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# Leveraging on the Affordance of Mobile Phones in Nigeria for mLearning Modeling

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## ABSTRACT

This work identified that smartphones and tablets are becoming commonplace in Nigeria. Armed with this knowledge; coupled with the desire to to utilise the technology in the hands of everyone to enhance their learning experiences, we designed and implemented a student-student and student-lecturer collaboration model for mobile learning The research considered the design and delivery of educational contents to mobile users remotely using the object oriented analysis model and the waterfall software process model. Particular attention was also placed on academic assessment and evaluation; this included mobile submission of class works and assignments, which are part of academic continuous assessment for the students.

**Keywords:** *mlearning, smartphones, developing economies, elearning*

## I. INTRODUCTION

Smartphones and mobile devices are becoming commonplace in Nigeria and all over the world and the buzz about mobile learning is growing. The researchers had identified the following problems in delivering learning contents to students in Nigeria:

1. Ensuring delivery of educational contents to people with mobile devices without necessarily coming to the campus for lectures.
2. Inadequate literacy rate in the country.
3. People with busy schedules do not have remote access to quality education anywhere and anytime.
4. The burden of face-to-face method of learning.
5. Little or lack of knowledge sharing among peers through collaboration

This paper is aimed at presenting the researchers work towards leveraging on the affordances of mobile phones in Nigeria to solve some of the problems highlighted above in order to enhance education and learning by developing a system that enables students' access to education and learning through the use of mobile phones.

This work is significant because ubiquitous computing is the vision of the future in which computational devices are distributed invisibly throughout our environment. The proliferation of mobile phones into Nigeria is seen as an avenue of enhancing existing systems such as learning and other practices. Therefore, the significance of this study is to utilise the technology in the hands of everyone to enhance their livings, most especially learning from at anytime and anywhere. The rest of this paper is organized as follows: we presented a number of related work in the next section, described our deployed methodlogies in section three and discussed our obtained results in section four.

## II. REVIEW OF RELATED WORK

M-learning has now emerged as a new wave of development, based on the use of mobile devices combined with wireless infrastructure, and much of the current literature on m-learning reveals all the strengths and weaknesses associated with the more mature e-learning communities. There are, of course, close links between e-learning and m-learning and it can be argued that they represent a continuum based on the deployment of ever-more sophisticated technologies. M-learning is a natural extension of e-learning. It has the potential to further expand where, how, and when we learn and perform in all the aspects of our life and one of its key is its potential for increasing productivity by making learning available anywhere and anytime, allowing learners to participate in educational activities without the restrictions of time and place [1]. Some successful m-learning implementations are presented in this section.

In the past decade, e-learning was the state of the art for many universities and institutions; while many predicted that e-learning is the final solution for corporate training and university programs, there has been a continuous evolution in wireless and mobile technologies. We have observed a proliferation in mobile devices capabilities aligned with a decrease in their prices which makes them more cost effective than desktop computers [2].

Brown (2003) shared the latest developments regarding m-learning project in Africa and proposed a model for the implementation of m-learning in higher education in developing countries. The paper took into account the relevance of mobile technologies for e-learning in developing countries and also touched on the didactical issues involved. The author further showed with the aid of statistics that mlearning has already started to play a very important role in e-learning in Africa and had brought e-learning to the rural communities of Africa – to learners that were never imagined as e-learning learners just a few years ago. He believed that mlearning is the gateway to e-learning for most Africans as the rapidly growing

wireless infrastructure fulfils the access needs more and more; and that Africa is actually leapfrogging from an unwired, non-existent e-learning infrastructure to a wireless e-learning infrastructure [3].

According to Georgiev, *et al*,2006, in the mid of 2005, the number of cellular phones per person, were more three times than PCs, and most of sophisticated phones have the processing power of a mid-1990s PC, and it is increasing [4]. As the result, the number of mobile users increased rapidly and nowadays they are estimated to be 2 billion users. Beside, the advancements in wireless technologies play a major role in escalating the number worldwide mobile Internet subscribers who have a wireless access to various online recourses through mobile devices [5].

Reference [6] presented the use of activity theory as a framework for describing the components of an activity system for the design of a context-aware mobile learning application. The author in the work discussed the implications of context for mobile design are discussed and presented a brief review of activity theory and its benefits. A discussion of how the principles of activity theory can be used to show the various components of the model for a mobile learning environment was presented and the author concluded the paper with suggestions for further work.

A report of a workshop by the Kaleidoscope Network of Excellence Mobile Learning Initiative; Big Issues in Mobile Learning and edited by Mike Sharples (2006). Following a practically orientated approach, the report corroborated the claim that it is necessary to take an integrative perspective on orchestrating technology enhanced educational scenarios. Although theory was not in the foreground, the scenario development illustrated that theoretical underpinnings (such as activity theory) may provide a reference frame to describe technology and education in a common context. From the elaboration of the second theme the report concluded that an adequate integrative design for mobile learning needs also a deep understanding of the affordances and inherent functional constraints of the technological components, and that this would not come as a consequence of the theoretical underpinning. So, an elaborate model of the educational situation and requirements, theory based structuring principles and technical expertise about the available and adequate technologies are all needed in a synergetic approach [7].

Hildreth (2011) described some concerns when designing mobile learning enironments. The concerns were multiple platforms and shifting standards, speed, security, economics, the rise of Android devices, the skyrocketing popularity of iPad and other tablets. The author believed thain t it is important the design of any mobile learning strategy to focus on the aforementioned basic issues before embarking on any design and or adoption of mobility [8].

A description of the experiences of Sun microsystems in the application of the Thiagi 4-Door Model for mobile learning was given in a report by by Powell and Carson (2010). The report described the Four-Door (4D) eLearning model; with the four doors representing four different components of learning environments and developed over the last few years by Dr. Sivasailam "Thiagi" Thiagarajan, as a simple instructional design model that helped training and non-training professionals build eLearning programs that addressed the needs of many types of learners relatively quickly and cheaply.

The report described Sun's experiences with respect to analysis and design issues, technical issues, pilot implementation success and the feedback [9].Reference [10] described the The Framework for the Rational Analysis of Mobile Education (FRAME) model in his paper. The FRAME model presented mobile learning as a process resulting from the convergence of mobile technologies, human learning capacities, and social interaction. It specifically addressed contemporary pedagogical issues of information overload, knowledge navigation, and collaboration in learning. The model's usefulness as guiding the development of future mobile devices, the development of learning materials, and the design of teaching and learning strategies for mobile education was demostrated.

Baker et al (2005) proposed a theoretical Model for M-Learning Adoption in Developing Countries. The researchers investigated the use of wireless technologies in education with particular reference to the potential for m-learning in developing countries and explored the reports of a number of current m-learning projectsas well. The results of these investigation was the derivation of the perceived benefits of using wireless technologies in education, and potential barriers to their use. The authors further proposed a theoritical model for m-learning adoption in a developing country based on their findings. The proposed model emphasised the importance of taking a systems view of all the elements that needed to be in place in an m-learning environment, including the necessary stakeholders and key elements (communication infrastructure, mobile devices, learners and teachers), in order to ensure the effective adoption of wireless technologies in education. The model embraced the key issues with regard to m-learning as well as the critical success factors that were essential in ensuring successful adoption [11].

Khaddage *et al*., (2009) investigated the use of mobile learning technologies in higher education, and proposed a blended mobile learning model, which ha the ability to serve the emerging learning process and delivery, and provide a well balanced learning environment that met the current learners' needs. The proposed model took into consideration all aspects of learning via technology, and how best to successfully integrate mobile devices into the university sector. The researchers believed that the proposed blended mobile learning model was capable of merging within the online learning and the traditional learning environment without any major changes, thus forming an important part within the overall flexible learning environment [12].

A mobile learning framework was described by Hosseini and Tuimala (2005) as a result of analysing different factors involved in developing mobile learning systems and classisying the factors as mobile usability, network capabilities and e-learning components. The paper argued the importance of

each factor and also assessed the m-learning systems developed based on the mentioned platform; the assessment showed that the students and staff are willing to enhanced m-learning system in their education process; also, at the time of the assessment there were many restrictions for implementing the exact functional prototype. The main abstractions for the development of the prototype were the network capabilities and the deficiency of deploying self developed application on mobile devices. Results of the evolution of prototype showed that designing m-learning system required the mentioned platform to be care fully study in advance. The evaluation revealed that video stream plays an important role in the mobile learning system [13].

Leung and Chang (2003) introduce a proposed framework of mobile learning. The proposed framework consisted of four functional levels namely: mobile learning applications, mobile user infrastructure, mobile protocol andmobile network infrastructure. The framework was expected to simplify the design and development so that different parties (e.g. vendors, service providers, designers, developers) can address individual levels. A single party can build on the top of the functionalities provided by others. The functions of these four levels were described with some examples. The authors concluded by showing that practically, knowledge management and learning community were two major issues in the mobile learning and that they are the two states of changes in the learning paradigm [14].

Reference [15] believed that there is a need to re-conceptualise learning for the mobile age, to recognise the essential role of mobility and communication in the process of learning, and also to indicate the importance of context in establishing meaning, and the transformative effect of digital networks in supporting virtual communities that transcend barriers of age and culture. To this effect, the researchers developed a framework for theorising about mobile learning, to complement theories of infant, classroom, workplace and informal learning. A related aim was to inform the design of new environments and technologies to support mobile learning, since the work described in the paper had been developed through a series of projects to design mobile learning technology.

## III. MATERIALS AND METHODS

This work the object oriented analysis and design (OOAD) framework to define a model for mobile learning suitable for an academic institution in a developing economy. The choise of this methodology was based on the fact that the OOAD satisfied the need to develop a model that described computer software as it works to satisfy a set of customer defined requirement.

The application mobile interface was developed using java micro edition popularly known as Java 2 Micro Edition (J2ME); a version of Java 2 for mobile devices. The mobile learning application server side programming was done using Java servlet; and MYSQL**;** a very popular open source, relational DBMS for both web and embedded applications was deployed for the relational database design.

## IV. RESULT DISCUSSION AND CONCLUSION

Figure 1 showed the high level model (HLM) of the mlearning framework. The high level model is a top down presentation of the mlearning model. Topmost in the hierachy is the enrolment subsystem; where an intending user is enrolled as either a student or a lecturer. After the enrollment is successfully carried out, the user can now proceed hierachically through a list of learning activities in the model.

The mlearning application is menu driven as users are required to select menu option based on the operation they wish to execute. The application outlined the available menu options where selection can be made from. The menu options are only displayed after a successful login. The main menu of the mlearning system that resulted from the high level model is above is depicted below (Figure 2). The components of the mlearning system design were two interfaces for both the students and lecturers. With the students' interface, learners can submit their assignment from anywhere without being physically present on campus, share academic experiences with one another, add new courses to the database and view books and lecture materials. Lecturers on the other hand, through the lecturers' interface enabled the lecturers to post assignment, put deadline for the assignment and equally view assignment submitted by students.

The data flow diagram(DFD) for the mlearning system is shown in Figure 3 below. This is a graphical representation of the "flow" of data through the information system and it was used for the visualization of data processing (structured design).

We have successfully designed and implemented a mobile learning platform that enabled educational content delivery through mobile phones. The sample screenshots are shown in Figure 4 below. Today the web based electronic learning only allows those with computer systems leaving out those with mobile phones. Although some web based electronic learning systems can be accessed through mobile phones but without the full features. Furthermore, there are more mobile phone users than computer system in Nigeria due to the facts that the prices of mobile phones are cheaper compared to computer systems. In addition, the technological revolution in the field of mobile phones has led to manufacturing of computer capability phones at relative cheap prices. This implies that the developed mobile learning system uses what the students have to perform academic activity.

This work contributed conveniences, portability and mobility, which are the attributes of mobile phone to learning. This implies that the developed system enables users to learn anytime, anywhere and anyhow. This can be viewed as a great achievement in the field of mobile computing. One noticeable problem with most of the existing mobile learning and web based learning system is that they are localized to certain

country or region. In most cases Africans are excluded from the list due to our educational systems and curriculum contents. This project work contributed greatly to the localization of the mobile learning to Nigerian setting with focus on Nnamdi Azikiwe University, Awka as case study.

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# APPENDIX

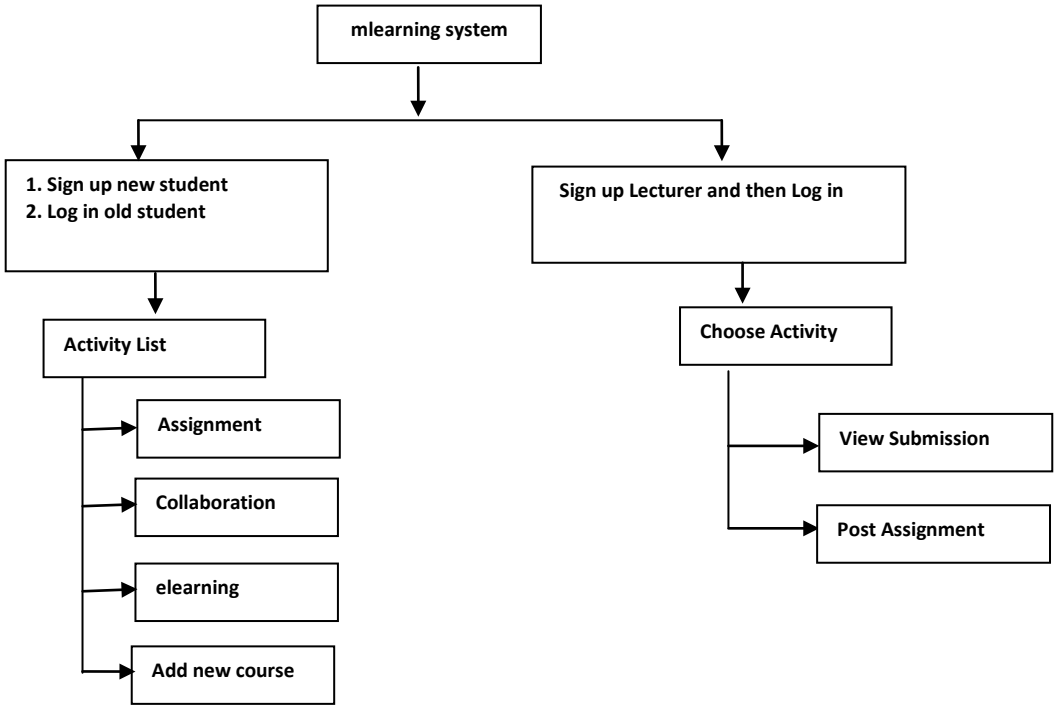


**Figure 1. the High Level Model of the Mobile Learning Framework**

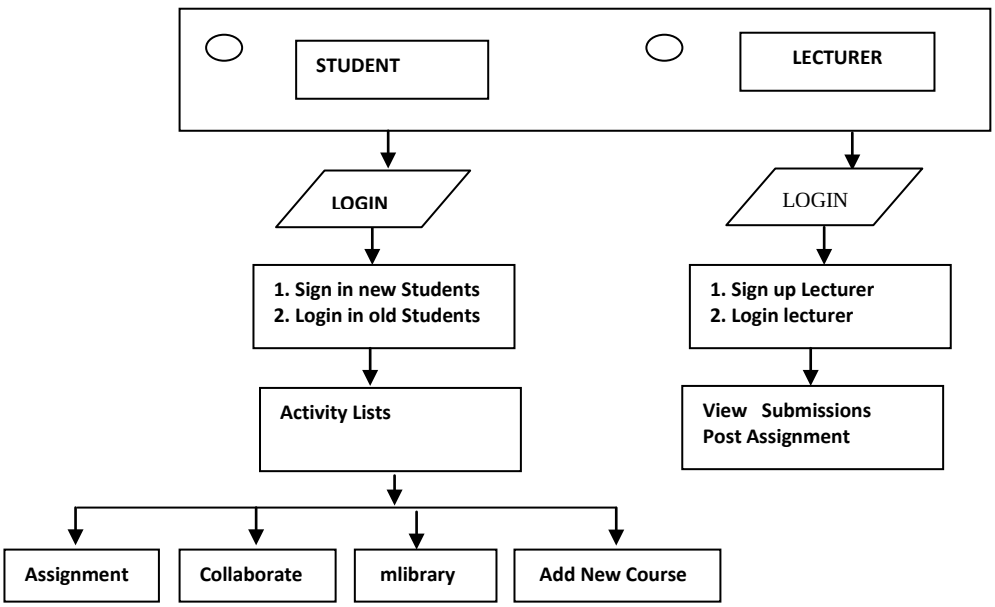


**Figure 2. The HLM decomposed into a main menu of the mlearning system**

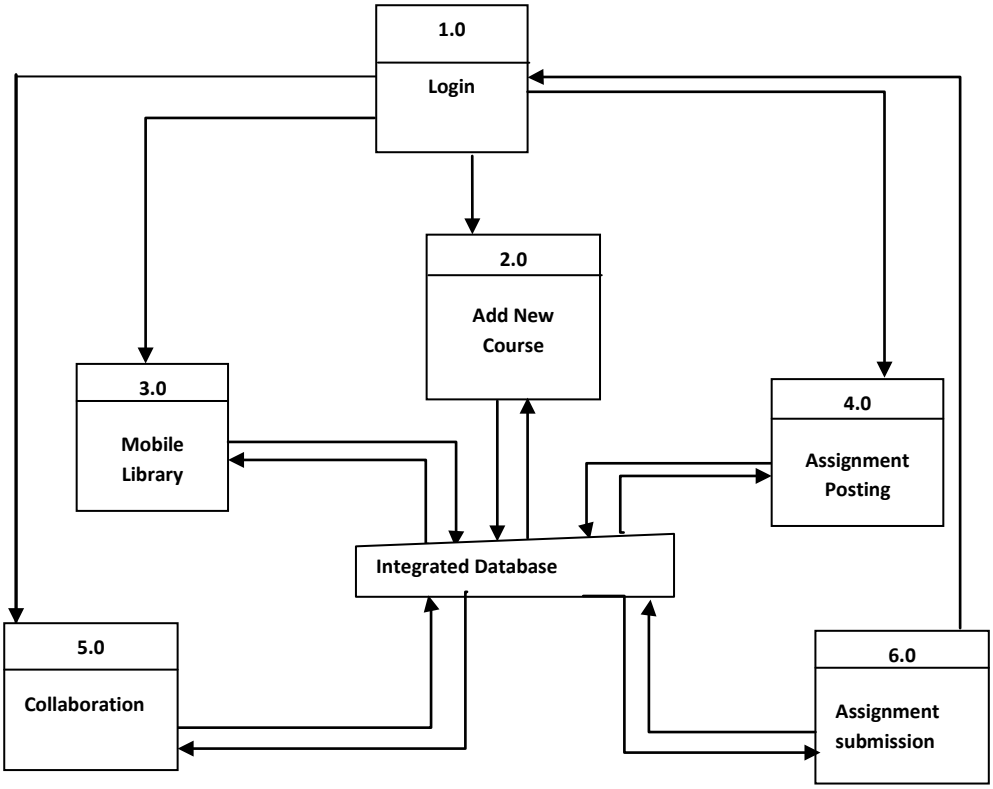


**Figure 3. The Data Flow Diagram of the mLearning System**

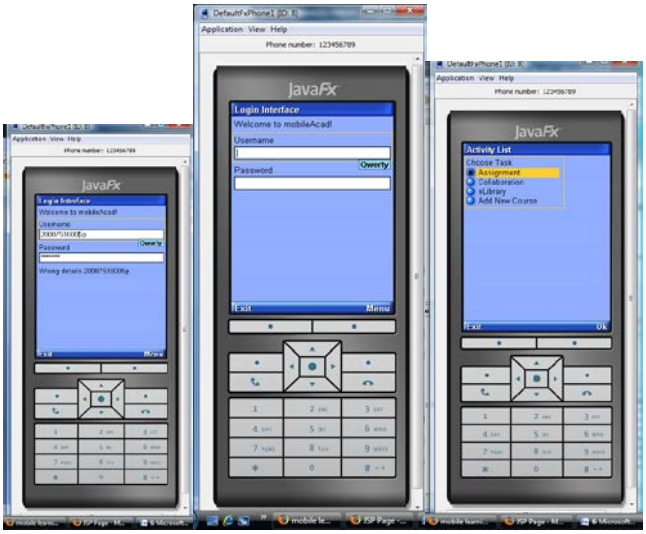


**Figure 4. Sample Output for the mLearning System**