environment.

The standard allocation on the timetable for the traditional class was four (4) hours. On the M- learning the students spent an average of 10.5 hours offline and 7.1 hours online meaning that the students had more time of interaction with the content and learning on m-learning than the traditional class. The students also perceived that 11 out of a possible 16 units per academic year would be handled using m-learning.

Access tools - Mobile phones were used 65.4% of the times. On the other hand, tablets were used 5.6% while mini-laptops were used 9.8%. The low use of the tablets and mini-laptops may be attributed to the low number of devices available for use. Laptops and desktops were also used by 55.2% and 26% respectively. The percentages would not add up to 100% because the mobile phones would sometimes be used as modems.

The mobile phones were seen to have played dual roles, both as modems and access devices. Of the period, an average of 71% used mobile phones and tablets while a 10% used the ordinary modems. This could signify the demise of the ordinary modem as mobile replace their role through the tethering function.

4.3.4 Examinations Preparedness

General preparedness

One week before the end of semester examinations were undertaken, a questionnaire was administered to establish the participants' perceptions and determine the level of preparedness. Thirty one (31) students participated in this survey out of which nineteen (19) belonged to the active group. Of the active participants, 94.8% had no regrets having been in the active group and confirmed to having had a great experience. Asked whether they felt they would have performed better in CATs and assignments if the unit was not through m-learning, 78.9% disagreed and so the m-learning experience was fulfilling with 89.5% indicating that they had no reservations in recommending m-learning to anyone.

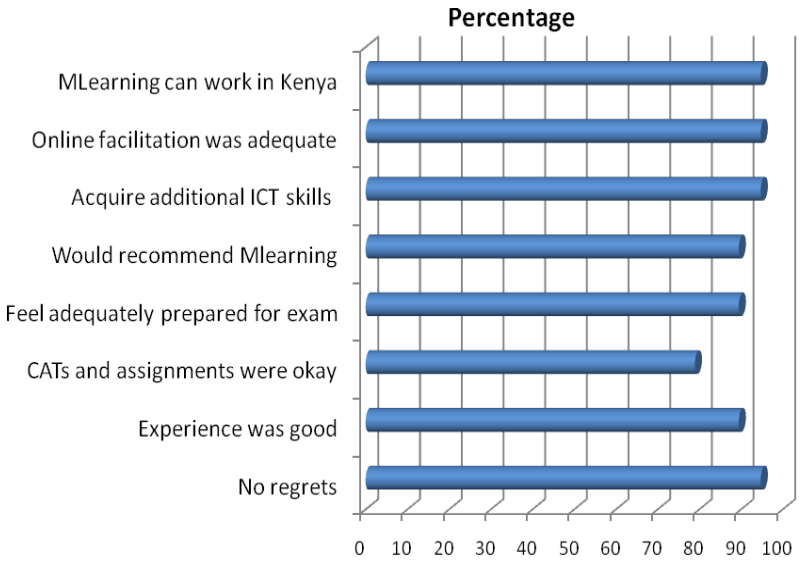

Figure 1: Perceptions after m-Learning Experience

Table 1: Mean Rating of Post-Project Perceptions

	Active group (n=19)		Control Group (n=12)	
Area	Mean	Standard Deviation	Mean	Standard deviation
Tackling multiple choice	4.842	0.375	4.333	1.155
Answering short answer type of	4.421	0.607	4.333	0.778
Answering path/network questions	4.474	0.612	3.333	0.985
Answering matching type of	4.421	0.902	3.667	1.073
Answering essay type of	4.368	0.761	3.583	1.240
Answering application questions	4.474	0.697	3.583	1.379
Applying the acquired life situations	4.579	0.607	3.500	1.314
Identifying practical applications	4.421	0.838	3.833	1.403
Aggregated variable	4.50	.443	3.77	.952

The figures in the above table indicate some differences in the mean level of preparedness of the participants in tackling different type of questions. Apparently, the mean scores for the active group are higher than those of the control group in all cases. The standard deviations are also quite big in the control group giving the impression that the level of preparedness was more diverse among the offline group.

Difference in preparedness Hypothesis testing

To determine whether the differences are by chance, independent samples t-test was conducted on an aggregated score to test the null hypothesis;

H_0 : There is no significant difference between the two groups in level of preparedness

versus

H_1 : There is significant difference between the two groups in level of preparedness

Levene's test for equality of variances revealed that the variances within the two groups are significantly different and so the reported degrees of freedom have been adjusted appropriately. Since $t_{14,0.55} = 2.899, p < 0.026 < 5\%$ we reject the null hypothesis and conclude that there is significant difference in the general level of preparedness to tackle the end of semester examination. The active group has a significantly higher confidence level $\bar{x}_{active} = 4.5, \bar{x}_{control} = 3.77$

4.3.5 Academic Performance Results

An end of semester examination was also administered in the traditional manner to all the students. In the final data file we had data for all students on four key variables; The year two average score, the CAT marks, the written examination marks and The aggregated marks. The following is the result of comparative analysis of the performance scores. The bio data is also used in performing various comparisons.

Performance between control and active group

Once the sampling was done, it was important to verify that the participants were homogeneous in terms of performance. An independent samples t-test was conducted on the mean performance for the second academic year of study. To test the null hypothesis;

H_0 : There is no significant difference in performance score between the two groups

versus

H_1 : There is significant difference in performance score between the two groups

The results reveal that the two groups did not differ $t_{46,0.05} = 0.137, p = 0.892$.We therefore fail to reject the null hypothesis and conclude that there is no significant difference in the general performance of the two groups prior to treatment (exposure to m-learning). The mean scores of the two groups were $\bar{x}_{active} = 545\%, \bar{x}_{control} = 54.8\%$.

Performance in Continuous Assessment Tests (CATs)

One notable observation is that m-learning interfered with a traditional practice of students attending lectures to just copy and store notes then towards the end of the semester when retrieve them and seriously cram them in order to pass exams. The fact that the content was only accessible weekly with conditional controls meant that students had to be on their toes to complete each week's online activity before proceeding to the next one. By the time both CAT's were being given, the effect of this control was very evident. The two CAT's were administered at the same time for both groups but the online group had the advantage of receiving their results almost instantly, while the offline one had to wait for the scripts to be marked physically which took two days.

Independent sample t-test performed on aggregated marks revealed that the online group was significantly better than the control group; $t_{46,0.05} = -5.829, p < 0.001$ $\bar{x}_{active} = 22.4, \bar{x}_{control} = 17.5$.This is quite a big difference and only confirms the fact that the control group had a challenge in mastering the stuff within the semester.

Performance in written end of semester examination

A standard end of year semester examination was administered as per the university schedule and regulations. Although in the CAT's the active group was significantly better than the control group, this difference disappeared in the end of semester examination. The independent sample t-test led to acceptance of the null hypothesis that the two groups are not significantly different $t_{46,0.05} = 0.18, p = 0.858$ $\bar{x}_{active} = 28.9, \bar{x}_{control} = 28.5$ .This indicates that the control group, though not adequately prepared one week to the exam as revealed in section 4.3.3, caught up with the active group in the last one week.

Overall performance

The university relies on an aggregated score of CAT marks and end of semester examinations results. This therefore means that students can greatly benefit from CAT marks under m-learning mode of content delivery. This is because on aggregating CAT and examination marks, the online group was found to be significantly better than the control group. The independent sample t-test results are: $t_{46,0.05} = -2.194, p = 0.033$ ($\bar{x}_{active} = 51.3\%, \bar{x}_{control} = 46\%$) Note that the general performance of the active group is slightly above 50% which is a Grade C according to the university grading system, while the Control group remains in Grade D.

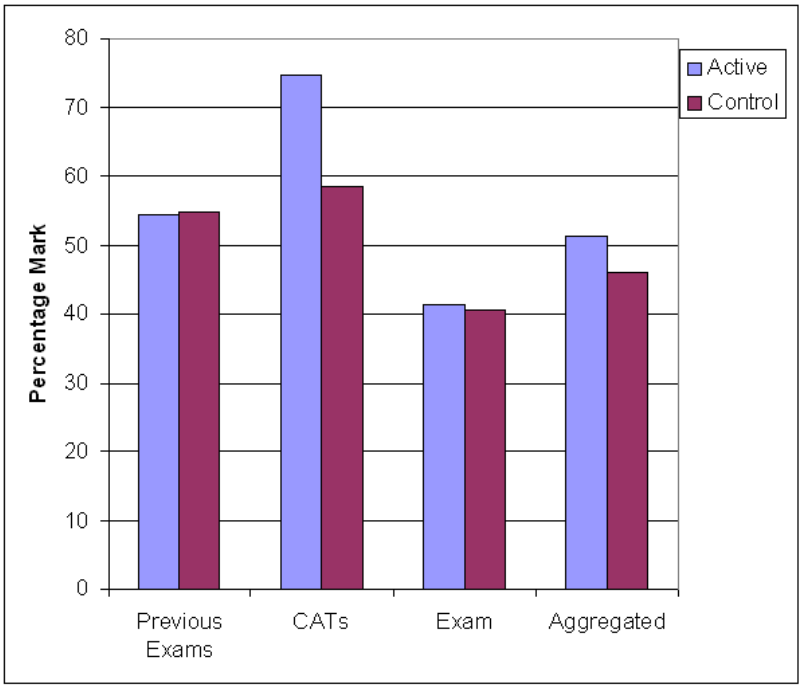

Figure 2: Comparison of the Groups by Performance

5. Conclusions and Summary Recommendations

5.1 Conclusions

From the project results and particularly performance analysis, it is clear that m-learning addressed an existing problem. Besides allowing learners to be mobile and access content even at odd hours, the issue of cramming to pass examinations is addressed. Continuous interaction with the learning materials ensures that the learner is always ready for evaluation [8]. Online testing is another component of this project that excited the participants and the fact that they could get differences instant results made it the preferred mode. The significant in CAT marks and overall examination results is significant finding that leads to the conclusion that m-learning is superior to the face-to-face mode especially where the content needs to be mastered as the semester progresses.

It is also evident that mobile learning is as effective and beneficial to both the learner and the institution than the traditional class-room environment. It ripe for full-scale adoption in higher education for effective implementation of Technology supported Distance Learning programmes. The institutions can encourage m-learning by implementing distance learning programmes in which tuition fees is adjusted downwards to allow transfer of those costs to purchasing of handheld gadgets and learning internet bundles. With such a strategy, the Universities would save much from unnecessary physical infrastructure and be able to handle large number of learners in virtual classroom.

5.2 Recommendations

Universities have been plagued with the problem of students cramming to pass examinations. They have also been faced with the challenges of facilitating teaching and learning without the restrictions of time, location, mobility and testing. This research has revealed that m-learning significantly improved the students preparedness for the end of semester examination and reduced the need for cramming. It also blotted out the relevance of time, location and access tools while also facilitating instant feedback to students on their performance on quizzes and continuous assessment tests. It is therefore recommended that

the rapid adoption of m-learning has significant gains for improved and flexible learning experiences and, perhaps, a re-orientation of higher education from cramming to learning.

This study has also brought out some interesting finding that need to be verified for a different group of students and other units. The Unit used in this study had little computations and so it was easy to disseminate textual notes to the learners. Highly mathematical and graphical content may pose different challenges and so the project could be repeated with course units in engineering, architecture, mathematics and agriculture.

The next important step in this research is to evaluate the policy options for the large-scale adoption of mobile learning and the impact of the incorporation of the BYOD [9], bring your own device, concept in the advancement of flexible and mobile higher education. This can open new areas of collaboration. Kenyan and European institutions would be in a passion to offer joint programmes in which course online facilitators from any partnering institution can be utilized. This can help address the problem of inadequate staffing in some key areas. The gargets used are also not locally available and so Collaborators can take advantage of providing the same at a cost.

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