



**UNIVERSITY OF NAIROBI  
SCHOOL OF COMPUTING AND INFORMATICS**

**A FRAMEWORK FOR EVALUATING MOBILE LEARNING (M-LEARNING)  
SYSTEMS IN KENYA**

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**Submitted to the University of Nairobi in partial fulfillment for the award of Master of  
Science degree in (Information Systems)**

## DECLARATION

I declare that this project work as presented in this report is my own original work and has not been presented anywhere else for any award.

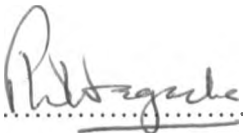
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This work has been submitted as part of the fulfillment of the requirements for the award of Master of Science in Information Systems degree at the University of Nairobi with my approval as the university supervisor.

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## **DEDICATION**

This work is dedicated to:

My family and loved ones for your support, understanding and love and care you missed during  
my absence

## **ACKNOWLEDGEMENT**

I heartily thank the Almighty God for letting me accomplish this study.

For the scholarly guidance I received from my supervisor, Dr. Peter Wagacha, I want to recognize and appreciate what you have done to me. You have always been a listener and a solution provider whenever I experienced problems during my research. You have shaped my research acumen and inculcated in me the spirit of not giving up. To Dr. Wausi, Mr. Ogutu and Mr. Moturi and Mr. Dan Orwa, your relentless critique and scholarly guidance has been instrumental to the timely completion of this study.

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## ABSTRACT

Mobile learning (m-learning) is a methodology of supporting learning which is spontaneous, anywhere-anytime learning through the use of mobile technology. With the ubiquity of mobile phones and the broad availability of advanced features similar to PCs, there is sufficiently large basis for development of education-rich applications. M-learning projects are pre-dominantly being carried out in the developed countries. The designers of current mobile technologies do not necessarily consider the conditions of developing countries when designing and so their products are not always applicable in the developing world. Therefore, the evaluation frameworks used in developed countries are not applicable in developing countries.

Using survey and case study methodology, this research developed and tested a *Mobile Learning Impact Measurement Framework (MLIMF)* to address the problem. Using standards from training and development community, the researcher developed dimensions to evaluate m-learning. The dimensions were then applied to a sample of thirty eight (38) participants who have used or are using m-learning systems. This was in order to assess the feasibility of the framework and the dimensions in evaluating m-learning. To develop the *MLIMF*, three hypotheses were tested. The data available for this study was limited to a sample of thirty eight (38) participants and two m-learning systems allowing only a broad analysis. However, the research undertaken proved the value of the framework as a tool for research and confirmed the validity of the framework design.

Analysis of the results indicates that learner and environmental characteristics impact on the success of m-learning. The results have indicated that learner attitudes, motivations, experience, existing knowledge and skills and performance are significant to the success of m-learning systems. We also established that the application characteristics including content adaptability, cost, reliability and relevance of the materials are important aspects to consider.

The framework aims at guiding policy in development of applications that can enable learners in developing countries obtain access to and use learning, through the use of mobile phones. It provides a competency set of novel guidelines to be followed when developing mobile learning systems and also to evaluate existing m-learning environments, products and services.

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**List of abbreviations**

GeSCI	Global e-Schools and Communities Initiative
UNESCO	United Nations Educational, Scientific and Cultural Organization

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background to the study

Developments in science and technology have provided opportunities to create new learning environments that cater for diverse learning needs. The use of Information Communication Technology (ICT) to support learning is a major milestone in the education sector. The growth of the mobile devices and internet is providing a rich area for educators to enhance learning. The International Telecommunication Union (ITU) estimates that there will be 5.3 billion mobile phone subscribers by the end of 2010 and that 90% of the world population have access to mobile networks (ITU, 2010). This means most of the populations have a mobile phone at hand. Further it is estimated that 1.7 billion people were using the internet in 2009 (ITU, 2010). A number of countries are also moving to the 4<sup>th</sup> Generation (4G) wireless network platform. The Horizon Report (Johnson et al., 2011) has identified mobile technology as one of the six technologies to watch in the near term horizon.

Mobile learning is a methodology of supporting learning which is spontaneous, anywhere-anytime learning through the use of mobile technology. Mobile technology is therefore providing an important research area in education technology. It is enabling people to simultaneously work, learn and study whenever and wherever they want.

With the ubiquity of mobile phones and the broad availability of advanced features similar to PCs, there is sufficiently large basis for development of education-rich applications. As Morita (2000) observes, most mobile phones have the capability of browsing information through the internet and running softwares written in programs such as JAVA. The rapid development of platforms such as the iPad, Kindle, and iPod touch and smart phones such as Android and iPhones accompanied by rapid price decreases, is opening up new possibilities and new demands for mobile learning. Wireless devices will be the dominant mode of access to the internet and therefore e-learning will simply become m-learning. There is now a paradigm shift in e-learning as a result of this. Hwang et al. (2008) state that e-learning has evolved into mobile learning. Mobile learning has growing visibility and significance (Traxler, 2007). There are now dedicated conferences, seminars and workshops notably the MLEARN series of workshops and the

International Workshops on Mobile and Wireless Technologies in Education. M-learning is being used in many educational arenas including corporate training, medical and nurses training and teacher training.

## **1.2 Problem Statement**

M-learning is such a new field and as such different categories of m-learning pedagogy are being identified, developed and researched (Caudill, 2002; Wingkvist, 2009). There has been an increase in the number and variety of mobile learning projects. M-learning projects are predominantly being carried out in the developed countries of Europe, North America and the Pacific (Traxler, 2007; Traxler and Kukulska-Hulme, 2005).

One of the major challenges in m-learning is the applicability of the technology within social and cultural context of learning especially in developing countries. The designers of current mobile technologies do not necessarily consider the conditions of developing countries when designing and so their products are not always applicable in the developing world (UNESCO, 2005). Further, internet-based e-learning is unsuitable for needs of developing countries. As Motlik (2008) observes, developing countries will be better off pursuing m-learning since the mobile technology is widespread and easy to use. In a study carried out by Gonklund A., Andersson A., Hattaka M., (2008) on adoption of mobile applications in developing countries, they found out that the main issue of concern was the innovativeness of the application. The study also found out that the main challenges in adopting mobile applications are (1) sustainable business models (2) process re-organisation and (3) social and cultural challenges.

These issues pose a big question as to whether the evaluation frameworks used in developed countries are applicable in developing countries. There is usually a big gap between rural and urban areas in penetration and adoption of mobile technology in developing countries. (Litchfield A., Dyson E L., Lawrence E., Zmijewska A., 2007). There is also a high learner diversity: there are the 'digital natives' – young and techno-savvy and 'digital immigrants' - mature-age learners yet to embrace modern ICT tools. Further, many policy makers, planners, managers and practitioners in developing countries still lack the experience, knowledge and judgment capabilities in mobile learning systems.

Most evaluation studies on mobile learning systems have been attitude surveys. Vavoula and Sharples (2009) note that the settings and context in which learning takes place can present problems when evaluating learning systems. They also note that to evaluate a system fully one has to mix many methods and this presents challenges when evaluating large amounts of data from different methods. Stakeholder divergent views on goal setting for the system may present difficulties in evaluating the system. There is also the problem of ethics in evaluation. Many people consider m-learning as intruding into the privacy of learners. Lastly, it is not easy to predict where and how learning may occur during evaluation.

The mobile learning systems are being implemented in Kenya. The projects being carried out in developing countries are experimental, problematic or new to providers with little follow-up evaluation on the efficiency and effectiveness of these projects (GeSCI, 2010; UNESCO, 2012). Therefore, no framework has been proposed to evaluate such systems within the context of Kenya as a developing country. This presents a challenge in improving learning and meeting learners' expectations using mobile technology. There is also need to ensure that mobile learning systems add value to learning by providing relevant technologies that meet users' expectations.

### **1.3 Research Objectives**

The study objectives are:

1. To evaluate the status and effectiveness of m-learning systems in Kenya;
2. To identify the critical success factors for the development of m-learning systems;
3. To propose an evaluation framework for mobile system which is applicable in Kenya
4. To validate the framework within the context of mobile learning in Kenya

### **1.4 Research Questions**

1. What types of mobile learning systems are commonly used in Kenya?
2. To what extent do they succeed in capturing all the requirements of the learning process enriched as it now is by these new forms of learning?
3. What are the major dimensions and sub-dimensions of a mobile learning evaluation framework and how are they related?
4. Are there unique qualities of learners and learning environment in Kenya that affect successful implementation of m-learning systems?
5. Where are the similarities and differences with other similar learning frameworks?

## **1.6 Significance of the Study**

The study will come up with a framework which will assist all stakeholders in mobile learning in improving the m-learning products and systems. It can also be used to support policy making in m-learning and also as a baseline of information for developing a new system.



## CHAPTER 2

### LITERATURE REVIEW

This chapter discusses the work of other authors in developing evaluation frameworks for m-learning systems

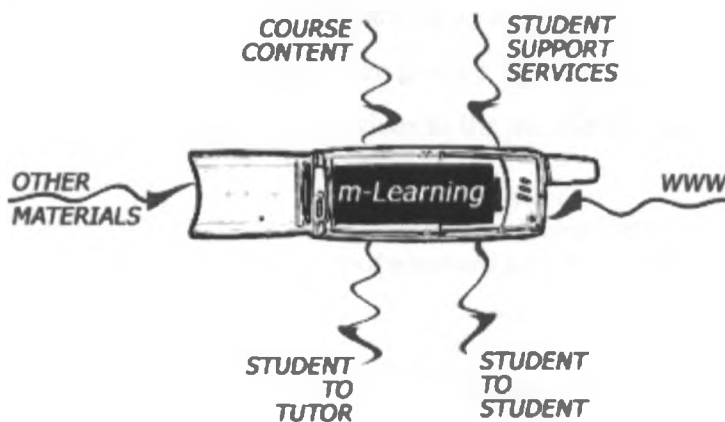
#### 2.1 Concept of m-learning

M-learning can be described as the acquisition of any knowledge and skill through mobile technology, anywhere, anytime that results in an alteration in behavior. It is the art of using mobile technologies to enhance the learning experiences (Geddes, 2004; Ismael et al, 2010). These technologies include mobile and pocket IT devices such as Personal Digital Assistants (PDAs), mobile phones, pocket PCs', laptops and internet. M-learning is online learning and blended instruction, both utilizing technology to convey educational content (Caudill, 2007). It is personal, unobtrusive, spontaneous, anytime, anywhere way to learn and to access educational tools and material that enlarges access to education for all (Traxler and Kukulska-Hulme, 2005). It is the personal access to mobile technologies providing learners with opportunities to be flexible in the way in they collect, store and share information to support their learning (Lefoe and Olney, 2007).

The conceptualization and definition of mobile learning shows that m-learning is a discipline unto itself. It can be defined in terms of (1) devices and technologies; (2) mobility of learners and learning; and (3) learners' experiences of learning with mobile devices. Sharples (2009) argues that the focal point in m-learning is the creation of new learning opportunities as people interact through conversations and explore the real world. Furthermore, the concept of mobility is central to m-learning (Sharples, 2005; Geddes, 2004). Learners are continuously on the move and therefore are interacting with the real world and gaining new knowledge. There is mobility of learning settings. Hugel (2005) further says m-learning integrates learning into the daily life. Learning continues as learners' carryout everyday activities such as entertainment, reading e.t.c. M-learning is ubiquitous (Morita, 2003; Holzinger et al., 2005; Johnson et al., 2011). Learners learn wherever and whenever they want to have access to resources.

Many authors have argued that m-learning is an extension of conventional e-learning. However, m-learning is not simply a variant of e-learning. E-learning evolved to supplement the traditional classroom setting especially in distance and open education. Khan (2004) describes e-learning as a form of open learning since one can learn at their own time, pace and place. E-Learning approach utilizes the features and resources of digital technology to enhance learning. Such resources include the Personal Computer (PC), internet, voice over Internet Protocol (IP) phones and web cameras and digital learning games

Caudill (2007) argues that e-learning is not an anytime, anyplace learning. It is constrained by time and location. The learner has to be physically on the computer and connected to a physical network. Therefore, e-learning has transitioned to m-learning.



**Figure 1: Wireless Virtual Learning Environment (Launders ed, 2002)**

## 2.2 Mobile Learning System Domains

Kamburakis et al (2004) cited in Caudill (2007) view m-learning as the point which mobile computing and e-learning interact to produce an anytime, anywhere learning experience. M-learning is a convergence of rich experiences with wireless networks and device technologies.

There are two key components to the emergence of m-learning: (1) hardware advances; and (2) growth of networking. The mobile learning system is based on the following three domains (Mostakhdemin-Hosseini and Tuimala, 2005; Motiwalla, 2007):

### 1. Mobile usability

This is the main domain in the mobile learning system. Users utilize the mobile devices and use the services if they feel that services are usable and do not consume extra time. Vavoula (2009) identifies usability as one the critical success factors in m-learning.

## 2. Wireless Technology

This is the network connection. The growth of wireless networking especially the Wi-Fi (IEEE 802.11 Standard) has enabled learners access the Internet to exchange information and access up-to-date information (Caudill, 2007). The networks are also becoming affordable and reliable (Johnson et al., 2011). Issues, which are related to the wireless networks which directly influence the mobile learning systems, are network infrastructure and operators rolls. This is because mobility is the core issue in m-learning systems. The users utilize the mobile devices if the network provides fast, secure and reliable network connections.

## 3. E-learning system

The mobile devices were enhanced to the existing e-learning systems. Issues related to e-learning, which affects the mobile learning system, are the requirements of the e-learning system and the type of utilized e-learning platform. The e-learning platform will influence greatly the mobile learning system (adaptive system is more complex than the typical e-learning system). User groups will influence the selection of e-learning types and also the distribution of services to the mobile devices.

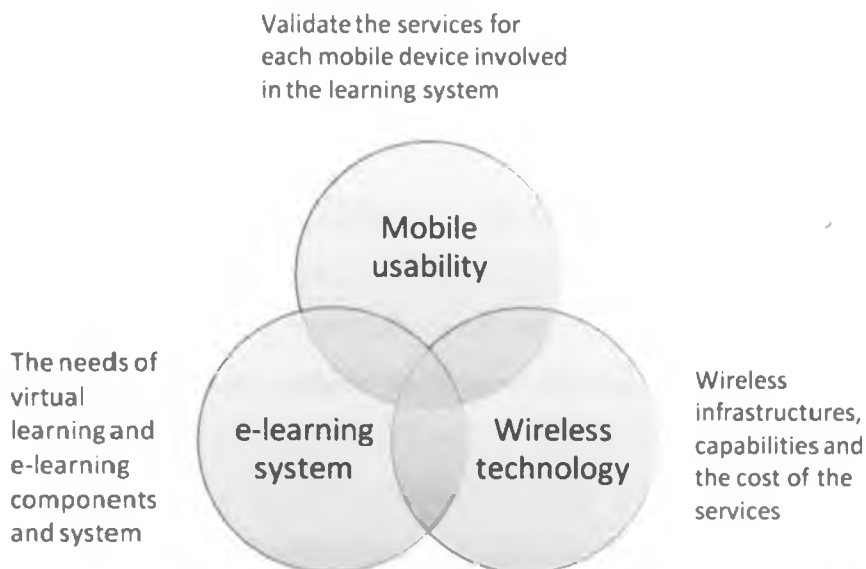


Figure 2: Domains of mobile learning (Source, Mostakhdemin-Hosseini and Tuimala, 2005; Motiwalla, 2007)

### 2.2.1 Categories of mobile learning

Kukulska-Hulme and Traxler, 2007 have outlined the following emerging categories of mobile learning.

- **Technology-driven mobile learning** – Some specific technological innovation is deployed in an academic setting to demonstrate technical feasibility and pedagogic possibility.
- **Miniature but portable e-learning** – Mobile, wireless, and handheld technologies are used to re-enact approaches and solutions already used in conventional e-learning, perhaps porting some e-learning technology such as a Virtual Learning Environment (VLE) to these technologies or perhaps merely using mobile technologies as flexible replacements for static desktop technologies.
- **Connected classroom learning** – The same technologies are used in classroom settings to support collaborative learning, perhaps connected to other classroom technologies such as interactive whiteboards.
- **Informal, personalized, situated mobile learning** – The same technologies are enhanced with additional functionality, for example location awareness or video-capture, and deployed to deliver educational experiences that would otherwise be difficult or impossible.
- **Mobile training/ performance support** – The technologies are used to improve the productivity and efficiency of mobile workers by delivering information and support just-in-time and in context for their immediate priorities.
- **Remote/rural/development mobile learning** – The technologies are used to address environmental and infrastructural challenges to delivering and supporting education where conventional e-learning technologies would fail, often troubling accepted developmental or evolutionary paradigms.

## 2.3 Mobile Learning Evaluation

### 2.3.1 Importance of Evaluation

Educators are continuously seeking ways of effectively integrating instructional technology to address technology-driven learning preferences of the current generation of learners. It can be defined as to judge or determine the significance, worth, or quality. Evaluation is concerned with determining the success of a system. It measures what a system actually accomplishes in relation to its stated goals. It consists of processes which take place at different points in time or

continuously, for searching and for making explicit, quantitatively or qualitatively, all the impacts of the system.

Evaluation is a fundamental and critical activity that needs to be thoroughly conducted in any phase of the system's life cycle. This places evaluation at the centre of the development process, from the early stages of design to a final assessment of the deployed technology in use. Evaluation activities can be undertaken at key points that are of most value to support the design process. The basic functions of evaluation are:

1. To provide feedback to the stakeholders.
2. To guide the next phase of the system development.
3. To support the system learning process by feeding into an iteration of an earlier phase.
4. To allow problem diagnosis, planning and reduction of uncertainty in the system.
5. To assist in estimating the expected value of the investment in the system.

An evaluation of the m-learning system should therefore consist of systems functionality and features in light of instructor and student needs and preferences. It is worth noting that a specific evaluation framework cannot evaluate all the aspects of the system.

### **2.3.2 Attributes of a Good Evaluation**

The literature on the evaluation of mobile learning is building steadily, but still, the impacts remain difficult to identify and quantify. This is due to a range of factors, including numerous measurement and analytical challenges. Further, the systems work jointly with intangible-inputs such as human capital. As Traxler (2002) notes, evaluation is key to sustainability of mobile learning. He therefore outlines a set of attributes that a good evaluation should have:

1. Rigorous: conclusions must be trustworthy and transferrable;
2. Efficient in terms of cost, effort and time;
3. Ethical in relation to the nuances of evolving forms of provision;
4. Appropriate to the specific learning technologies, learners and ethos of the system concerned;
5. Consistent with the teaching and learning philosophy and conceptions of teaching and learning of all participants; and
6. Aligned to the chosen medium and technology of learning.

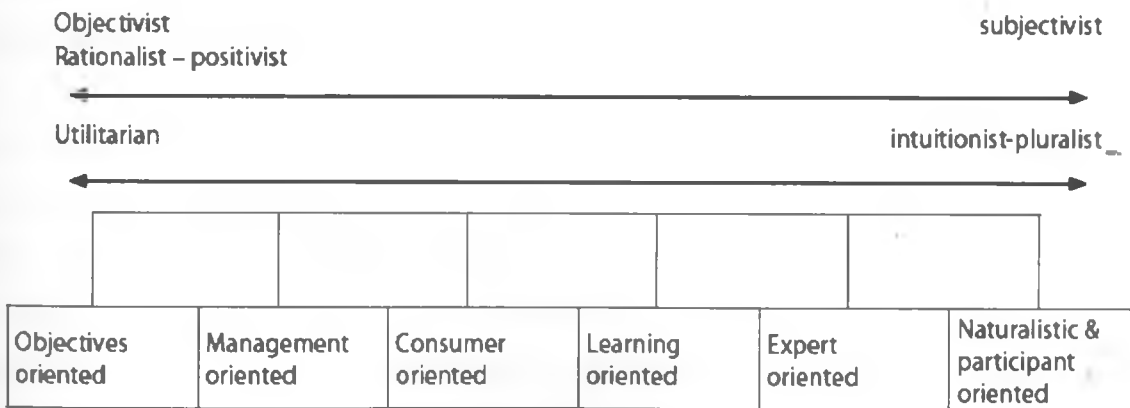
### 2.3.3 Types of Evaluation

According to Al-Yaseen et al (2010), evaluation of information system can be classified in to two types with regards to the development stage of the system or the timing of evaluation. Type A is a Prior Implementation Evaluation. This is a formative and predictive evaluation performed to forecast the impact of information system project. It is carried out before the system is operationalised. Type B is referred to as Operational Use evaluation. It is performed after the system is implemented. It is used to justify the adoption, estimate costs and benefits, ensure that the system meets requirements and measure the system effectiveness and efficiency and quality of products.

Delone and McLean (2003) however, observe that there is need to shift evaluation focus from efficiency to effectiveness. This is because the systems goals are more important than the internal organizational goals. Further, efficiency focuses on internal requirements of the system while effectiveness focuses on the impact of the system on the end users.

### 2.3.4 E-Learning evaluation

E-learning is based on dimensions of synchronicity, location, independence, and mode of delivery



**A Continuum of Evaluation Models**

Figure 3: E-Learning evaluation models (Source: Attwell G, 2006)

Evaluation of e-learning therefore takes into context variables such as geographical conditions and pedagogical issues such as accessibility.

There are various approaches used to evaluate e-learning. Figure 3 above summarizes Attwell (2006) classification of e-learning evaluation approaches. Attwell (2006) further suggests different methods that can be used to evaluate e-learning. These include:

- a. On-line perception questionnaires and logs of number of hits
- b. Return on investment studies/Financial Evaluation
- c. Product (software) evaluation
- d. Benchmarking models such as ISO standards of quality
- e. Performance evaluation

There are many diverse frameworks developed for e-learning evaluation. Lee-Post (2009) has proposed an e-learning success model that can be used to guide design, development and delivery of e-learning initiatives. It is based on the Delone and McLean's Information Systems Success model. It identifies six success factors: system quality, information quality, service quality, use, user satisfaction and net benefits.

Marshal and Shriver (2009) model of five levels of evaluation looks at teaching, materials of the course, curriculum, modules of the courses and transfer of learning as the important dimensions for evaluation. Kirkpatrick (2004) model of evaluation has also been used in e-learning evaluation. It identifies four levels of evaluation: Reaction of participants, perceived learning, reached transfer level and the resulting impact.

Bats (1999) ACTION Model cited in Rubio (2003) proposes evaluation of the advantages and inconveniences of five components: Access, costs, teaching and learning, interactivity and facility use, organizational issues, novelty and speed. Finally, Ozkan and Koseler (2009) HELAM Model proposes evaluation of e-learning in six dimensions: (1) system quality, (2) service quality, (3) content quality, (4) learner perspective, (5) instructor attitudes, and (6) supportive issues.

### **2.3.5 Approaches in evaluating m-learning**

Traxler (2005) posits that e-learning is formal, structured and 'tethered' learning with fixed infrastructure. M-learning is therefore differentiated from e-learning in its ability to unlock the user from fixed infrastructure and limited distribution. M-learning has unique attributes that

position it within informal learning rather than formal learning (Traxler, 2007). These attributes include: portability, social interactivity, context, and individuality.

Presently, there is no proper theoretical conceptualization of m-learning and therefore the evaluation models are not specifically aligned to the unique attributes of m-learning. Therefore, e-learning evaluation models cannot be used to evaluate m-learning. However, we can draw from existing e-learning frameworks as we seek to come up with an m-learning framework as there are some cross-cutting pedagogies between m-learning and e-learning. Further, Existing e-learning frameworks are silent on issues related to m-learning such as m-learning cost, learning processes that can be fulfilled by m-learning (m-learning processes), m-learning objects to be used in m-learning processes, policies to guide the development and practice of m-learning, learner context, access to and use of technology and personalization of learning (Muyinda, 2010).

Yau and Joy, 2009a as cited in Yau and Joy, 2010 also outline three perspectives of evaluating m-learning systems:

- **Pedagogical evaluation** assesses the user's learning experiences in terms of the learning process, opportunities, and/or learning outcomes. This may necessitate the tracking of individuals or groups who are moving across different locations; the locations may include various public and their own private spaces (such as library, café, transport and home). There are many practical and ethical issues during the evaluation. For instance, the data collected may not reflect the true learning experiences that volunteers have had due to the possibility that they may have been uncomfortable whilst being tracked.
- **Usability evaluation** assesses the application in terms of its usability aspects and utility of functions. The measurable aspects of usability include:

(a) 'Learnability' and efficiency

This measures how easy the system or services is to learn or use or memorise, how efficient or productive the system is, how much training time and support is required to use the system, how clear and consistent is the language of the system, how much feedback is given from the system and how much technical maintenance costs.

(b) System design



This measures how easy the data is to be interpreted, how fast data can be inputted, how satisfied the users are with the system, if any errors occurred in the system, how visible the system is, the use of any physical constraints, whether actions can be invalidated, whether users have control over the system, if it is flexible, whether the design include the users' knowledge base, if there are any cultural constraints and if it meets existing standards.

- **Technological evaluation** assesses the technology and the user's experience relating to it. It involves implementation of a prototype which users will evaluate and provide feedback regarding it. The user can provide information about the application usage before, during and/or after the hands-on experience with the device. System logs, interviews or questionnaires can be used to collect the data.

## 2.4 Evaluation Frameworks

Evaluation models can either be concerned with mobile learning as a product or as part of the life cycle development process. There has not been a lot of research in evaluation of m-learning systems. However, several authors have attempted to provide a framework. In addition, borrowing frameworks from other areas such as e-learning can also provide a starting point for research (Vavoula & Sharples, 2009).

### 2.4.1 Learning Value Chain Framework

Petrova and Li (2009) propose a framework which views m-learning as part of a learning value chain. The value chain consists of stakeholders' who supply and demand m-learning services.

The model provides the following criteria for any successful m-learning system.

- i. It must provide a specific mobile value and clear learning value.
- ii. It must be student-centred.
- iii. It must have high technical quality.

They argue that if we allow technology to drive learning systems without giving due consideration to the learners needs, the learning cannot be achieved. The framework recognizes the role of adoption in mobile learning. It also recognizes the role of players in the value chain in adding value to the learning process. The framework however, has a limitation in that it was developed for mobile internet learning and therefore does not provide ways of evaluating other mobile learning technologies such as SMS learning.

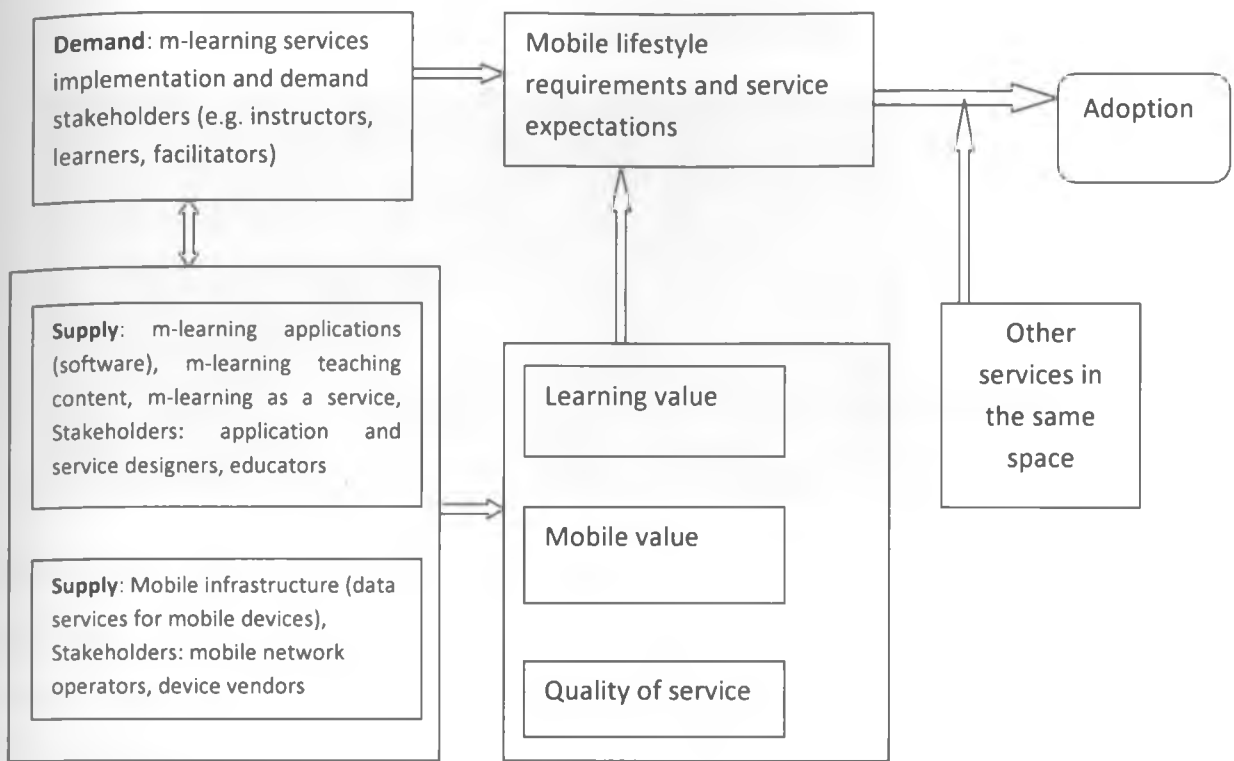


Figure 4: Learning Value Chain Framework (Petrova and Li, 2009)

### 2.4.2 M3 Evaluation framework

This framework, proposed by Vavoula et al (2009), was designed with the concept of mobility as the central focus. It was based on an m-learning system called Myartspace. This system enabled students to collect museum exhibits using mobile devices and then send the details including their opinions to the schools website. The information could then be shared among the students.

Evaluation under M3 is conducted at three levels:

1. *Micro level*, which examines the individual activities of the technology users and assesses the usability and utility of the educational technology system
2. *Meso level*, which examines the learning experience as a whole, to identify learning breakthroughs and breakdowns. It also assesses how well the learning experience integrates with other related activities and experiences.
3. *Macro level*, which examines the impact of the new technology on established educational and learning practices and institutions.

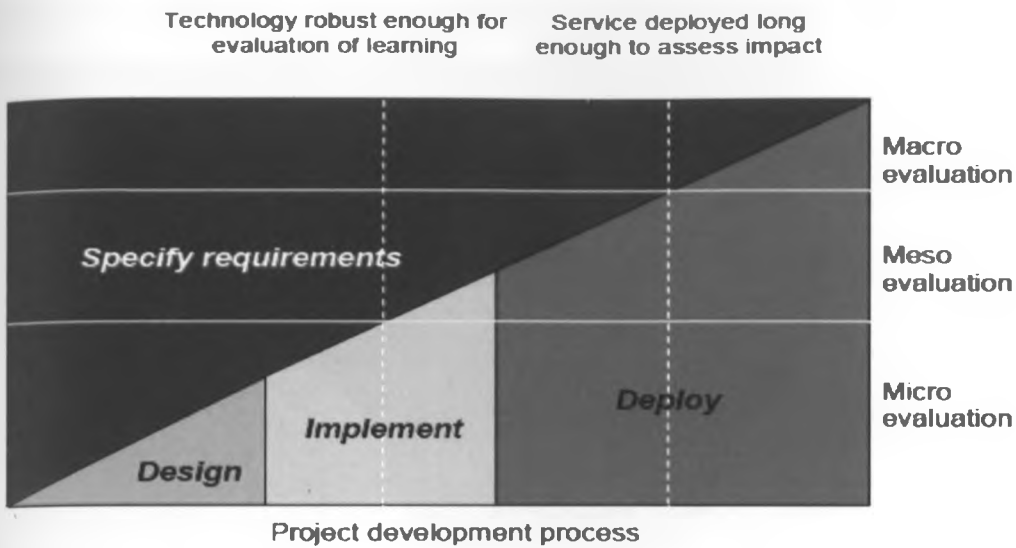


Figure 5: M3 Evaluation (Vavoula and Sharples, 2009)

The focus of the framework is on evaluation of learner requirements at all levels during the system design. The emphasis on level of evaluation changes during the development process. Early evaluations at micro level assist in designing the user interface and human-technology interactions. Once the technology is rich enough to allow assessment of educational value, evaluation activities at the meso level are introduced during the implementation phase. Similarly, the macro level requires that the technology is in place and used for long enough to establish its effects on learning.

The framework is comprehensive since it looks at evaluation from the inception of the system to post implementation. It reinforces the critical importance of evaluation in systems lifecycle. The evaluation is also incremental and therefore it aids in refining the system and learning deliverables as the system is being built. However, it is a complex framework to understand and there is no evidence that it has been tested on other learning experiences other than museum trips. The framework does not all look at how adoption affects learning.

### 2.4.3 The Framework for the Rational Analysis of Mobile Education (FRAME) Model

This model was developed by Koole (2005) and later refined by Koole and Ally (2006). This model is used as a standard for analyzing the process of mobile learning. Koole (2005) represents the aspects of mobile learning as a Venn diagram representing intersections between device usability, learner, and the social aspects of learning. Mobile learning takes advantage of the

context of the device with respect to individual learners, the ability of the device to interact with the environment as well as with other learners with mobile devices.

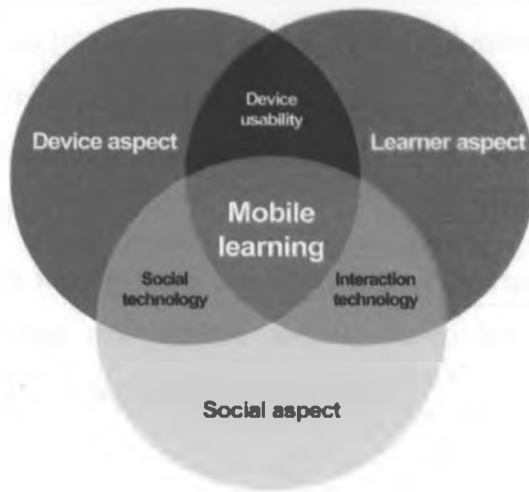


Figure 6: The FRAME Model of Mobile Learning ((Koole 2005; Koole and Ally 2006)

### **1. Device Aspect**

This describes the physical, technical, and functional components of mobile devices, the medium through which mobile learners and mobile community members interact. This interface is both enabled and constrained by the hardware and software design of the devices and can have a significant impact on the physical and psychological comfort levels of the users.

### **2. Learner Aspect**

This refers to the individual learner's cognitive abilities, memory, and prior knowledge and those situations and tasks in which a learner needs to succeed. It explains how mobile learning offers an extended environment where learners can interact within their physical and social environments.

### **3. Social Aspect**

This aspect refers to the processes of social interaction and cooperation. The way in which individuals exchange information affects how groups of people develop knowledge and sustain cultural practices.

#### **4. Social Technology**

This secondary intersection describes how mobile devices enable users to communicate with each other and to gain access to other networked systems and information. When people are able to exchange relevant information at appropriate times, they can participate in collaborative situations that are normally difficult at a distance.

#### **5. Interaction Technology**

This secondary intersection focuses on social interaction. Participation in learning communities and cognitive apprenticeships can provide socially based learning environments in which learners can acquire information and negotiate meaning.

#### **6. Mobile Learning**

All three aspects overlap at the primary intersection, which represents a convergence of all three aspects and defines the m-learning process. As such, m-learning can afford learners access to a variety of human, system, and data resources, as well as to assist them to assess and select relevant information and re-define their goals (Koole, 2005). M-learning is, however, also constrained by the mobile device hardware and software configurations and dependent upon adjustments in teaching and learning strategies.

The FRAME model was originally developed in order to understand the process of mobile learning. In particular, it was developed to facilitate the understanding of various mobile devices as distance learning tools. While it would be possible to evaluate mobile devices, themselves, strictly on the basis of their hardware and software characteristics, such an evaluation would not effectively address the relationship between technology and the phenomena of learning and interaction. However, the model is more concerned with the mobile technology and how it can enhance learning. This is a technology view point which does not address how learning takes advantage of technology to add value to learning. Further, other important critical aspects such as learner motivation, learner control, and sustainability of the system are not addressed by the model.

#### **2.5 Summary of review**

M-learning is fundamentally different from e-learning in that it provides learning opportunities as people interact and move in different settings. This therefore makes evaluation of m-learning systems unique. There is need to consider the learners and instructors needs and preferences

when designing and evaluating such systems. The frameworks reviewed show that evaluation is not just summative. It needs to be carried out even at the inception of the system. Further, technology is not only the main focus during evaluation, but the value added by the technology in the learning process is important.

However, there are seemingly diverse and incoherent views of how best to evaluate m-learning. This is not surprising given that research in this area is at its infancy in developing countries as mobile technology is being embraced. There is a need to integrate and formulate a holistic and comprehensive framework for evaluating m-learning. Another shortcoming of these studies is that success measures are derived from assessing the results of the development effort only. There is also a need to broaden the viewpoint of learning success from a result to a process perspective.

## **2.6 PROPOSED FRAMEWORK: MOBILE LEARNING IMPACT MEASUREMENT FRAMEWORK**

Frameworks are created in an attempt to capture a certain degree of abstraction. It contains a unification or synthesis and also triggers the ability to understand the magnitude of issues involved (Winqvist, 2009). A framework is the abstraction of a real or proposed system. The framework is there to correspond to the actual research. This is to understand better the different findings throughout the research and put them into context. Frameworks can be useful as a thinking tool, as it is bringing together practice, theory, and research in a attempt to give greater understanding of the complexity involved.

### **2.6.1 Mobile Learning Impact Measurement Framework**

Most studies on evaluation can be divided into three: (a) Information systems development which attempts to establish feasibility of the system; (b) Information System in use which seeks to evaluate the success of the implemented information system; and (c) business benefits which deals with methods and procedures to identify business benefits of the information system.

The framework proposed was designed and developed via an extensive literature review. It is based on information system in use and business benefits. It is also based on process approach. The process approach posits that the overall success of m-learning initiatives depends on the

attainment of success at each of the four phases of m-learning systems process: objectives definition, m-learning application development, learner performance and organizational performance.

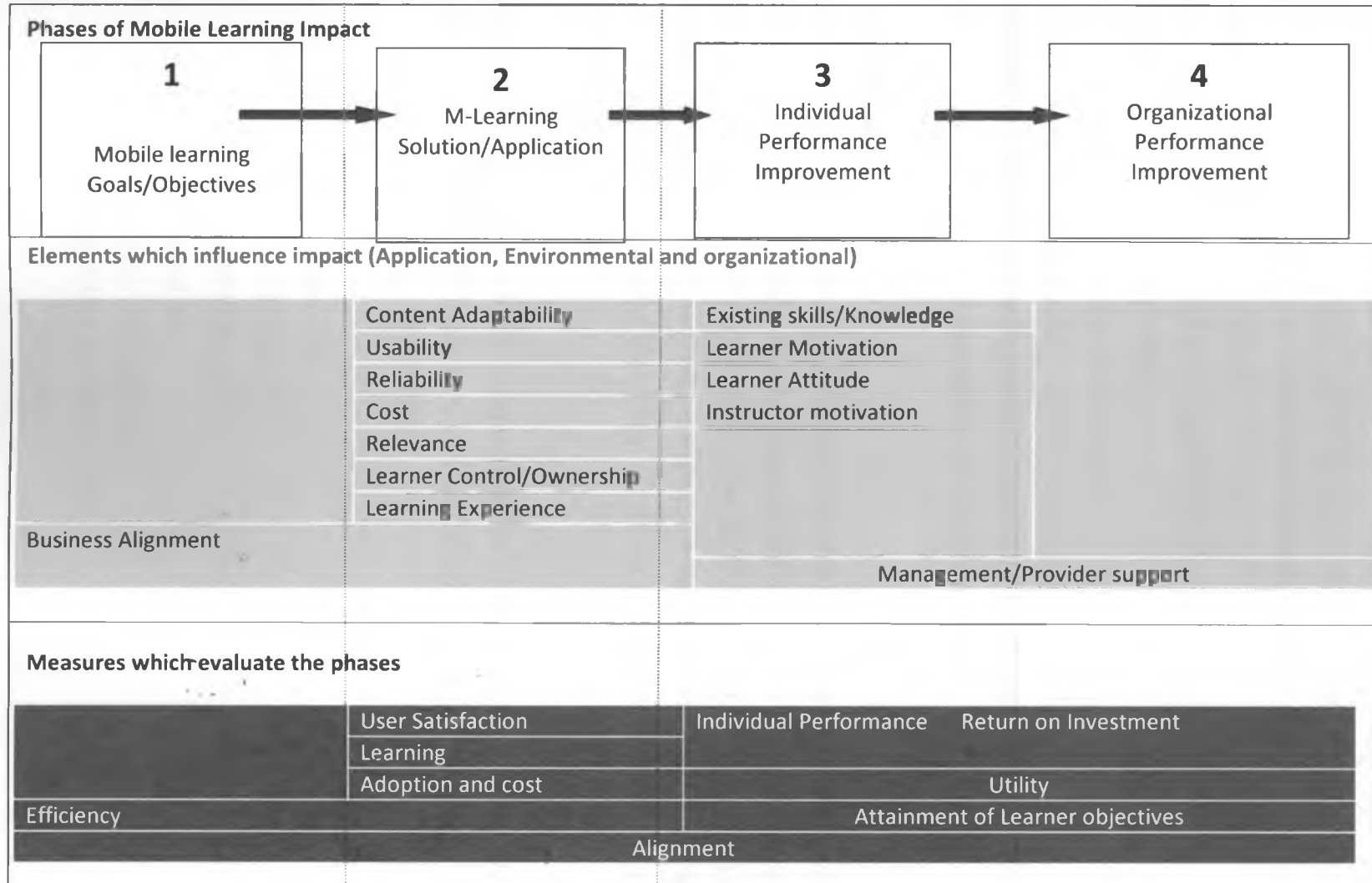
The Framework is based on measuring impact (outcomes) of the system. Such measures include student reactions, learning, job performance and organizational outcomes. The framework includes actionable, pragmatic evaluation metrics of activity, utilization, efficiency and impact developed specifically for the m-learning context being investigated.

The validity of viewing m-learning initiatives' from an impact perspective is supported by recognizing the value that m-learning adds value to better meet the needs of their users. Added values of m-learning are necessary to attract new users. Delone McLean (2001) posits that there is need to shift evaluation focus from efficiency to effectiveness. This is because the systems goals are more important than the internal organizational goals. Further, efficiency focuses on internal requirements of the system while effectiveness focuses on the impact of the system on the end users and the organization as a whole.

The Framework enables m-learning to be viewed in a broader concept. It is appropriate to develop appropriate and sustainable business models for m-learning that provide added value for both providers and users. This framework also depicts that the success of m-learning is dependent on the extent to which it satisfies the needs and addresses the concerns of its key stakeholders.

Developing countries experience a myriad of challenges in the education sector (GeSCI, 2010). These include: Cost, sustainability of learning, optimizing usage of local resources and making teaching and learning meaningful for students and relevant for the development of the country. The framework is therefore founded on these problems and attempts to identify ways of making mobile learning improve and be relevant to the learning process.

**Figure 7: Mobile Learning Impact Measurement Framework (Source, Author)**





## 2.6.2 Components of the Framework

The Framework has been developed from general standards used by the training and development community. The standards enabled the researcher to develop criteria/dimensions to evaluate m-learning. The framework also uses the proposed GeSCI (2009) criteria which need to be considered when introducing m-learning. GeSCI has identified seven evaluation dimensions:

- (a) Problems the system solves in education for example access to education, quality of learning, efficiency and relevance.
- (b) Learning and teaching process including content
- (c) Education philosophy or approach
- (d) Affordability and sustainability of the system
- (e) Inclusiveness of the stakeholders – is the system available to all?
- (f) Relevance of learning outcomes to learners especially the content
- (g) Efficiency of the system – does it utilize the current resources?

### 1. Objectives definition

The objectives definition phase identifies impediments to successful m-learning initiatives so that measures to overcome these impediments can be developed in the m-learning solution phase. The objective must map the national vision with a clear understanding of the country's goals, plans, and educational context. It is critical to establish and define the educational objectives. A possible lack of well-defined m-learning objectives also makes it difficult for assessment to be done (UNESCO, 2010).

When analysing areas for ICT intervention in education it is important to think about how m-learning could be used to facilitate the goals in each of the following categories:

- i. Expanding educational opportunities
- ii. Increasing efficiency
- iii. Enhancing quality of learning
- iv. Enhancing quality of teaching
- v. Sustaining lifelong learning
- vi. Facilitating skill formation
- vii. Advancing community development
- viii. Improving policy planning and management

Depending on the context, m-learning can be useful in all of the above areas. For example, it can support the expansion of educational opportunities (access to education) because it can be used to deliver educational opportunities to a range of types of people, including women who face social barriers to education; populations living in remote rural areas; and working adults whose time is limited. Likewise, if the goal is sustaining lifelong learning, m-learning is useful as it can provide convenient, user-centred learning.

In this phase, we must consider how we measure business alignment. If we develop a fantastic m-learning solution that focuses on the “wrong problem,” no measures of satisfaction or learning will be relevant. No m-learning system will drive value unless (a) It is highly relevant to the organization’s current business challenges; (b) Timely and up to date in its delivery and content; and, (c) Completely adopted and well understood by learners. Traxler and Kukulska-Hulmes (2009) argue that m-learning systems needs to align with business aims to (a) remain at the cutting edge of educational technology; (b) to investigate whether an integrated set of learning tools would be useful, which tools would be adopted and the contexts in which the tools would be used; and (c) development of a service model and new component concepts for lifelong mobile learning

## **2. M-learning Solution/Application**

When developing m-learning solutions, we must measure our ability to efficiently and effectively (a) Design and develop m-learning programs; (b) Target the right audience; (c) Roll out the program; and, (d) Deliver an interesting and relevant learning experience.

One of the critical aspects that impacts on the solution is the user’s external contexts. This includes their location, available time, and mobile devices used as well as devices available to them. This in turn affects learner satisfaction, amount of learning and adoption. “Adoption” measures indicate how well the learners actually received the system.

We also want to look at the efficiency of m-learning system development processes, along with how well we stay aligned with the business during the design, development and delivery stages.

### **3. Individual Performance Improvement**

In this phase, we want to measure how well the individuals using the m-learning system actually improved their performance. We also want to look at the learners' (a) Existing skills (b) Motivation; and (c) Attitudes (e.g., do the learners actually want to learn or do we need to coerce them). Learners' indifferent attitude towards m-learning can be a major barrier to successful development of m-learning initiatives (Lee-Post, 2009). It is important to evaluate learner needs by examining their technical skills, experience with computers and/or mobile devices, and task-performance ability.

Most importantly, we must look at the role of the manager and provider. Managers include teachers or trainers and coordinators of the systems. It is clear that teachers will use the technology if they recognize that it enhances learning content and improves the quality of education. It is important to make teachers aware that m-learning extends mainstream learning, and can therefore meet student's needs and bring benefits. Further, no m-learning program has impact if the managers/providers do not reinforce its use for many months after the program is completed. While a learner may score a course high in satisfaction, if the manager or provider scores it low or does not reinforce the materials, the course is likely to be a waste of time and money.

### **4. Organizational Performance Improvement**

Finally, we must consider how the improvement in learner results impacts the business. M-learning has multiple impacts at the organization and learner level. For example, it introduces flexible learning practices, hours and location. Questions that need to be evaluated at this phase include:

- (a) Was it worth to invest in the m-learning system?
- (b) Can we somehow make sure that the information gained from this program is shared among others, and now reinforced and improved over time?
- (c) Can we find ways to transfer this learning back into the organization, so that it improves itself over the long term?

### **2.6.3 Critical areas of measurement**

In order to complete the solution, the framework has identified nine critical areas of measurement which evaluate the individual phases. There are many possible measures of the critical areas.

#### **(a) Utility**

This is a measure of how well the learners themselves rate the training in “usefulness” to their actual learning environments.

#### **(b) Efficiency**

While there may be very positive outcome from a system, was it developed and delivered in a cost-effective way? There is a real cost to system – development, delivery, infrastructure and learner time. While some solutions may be highly valued, we really need to compare them against others such as e-learning or classroom courses on the basis of total value to cost. We also look at how well did business buy in on the value of this system relative to other investments.

#### **(c) Attainment**

Attainment refers to the measurement of actual learner satisfaction.

## CHAPTER 3

### RESEARCH METHODOLOGY

This chapter describes the research design that will be used during the research process. The research was carried out in institutions that have used or are using m-learning systems. The institutions are located within Nairobi.

#### 3.1 Research Design

The research was carried out using the survey method. The survey approach refers to a group of methods which emphasize quantitative analysis, where data for a large number of organizations are collected and analyzed using statistical techniques. By studying a representative sample of organizations, the survey approach seeks to discover relationships that are common across organizations and hence to provide generalizable statements about the object of study (Gable, 1994). Survey research is useful to elicit views, attitudes or perception held about a phenomenon. Chen & Hirschheim (2004) show that survey research is still the most widely used design in information systems research especially in the study of projects, applications and systems.

Survey research is ideal where control of the independent and dependent variables is not possible or not desirable, the phenomena of interest must be studied in its natural setting and phenomena of interest occur in current time or the recent past. However, often the survey approach provides only a "snapshot" of the situation at a certain point in time, yielding little information on the underlying meaning of the data (Gable, 1994). Survey research usually serves as a methodology of verification rather than discovery. Chen & Hirschheim (2004) show that survey research is still the most widely used method (41%)

The survey was undertaken in a two phase approach: (a) content analysis, and (b) case studies. Content analysis is a qualitative research technique that is used to compress many words of text into fewer content categories based on explicit rules of coding (Rabaa'i et al., 2010). This technique is useful when existing theory or research literature on a phenomenon is limited. The technique will attempt to identify dimensions and measures from the existing m-learning literature. Deriving dimensions and measures from a thorough literature review ensures that the referent dimensions are (1) conceptual, and (2) empirically relevant to the mobile learning context (Rabaa'i et al., 2010).

The case study was integrated to the survey method. Case study research can be combined with other research methods in studies where there is one research gain (Darke et al., 1998). Gabbler (1994) notes that survey research is greatly improved when used with other qualitative research methods. He further asserts that no one approach to information systems research can provide the richness that information systems as a discipline, needs or further advancement. He suggests the use of case study research to define constructs first and develop theory which can then be tested using survey research methods.

Case study research strategy is qualitative research. It includes studies that are involved with a single site or a few sites over a certain period of time. Case studies involve the intense qualitative examination of a small number of entities by the researcher, where no independent variables are neither manipulated nor confounding variables controlled. Case study research approach is often a good choice when theory and understanding are not well developed and the focus is on contemporary events (Halonen, 2009). Case study is the most widely used qualitative research method in information systems research (Orlikowski & Baroudi, 1991). Case studies are most suitable for the exploration, classification and hypothesis testing and development stages in information systems research. The case studies aim at developing a grounded understanding of the mobile learning and investigate the dimensions and measures applicable to mobile learning.

### **3.1.1 Target Population**

A population is a group of all possible objects of investigation in a given domain (Calder, 1998). These objects form the survey population. The target population consisted of all institutions that have used or are using mobile learning systems. Learners were considered to be the direct beneficiaries of the learning system and therefore drawing the framework requirements from them would create a framework that meets their m-learning needs. Drawing an information system's requirements from its immediate users breeds acceptability and ownership of such a system. Providers and managers of the m-learning systems were considered on the account that they benefit from the increased efficiency and flexibility brought about by m-learning through synchronous and asynchronous collaboration.

### **3.1.2 Sample design**

Sampling designs represent the framework within which the sampling takes place, including the number and types of sampling schemes as well as the sample size.

#### **3.1.2.1 Sample Size**

Usually, because of time and financial resource constraints, a census of all elements in the population is not possible (Calder, 1998). Instead a representative sample of the population is selected using sample selection methods. A sample is a collection of representative research objects drawn from a population (Calder, 1998). The sample size must be big enough and properly constituted to represent all the characteristics of the population. The choice of sample size is important because it also determines the extent to which the researcher can make statistical and/or analytic generalizations.

The sample size ( $n$ ) was determined using the minimum recommended basis by Onwuegbuzie and Collins (2007). Sample sizes can be determined by the research design and data collection procedure. The rule of the thumb approach was adopted for the study where for a small population under 1000 a sampling ratio of about 30% is recommended for equal accuracy. The researcher expected to obtain at least 40% usable responses. A sample size of 36 participants was derived from two projects that use or have used m-learning systems in Nairobi and distributed as follows:

- (a) Kenya Institute of Technology Studies m-learning project – 7 participants
- (b) The M-Prep mobile learning system – 31 participants

The sample consists of stakeholders of mobile learning systems.

#### **3.1.2.2 Sample Selection**

Sample members were selected using cluster and convenience sampling. Cluster sampling involves selecting intact groups representing clusters of individuals rather than choosing individuals one at a time. Convenience sampling includes choosing settings, groups, and/or individuals that are conveniently available and willing to participate in the study.

It is possible to use non-random sampling techniques when using mixed methods of research (Onwuegbuzie and Collins, 2007). This is because the members may be geographically dispersed and therefore it is not easy to reach all the members of the sample. To increase the reliability of

the study, specific members of the sample were identified; for example those who have used the system for long. To select the sample, the accessibility of information criteria and the experience that the respondent has in using the system was critical.

The sampling frame was obtained from each institution. The sample of 36 consists of students and providers/managers of the m-learning systems.

### **3.2 Data collection**

Data was collected from primary sources (mail questionnaires and interviews) and secondary sources (document analysis). This study employed a semi-structured, self-administered questionnaire to capture data. The survey consisted of open and close ended questions (*Appendix C*). Questionnaires were administered to users of the systems to elicit opinions about the systems. Questionnaires contain four stages: designing and testing the questionnaire; followed by data collection and then data analysis and finally the preliminary findings of the questionnaire.

Open ended questions were of the 'fill-in' type aimed at soliciting respondents' own opinions and suggestions about topical issues in m-learning. Open ended questions were used when all possible answers to the question were not known.

In close ended questions, responses to questions were pre-specified. Close ended questions took any of the following forms: option questions - where respondents were required to give one response and rated/scaled questions - where respondents were required to rate responses according to a likert scale. Five point likert scale questions permitted 'uncertain' options. In five point likert scale questions, the options were: 'strongly disagree', 'disagree', 'uncertain', 'agree' and 'strongly agree'.

Interviews were conducted on the providers and managers of the learning system. Document analysis was done on the systems to obtain the objectives of the systems and how they have been designed and implemented. Ethical issues were observed during data collection.

This research targeted actual users and non-users in a voluntary usage context. Although a controlled environment where actual behaviour can be measured by means of observation or



electronic observation would enhance the generalizability of the findings, the resources necessary for this option were not available to the researcher.

### **3.3 Piloting the Questionnaire**

The survey was piloted on 3 participants at the Kenya School of Technology Studies, before developing the final survey tool for collecting data. Piloting is necessary to ensure that questions to be asked are significant and not redundant. Pilot data was used to refine the survey. Piloting can help to detect any flaws in the questioning and correct these prior to the main survey. Through piloting, some of the closed ended questions received categories of responses that enabled the questions to be converted to open ended questions. The pilot also enabled trial data analysis. Piloting also enabled the reliability of questions in the survey to be measured.

#### **3.3.1 Survey Questions Reliability Test**

One of the purposes of undertaking the pilot was to determine the reliability of the questions (variables) in the survey. Reliability and validity tests ensure that questions in a research instrument are replicable and measure what they are intended to measure (Golafshani, 2003). They ensure that the research instrument can be used again to derive similar results with the same level of accuracy.

Pilot data was entered into SPSS version 16.0 data analysis tool and overall Cronbach's alpha (Cronbach, 1951) of 0.8821 was obtained.

#### **3.3.2 Pilot Validity Test**

This study adopted content validity and construct validity assessments. Content validity was achieved by examining responses from the respondents of the pilot study. Construct validity was determined through assessment of the convergent validity which is synonymous to correlation analysis. This was done in order to find out the degree to which two measures of the same concept correlated with each other. Correlation analysis was conducted using SPSS version 16.0. The results of correlation analysis for the item-total correlation for many items in most constructs were within the acceptable range implying good validity of the instrument being tested. The acceptable values range from 0.3 and above. The questions included in the questionnaire had acceptable validity values.

### **3.4 Conducting the survey**

For the purpose of distributing the questionnaire, a list of the 36 respondents was created. The For ethical considerations, the respondents were not required to indicate their names on the questionnaire. Each questionnaire had a cover letter explaining the purpose of the survey, treatment of the data being collected and general instructions on how to complete the questionnaire. The questionnaires were hand-picked by the researcher.

### **3.5 Data analysis**

The data from the respondents was analysed using a combination of nonparametric statistical methods, Descriptive Analysis and Partial Least Squares Method. The five point Likert scale was also used. Person's Chi-Square test was used to establish relationships among the variable in each dimension to find their relevance in the framework.

### **3.7 Hypothesis development**

Hypothesis is a tentative explanation that accounts for a set of facts and can be tested by further investigation. Together with research questions and objectives, they provide a specific restatement and clarification of the problem statement/research question. A well-grounded hypothesis indicates that the researcher has sufficient knowledge in the area to undertake the investigation. The hypothesis gives direction to the collection and interpretation of data.

The study attempted to test hypothesis based on the following issues:

#### **3.7.1 Learner and Environmental and Organizational Characteristics**

The learner should always be the central focus when designing any learning system. Learning will be irrelevant if the learner is not satisfied or does not meet the learning needs. Learners' indifferent attitude towards m-learning can be a major barrier to successful development of m-learning initiatives. Attributes that enhance learner satisfaction include:

- Learner's existing skills and knowledge's
- Learner motivation
- Learner attitudes towards learning
- Learner Control/Ownership of the mobile devices
- Learning Experience

- User satisfaction
- Individual performance
- Their adoption of technology

These variables are expected to be strong indicators of a successful mobile learning system.

No m-learning program has impact if the managers/providers do not reinforce its use for many months after the program is completed. While a learner may score a course high in satisfaction, if the manager or provider scores it low or does not reinforce the materials, the course is likely to be a waste of time and money. Most learning systems cannot sustain themselves if there is no support from managers and providers. This also includes the motivation of the instructors.

**H1 Learner and Environmental Characteristics positively influence the impact of the learning system**

### **3.7.2 Mobile learning solution/ Application characteristics**

When developing m-learning solutions, we must measure our ability to efficiently and effectively (a) Design and develop m-learning programs; (b) Target the right audience; (c) Roll out the program; and. (d) Deliver an interesting and relevant learning experience. The content developed must be adoptable for mobile purposes. It should be easier to use the application while providing relevant and reliable content. The cost of the solution should be relevant to the user and the organization. It is expected that the characteristics of the mobile learning solution will impact on how learners meet their learning needs.

**H2 The application/solution characteristics are significant on the success of the of a mobile learning system**

### **3.7.3 Organizational Characteristics**

Organizations include schools, colleges and universities and any other institution that offers learning. Any learning solution should impact positively on the business. Therefore, m-learning should be aligned to the objectives of the business. The business alignment objective should facilitate the business to measure the return on investment for the venture. This in turn will affect the sustainability of the system.

**H3 Organizational characteristics are positively associated with the success of the m-learning system**

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

#### **4.0 Introduction**

In this chapter, the preliminary results of selected variables are presented. Data that provided the results in this Chapter was collected using both qualitative and quantitative techniques, namely: literature review, survey and in-depth interviews.

#### **4.1. Background to the surveyed m-learning systems**

Two m-learning systems were surveyed: KSTS M-learning system and Mprep learning system. These two systems are briefly described below:

##### **4.1.1 Mprep**

This is an in-house developed, text based system which allows primary school students to take quizzes for any subject. It uses low end mobile phones for text messaging. The system has been operational since July 2011. The objective of the system is to meet environmental and infrastructural challenges to delivering and supporting education where conventional e-learning technologies would fail especially in the rural areas.

It has a database of learning materials (a learning object repository) which can be made available to teachers to also develop their own appropriate learning materials to students. The system uses Short Messaging Service (SMS) quizzes where multiple Choice Questions (MCQs) are sent to students and a simple answer choice is replied via SMS. Answers and feedback are provided on each quiz. To access the service, the user sends a text message to given number and receives a prompt for authentication. Once authenticated, the system sends another text message requiring the student to choose the assessment (quiz) to undertake. Each quiz has a code which is displayed in the text message.

Currently there are 950 students in Class Seven and Eight using the system, spread in nine primary schools in Kenya. The students use their own and parents' mobile phones to access the system at a cost.

#### **4.1.2 KSTS M-Learning system**

This system was developed using open source components based on Moodle, open-source mobile learning software. The system aims to provide informal, personalized, situated mobile learning for all students. A user can browse and download video presentations of the courses they wish to undertake. It also uses SMS technology to register and log in. the system has been in use for the last two years. Twenty seven users have used the system.

#### **4.2 Context of Survey Respondents**

In information systems design and development, system users are important for the success of any information system. It was therefore necessary to profile the users who use m-learning systems. A profile of the users (learners) was achieved by characterizing them on two key variables with a bearing to m-learning. These included: the learners' background information and learners' characteristics.

##### **4.2.1 Learners' Background**

Learners' background information related to demographics of the learner such as their gender, age, occupation, level of education, mobile devices owned, place and mode of study of the course, and activities engaged in the mobile devices.

##### **4.2.1.1 Demographics of the learner**

As indicated in Table 1 below, 61% of the respondents were male while 39% were female. 83.3% of the respondents were under the age of 15 years. 8.3% were between 15 and 25 years and another 8.3% were between 25 and 30 years. 92% of the respondents were students. There were only 3% managers and teachers respectively.

36% of the respondents indicated that they owned a mobile phone while 64% indicated that they did not own any mobile device. This could be attributed to the fact that 91% of the respondents are students and 83% are under the age of 15 years as indicated in *Tables 1*.

**Table 1: Demographics of participants**

Demographic	Frequency	Percentage
<b>Gender</b>		
Male	22	61.1
Female	14	38.9
<b>Age (Yrs)</b>		
Under 15	30	83.3
15 – 25	3	8.3
25 – 30	3	8.3
<b>Occupation</b>		
Manager	1	2.8
Teacher/Trainer	1	2.8
Student	33	91.7
Other	1	2.8
<b>Mobile devices owned</b>		
Mobile phone	13	36.1
None	23	63.9

(Source: Researcher, 2012)

#### 4.2.1.2 Proportion of mobile device ownership and gender

**Table 2: Cross tabulation of Gender and Mobile devices ownership**

		Mobile devices owned (%)	
		Mobile Phone	None
Gender	Male	36	64
	Female	36	64
Total			

(Source: Researcher, 2012)

There was a similar proportion in mobile devices ownership between males and females. Of the total male and female respondents, 36% indicated that they owned mobile phones while 64% did not own any mobile device.

#### 4.2.1.3 Place of study for the course

**Table 3: Place of study of the course**

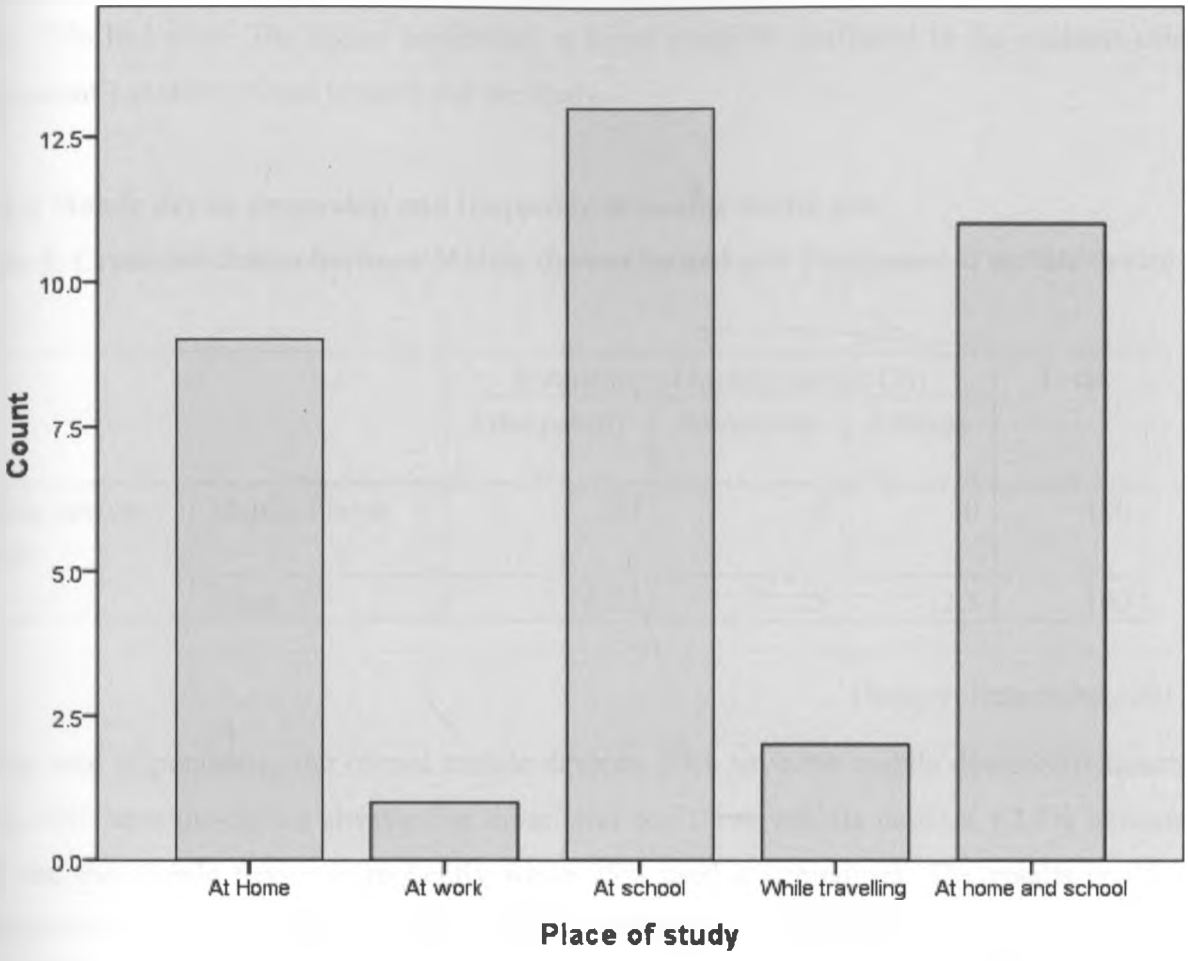
Place of study	Percent
At Home	25.0
At work	2.8
At school	36.1
While travelling	5.6
At home and school	30.6
Total	100.0

(Source: Researcher, 2012)

Of the total respondents, 36 % indicated that they carried the study at school only while 25% studied at home only. 31% indicated they studied both at home and at the school. Very few respondents studied the course at work or while travelling (3% and 6% respectively). This could be attributed to the fact that majority of the respondents are students as indicated in *Table 3* above.

This is graphically depicted in graph 1 below.

**Graph 1: Place of study of the course**



(Source: Researcher, 2012)

**4.2.1.4 Place of study and mobile devices owned**

**Table 4: Cross-tabulation between the Place of study and Mobile devices owned**

		Mobile devices owned	
		Mobile Phone	None
Place of study	At Home	4	5
	At work	1	0
	At school	3	10
	While travelling	1	1
	At home and school	4	7
Total		13	23

(Source: Researcher, 2012)



Table 4 indicates that of those who studied the course at home only, 44% had mobile phones while 56 % had none. Of the respondents who studied at school only, 23% had mobile phones while 77% had none. The higher percentage at home could be attributed to the students using their parent’s mobile phones to carry out the study.

#### 4.2.1.5 Mobile device ownership and frequency of mobile device use

**Table 5: Cross-tabulation between Mobile devices owned and Frequency of mobile device use**

		Frequency of mobile device (%)			Total
		Infrequently	Sometimes	Always	
Mobile devices owned	Mobile Phone	50	0	50	100
	None	62.5	25	12.5	100

(Source: Researcher, 2012)

Of the total respondents who owned mobile devices, 50% have the mobile device infrequently while 50% have the device always. For those who don’t own mobile devices, 62.5% indicated they use the mobile device infrequently while 25% used it sometimes. The results could be attributed to the reluctance of many learning institutions especially primary schools to let learners have mobile devices at schools for fear of theft, loss and damage. Moreover, in countries like Kenya, there are policies and parental agreements which bar children from bringing mobile devices to classrooms due to fear of inappropriate use of the devices. Further, from the qualitative data obtained, respondents indicated that their school did not allow mobile phone usage in class.

#### 4.2.1.6 Mobile devices owned and the motivation to learn and increased responsibility

61% of the respondents who owned mobile devices felt that ownership increased their motivation to learn and made them more responsible. 23% of them were uncertain while 15% disagreed.

55% of those who do not own a mobile device felt that ownership increased motivation to learn and responsibility. 40% were uncertain while 5% disagreed.

**Table 6: Cross-tabulation between Mobile devices owned and Ownership and motivation to learn and responsibility**

		Ownership and motivation to learn and responsibility			
		Strongly agree	Agree	Uncertain	Disagree
Mobile devices owned	Mobile Phone	3	5	3	2
	None	4	7	8	1

(Source: Researcher, 2012)

#### 4.2.2 Learner knowledge and skills

Existing knowledge and skills of the learner can influence how the learner is motivated to use the system. In the study, we looked at the prior knowledge of the learner, preparedness to use Information Technology in learning and the need for training to use the system.

##### 4.2.2.1 Preparedness to use Information Technology in learning

**Table 7: Preparedness to use IT in learning**

Likert Scale dimension	Percent
Strongly agree	8.3
Agree	19.4
Uncertain	47.2
Disagree	5.6
Strongly disagree	8.3
Total	88.9
Missing	11.1

(Source: Researcher, 2012)

30% of the respondents agreed that they were prepared to use IT in learning, 53% were uncertain while 15% did not agree. 11% of the respondents did not answer the question. The results could be as a result of poor literacy and the existence of digital divide in learners.

#### 4.2.2.2 Preparation to use IT and understanding of basic mobile techniques

**Table 8: Cross-tabulation between Preparation for IT in learning and Basic Mobile techniques**

		Basic Mobile techniques			
		Strongly agree	Agree	Uncertain	Disagree
Preparation for IT in learning	Strongly agree	3	0	0	0
	Agree	2	5	0	0
	Uncertain	1	9	1	6
	Disagree	0	2	0	0
	Strongly disagree	0	2	0	1

(Source: Researcher, 2012)

Of the respondents who were prepared to use IT for learning, 31% understood basic mobile techniques.

#### 4.2.2.3 Need for further training to use the system

**Table 9: Need for further training to use the system**

Likert Scale Dimension	Frequency	Percent
Strongly agree	1	2.8
Agree	5	13.9
Disagree	8	22.2
Strongly disagree	16	44.4
Total	30	83.3
Missing	6	16.7

(Source: Researcher, 2012)

66.6% indicated that they did not need further training to use the mobile learning system while 16.7 % indicated they needed training to use the system. 16.7% of the respondents did not answer this question.

The results in *Table 9* could be attributed to the systems being investigated being SMS-based. From the observations we made during the observational visits, the providers had sessions with the learners to explain new concepts once every week.

### 4.2.3 User Friendliness of the system

The ease of use of the system is critical to the acceptance of the system by the users. The user friendliness of the system was profiled by assessing the ease of use of the devices, satisfaction and the experience of the learner in the course and whether the learners will undertake similar courses in the future and recommend mobile learning to others.

#### 4.2.3.1 Ease of equipment use

Table 10: Ease of equipment use

	Frequency	Percent	Cumulative Percent
Strongly agree	6	16.7	16.7
Agree	27	75.0	91.7
Uncertain	1	2.8	94.4
Disagree	2	5.6	100.0

(Source: Researcher, 2012)

92% of the respondents found it easy to use the equipment. Only 5% did not find it easy. This could be possible for systems that do not require advanced devices such as smart phones.

#### 4.2.3.2 Enjoyment of the learning experience

Table 11: Enjoyment of Mobile learning experience

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	20	55.6	55.6	55.6
Agree	16	44.4	44.4	100.0
Total	36	100.0	100.0	

(Source: Researcher, 2012)

All the respondents found the learning experience enjoyable.

#### 4.2.3.3 Usefulness of mobile learning system in learning

For the respondents who answered the question on the usefulness of the m-learning system, all the found the system to be useful in learning the courses. 6 of the respondents did not answer the question.

**Table 12: Usefulness of the system in learning**

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	9	25.0	30.0	30.0
Agree	21	58.3	70.0	100.0
Missing	6	16.7		

(Source: Researcher, 2012)

#### 4.2.3.4 Mobile learning experience and motivation to take another m-learning course

**Table 13: Cross-tabulation between Mobile learning experience and motivation to undertake new mobile learning experience**

		New mobile learning experience	
		Strongly agree	Agree
Mobile learning experience	Strongly agree	12	8
	Agree	4	12

(Source: Researcher, 2012)

For the respondents who enjoyed the learning experience, all indicated that they would take another mobile learning course if it is relevant to their learning needs. They also indicated that they would recommend an m-learning as a method of study to others (Table 14 below).

**Table 14: Cross-tabulation between Mobile learning experience and Mobile learning recommendation**

		Mobile learning recommendation	
		Strongly agree	Agree
Mobile learning experience	Strongly agree	8	12
	Agree	4	11

(Source: Researcher, 2012)

#### 4.2.4 Didactic efficiency of m-learning systems

Didactic efficiency refers to how learning is achieved through the various methodologies used. Efficiency in mobile learning is achieved if learning objectives can be met through the system, relevance of the course content to the learner and the area of study.

Efficiency is also assessed by improvement in the learner performance and the ability to enhance communication with the tutors and other students.

##### 4.2.4.1 Ease of study of the course with mobile access only

Table 15: Ease of study of the course using mobile only

	Frequency	Percent	Cumulative Percent
Strongly agree	1	2.8	2.8
Agree	6	16.7	19.4
Uncertain	9	25.0	44.4
Disagree	15	41.7	86.1
Strongly disagree	5	13.9	100.0
Total	36	100.0	

(Source: Researcher, 2012)

19% of the respondents believe that it was easy to study the course using mobile devices only, 25% were uncertain while 55% were not convinced that the courses could be undertaken using mobile devices only. The results could be attributed to the fact that, not all courses are suited to m-learning environment. For example, short courses and mainly theory and information type courses are better suited to the m-learning environment.

##### 4.2.4.2 Course learning objectives can be met using mobile learning only

As indicated in Table 16 below, of the respondents who believe that it is easy to study the course using mobile devices only, they also believed that learning objectives could be met using mobile learning. For the respondents who did not at least agree that it is easier to study the course using mobile devices only, 73% still believed that course objectives can still be attained using mobile learning.

**Table 16: Cross-tabulation between Ease of study of the course using mobile only and Attaining course objectives**

		Attaining course objectives		
		Agree	Uncertain	Disagree
Ease of study of the course using mobile only	Strongly agree	1	0	0
	Agree	2	1	0
	Uncertain	2	5	0
	Disagree	11	1	1
	Strongly disagree	3	0	0

(Source: Researcher, 2012)

#### 4.2.4.3 Mobile learning enabled control over learning

**Table 17: Control over learning**

	Frequency	Percent	Cumulative Percent
Strongly agree	1	2.8	3.6
Agree	21	58.3	78.6
Uncertain	4	11.1	92.9
Disagree	2	5.6	100.0
Total	28	77.8	
Missing	8	22.2	
	36	100.0	

(Source: Researcher, 2012)

61% of the learners stated that mobile learning enabled them to have control over how and when to learn. 11% were uncertain while 6% did not agree. 22% of the respondents did not answer the question.

#### 4.2.4.4 Mobile learning enabled control over learning and improvement in class performance

**Table 18: Cross-tabulation between Control over learning and improved class performance**

		Improved class performance	
		Strongly agree	Agree
Control over learning	Strongly agree	1	0
	Agree	3	18
	Uncertain	0	4
	Disagree	0	2

(Source: Researcher, 2012)

Of the respondents who felt m-learning enabled them to control learning, 78% felt it improved their class performance while 20% were uncertain or disagreed.

#### 4.2.4.5 Mobile learning enabled communication with tutors and other course students

Mobile devices should enable communication with other learners as well as peers and tutors.

**Table 19: Ease of communication and feedback**

	Frequency	Percent	Cumulative Percent
Agree	7	24.1	24.1
Uncertain	18	62.1	86.2
Strongly disagree	4	13.8	100.0
Total	29	100.0	

(Source: Researcher, 2012)



**Table 20: Communication with other students**

	Frequency	Percent	Cumulative Percent
Agree	5	17.2	17.2
Uncertain	19	65.5	82.8
Disagree	1	3.4	86.2
Strongly disagree	4	13.8	100.0

(Source: Researcher, 2012)

From *Table 19* above, 24% of the respondents felt it was not easy to communicate with the tutors. 62% were uncertain while 17% disagreed. The results could be attributed to not engaging the tutors in the m-learning system.

*Table 20* indicates that 17% of the respondents felt the system was convenient to communicate with other course students. 66% were uncertain while 17% disagreed. The results arose because the systems under investigation did not make it possible for students to communicate with one another.

#### **4.2.4.6 Relevance of the materials/quizzes to learning**

The content adopted for m-learning must be relevant to learning. As indicated in *Table 12* above, most of the respondents indicated that they found the system to be useful for learning. In the study, all the respondents indicated that the materials/quizzes were relevant for learning. This further reinforces the earlier findings of the study on the usefulness of the system.

**Table 21: Relevance of course materials or quizzes**

	Valid Percent	Cumulative Percent
Strongly agree	26.7	26.7
Agree	73.3	100.0
Total	100.0	

(Source: Researcher, 2012)

#### 4.2.5 Technical feasibility of the system

We tried to establish the technical feasibility of the m-learning system. *Tables 25 and 26* present the results obtained from the assessment of the ease of downloading materials, the need for use of graphics and illustrations and the quality and functionality of the materials that were downloaded. We linked the various sub-dimensions in this category to elicit the opinions of the respondents.

##### 4.2.5.1 Graphics and illustrations can enhance the effectiveness of m-learning

**Table 22: Effectiveness of graphics and illustrations**

	Frequency	Percent	Cumulative Percent
Strongly agree	5	14.3	14.3
Agree	24	68.6	82.9
Uncertain	4	11.4	94.3
Disagree	2	5.7	100.0

(Source: Researcher, 2012)

83% of the respondents indicated that graphics and illustrations could enhance the effectiveness of an m-learning system while 11% were uncertain. 6% disagreed.

##### 4.2.5.2 Ease of downloading and ease of navigation

**Table 23: Cross-tabulation between Ease of downloading course content and Ease of navigation through the course**

		Ease of navigation through the course				
		Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Ease of downloading course content	Strongly agree	0	0	0	0	1
	Agree	1	20	2	4	0
	Uncertain	0	2	0	0	0
	Disagree	0	1	2	3	0

(Source: Researcher, 2012)

We cross tabulated the ease of downloading the materials with the ease of navigation through the system. Of the respondents who found it easy to download content, 58% felt it was easy to navigate while 19% felt it was not easy.

#### 4.2.6 Quality and functionality of the system

For a system to be effective there should be few problems. The quality of the content should be high as this will affect the functionality of the system.

##### 4.2.6.1 Problems experienced while using the system

**Table 24: Problems experienced**

	Frequency	Percent	Cumulative Percent
Agree	2	5.6	5.6
Uncertain	2	5.6	11.1
Disagree	25	69.4	80.6
Strongly disagree	7	19.4	100.0

(Source: Researcher, 2012)

Majority of the respondents 89% of the respondents indicated that they experienced problems with the system. In their response, respondents indicated that at times, they received the wrong quizzes and the questions will be incomplete.

##### 4.2.6.2 Cross tabulation of the problems experienced and the quality of the files downloaded

Of the respondents who did not experience any problems, only 1% indicated the files/SMSs' were of good quality. For the respondents who experienced problems with the system, only 20% indicated that the files/SMSs' were of poor quality (Table 25 below).

**Table 25: Cross tabulation of quality of files and problems experienced**

		Quality of video and audio files				
		Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Problems experienced	Agree	0	1	0	0	0
	Uncertain	0	0	2	0	0
	Disagree	1	6	6	12	0
	Strongly disagree	0	1	1	4	1

(Source: Researcher, 2012)

#### 4.2.7 Cost effectiveness

The cost m-learning is depicted by the cost of the system at the individual and institutional level. Further, the cost should be assessed in terms of the instructional method used and the medium used for course delivery.

As *Table 26* below indicates, 53% of the respondents felt that the cost of downloading the content was not affordable while 31% felt it was affordable.

**Table 26: Cost of downloading**

	Percent	Cumulative Percent
Agree	30.6	30.6
Uncertain	16.7	47.2
Disagree	47.2	94.4
Strongly disagree	5.6	100.0
Total	100.0	

(Source: Researcher, 2012)

The result could be attributed to the learner background especially their occupation. We cross tabulated the occupation and the cost of downloading. *Table 30* indicates that majority of the

respondents were students (92%) and only 28% of them felt the cost was affordable. 50% of the students felt the cost was not affordable.

**Table 27: Cross-tabulation of Occupation and Cost of downloading**

		Cost of downloading			
		Agree	Uncertain	Disagree	Strongly disagree
Occupation	Manager	0	1	0	0
	Teacher/Trainer	1	0	0	0
	Student	10	5	16	2
	Other	0	0	1	0

(Source: Researcher, 2012)

### 4.3 Testing of the hypothesis

To test the hypothesis developed, we used the Pearson Chi-square test to establish associations between the various variables in each dimension area.

#### 4.3.1 Hypothesis 1 Learner and Environmental Characteristics positively influence the impact of the learning system

Ownership of mobile devices is critical in ensuring that m-learning systems are effective. Becta's (2004) findings show that there is evidence that ownership of wireless devices increases a learner's motivation to learn and makes them more responsible. Perry (2002) cited in Barker et al (2008) suggests that allowing children personal ownership of mobile equipment can bring benefits to disadvantaged learners who would otherwise have no access to IT at home.

In our study, when we measured the relationship between mobile device ownership and motivation to learn, we found that there was a significant association between mobile device ownership and learner motivation ( $p=0.096$ ). Vahey and Crawford (2003) study found that learners demonstrated an increased autonomy in learning as learners show increased self-directedness in learning and take initiative in finding ways to use the devices for learning.

**Table 28: Influence of device ownership on motivation to learn**

**Test Statistics**

	Mobile devices owned	Ownership and motivation to learn and responsibility
Chi-Square	2.778 <sup>a</sup>	6.152 <sup>b</sup>
df	1	3
Asymp. Sig.	.096	.104

(Source: Researcher, 2012)

*a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.0.*

*b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.3.*

We also found a strong association between mobile device ownership and the place of study for m-learning courses. This explains why majority of the learners in our study undertook the courses at home and at school. This reinforces the notion that m-learning provides flexible, ubiquitous and personalized learning (Traxler, 2007).

**Table 29: Influence of device ownership on Place of study**

**Test Statistics**

	Mobile devices owned	Place of study
Chi-Square	2.778 <sup>a</sup>	16.222 <sup>b</sup>
df	1	4
Asymp. Sig.	.096	.003

(Source: Researcher, 2012)

*a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.0.*

*b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.2.*

We further established that when learners are in control of learning, it is possible to enhance the learning experience and improve the learner performance. This is indicated in Table 30 by the Pearson value of 0.000 which indicates a strong association between learner control and individual improvement and learning experience.

**Table 30: influence of learner control on individual performance and learning experience**

Test Statistics			
	Control over learning	Improved class performance	Enhanced Learning experience
Chi-Square	38.000 <sup>a</sup>	16.133 <sup>b</sup>	60.933 <sup>c</sup>
df	3	1	3
Asymp. Sig.	.000	.000	.000

(Source: Researcher, 2012)

- a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.0.*
- b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 15.0.*
- c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.5.*

The usefulness of the system is very important in ensuring that it meets its objectives. Moon et al (2005) identify two critical criteria for measuring the usefulness of ICT in learning.

- (i) Satisfaction and ease of understanding of materials and media
- (ii) Whether the learners would use the materials for future reference

We established that user satisfaction is important as it is likely to facilitate adoption of m-learning by learners. Adoption is measured by repeat usage of the system or similar systems by the learner and recommendation to others to use the system.

**Table 31: Usefulness of the system**

Test Statistics			
	Usefulness in learning	New mobile learning experience	Mobile learning recommendation
Chi-Square	4.800 <sup>a</sup>	.444 <sup>b</sup>	3.457 <sup>c</sup>
df	1	1	1
Asymp. Sig.	.028	.505	.063

(Source: Researcher, 2012)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 15.0.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.0.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 17.5.

As indicated in Table 14, there is significant association between the usefulness of the system (satisfaction) and the learners adoption of the system ( $p=0.028$ ).

#### 4.3.2 Hypothesis 2 the application/solution characteristics are significant on the success of the of a mobile learning system

Application characteristics are important factors in ensuring the learning system is accepted. We identified significance of some the variables that define application characteristics. They include content adaptability as indicated by quality of files, ease of use of the system as indicated by ease of download, navigation and problems experienced.

**Table 32: Ease of use of the system**

Test Statistics			
	Ease of navigation through the course	Ease of downloading course content	Problems experienced
Chi-Square	46.778 <sup>a</sup>	49.556 <sup>b</sup>	39.778 <sup>b</sup>
df	4	3	3
Asymp. Sig.	.000	.000	.000

(Source: Researcher, 2012)



As indicated in *Table 32* above, participants considered the m-learning easier to use and experienced few difficulties with its use. Both ease of downloading and navigation are significant ( $p=0.000$ ). This could attribute to the learners recommending the use of the system again as indicated in *Table 31*. Ease of use is significant especially if learners are not familiar with the devices. If the learners encounter fewer problems, they are likely to recommend the system.

**Table 33: problems experienced and quality of files downloaded**

Test Statistics		
	Problems experienced	Quality of video and audio files
Chi-Square	39.778 <sup>a</sup>	22.571 <sup>b</sup>
df	3	4
Asymp. Sig.	.000	.000

(Source: Researcher, 2012)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.0.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.0.

The reliability of the system is critical. A large proportion of the respondents were not happy with the quality of the files. In one of the observational visits, learners would complain that they would get the wrong questions or the responses would be incomplete. The respondents indicated that the learning could be enhanced if there were graphics in the system as indicated in *Table 34*.

**Table 34: Effectiveness of graphics**

Test Statistics	
	Effectiveness of graphics and illustrations
Chi-Square	35.971 <sup>a</sup>
Asymp. Sig.	.000

(Source: Researcher, 2012)

Last, the cost is an important factor to consider. The cost m-learning is depicted by the cost of the system at the individual and institutional level. Further, the cost should be assessed in terms of the instructional method used and the medium used for course delivery. As indicated in Table 26, 53% of the respondents felt that the cost of downloading the content was not affordable while 31% felt it was affordable.

**Table 35: Cost of downloading**

**Test Statistics**

	Cost of downloading
Chi-Square	14.000 <sup>a</sup>
Asymp. Sig.	.003

(Source: Researcher, 2012)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.0.

Cost is a significant variable in m-learning. As Muyinda (2010) study indicates, learners indicated that the cost of m-learning was high especially if they are the ones paying to access the materials. In other m-learning projects such as Yoza Cellphone Stories and Dr. Math also indicate that downloading-cost was a big consideration (UNESCO, 2012; Bakari and Nykvist, 2009). This could explain why many m-learning projects in developing countries use lower-end mobile phones. Downloading text messages is less costly than downloading images and therefore, texting is more appealing. The cost element could also be explained by the occupation of the learners.

**Table 36: Influence of occupation on cost**

	Occupation	Cost of downloading
Chi-Square	85.333 <sup>a</sup>	14.000 <sup>a</sup>
Asymp. Sig.	.000	.003

	Occupation	Cost of downloading
Chi-Square	85.333 <sup>a</sup>	14.000 <sup>a</sup>
Asymp. Sig.	.000	.003

(Source: Researcher, 2012)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.0.

Table 36 indicates that there is a significant association between the occupational of the learner ( $p=0.000$ ) and the cost consideration ( $p=0.003$ ). This could be attributed to the fact that most of the respondents were students and below the age of 15 years. We therefore posit that m-learning cost is a central aspect which requires special consideration during the development and growth of m-learning. According to results in this study, an m-learning cost sustainability plan requires the full commitment to m-learning by telecommunications companies, governments, learners, parents, employers and donors.

#### 4.3.3 Hypothesis 3 Organizational characteristics are positively associated with the success of the m-learning system

Any learning solution should impact positively on the business. Therefore, m-learning should be aligned to the objectives of the business. The business alignment objective should facilitate the business to measure the return on investment for the venture. This in turn will affect the sustainability of the system.

It was not possible to measure the return on investment on the projects as data could not be provided on actual costs incurred and total revenue generated by the systems. Therefore, we could not ascertain the sustainability of the systems and whether they were meeting the objectives they were designed to meet. GeSCI (2010) and Traxler (2011) assert that most of the m-learning projects in Africa are small scale pilots and they present difficulties to measure and evaluate. The community, especially the corporate and private sector organizations, must develop an understanding of mobile learning projects in terms of their ability to generate revenue or meet their costs and an understanding of their impact on human, economic and social capital in relation to their various costs.

## **CHAPTER 5**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.0 Introduction**

This Chapter provides the implications of the research to theory and practice. It also highlights the limitations that manifested during the study. We recommend areas of future research.

#### **5.1 Summary of key contributions**

The aim of the research was to develop a framework for evaluating mobile learning systems in Kenya. The main output of this research is the Mobile Learning Impact Measurement Framework (MLIF). This framework is composed of three main dimensions each with sub-dimensions that need to be evaluated. The main dimensions are (1) Phases of Mobile learning impact; (2) Learner, Environmental and organizational impact elements and; (3) Evaluation measures for the mobile learning phases.

We therefore conclude that evaluation of mobile learning systems in Kenya will depend on the ability to develop mobile learning goals and align them to organizational goals. Further, there is need to consider the factors that influence the impact of the learning system. These factors relate to the application itself, the learner and the organization. We also need to recognise that the organizational improvement is only possible if the learner is first improved. Therefore, the system must facilitate attainment of learner objectives and adoption and satisfy the learner.

The cost of m-learning is an important factor to consider. The cost must be viewed from the perspective of the learner and the organizational at large. This will call for a sustainability plan to be developed. The plan must balance between good return on investment for the institution and the learner improvement. It should not compromise the objectives of m-learning. The plan at the same time should facilitate scalability of the system so that as many learners as possible benefit from the system.

The foregoing conclusions provide a competence set of guidelines that can be used to evaluate mobile learning.

## **5.2 Implication of the research to theory and practice**

### **5.2.1 Implications of the research to theory**

The study has contributed to the knowledge base in mobile learning. The framework developed in this research enriches the development of m-learning theories. M-learning is a young field (Traxler, 2007; Caudil, 2002; Wingkvist, 2009) and new categories of pedagogy are being identified, developed and researched.

The need to incorporate the goal of m-learning during development is important as it distinguishes m-learning from e-learning thereby enabling proper learning environment for mobile learning to be developed. It also highlights the need to know how to integrate m-learning with class room settings especially in developing countries.

The research methodology adopted provides further proof that mixed methodologies can still be executed in information systems research.

### **5.2.2 Implication of the research to practice**

#### **5.2.2.1 Implication of the research to developing mobile learning products and systems**

The Framework developed provides guidelines for creating m-learning applications. Applications developed using the framework have the ability to reduce cost of accessing education to many deserving learners. The applications are likely to penetrate the rural and remote areas thereby reducing not only the literacy gap but also the digital divide between the “haves” and “have nots”.

It is also important to include all stakeholders in the development of such products. More importantly, the learner should be the central focus as he/she is the ultimate user and beneficiary of the system. This will also imply that the cost of the system be carefully considered to ensure sustainability of the products and systems.

### **5.2.2.2 Implications of the research to policy making for mobile learning**

In 2007, *infoDev*, a global partnership programme within the World Bank, reported that fortyeight out of fifty-three countries in Africa had some form of ICT in education policy in place. However, many of these policies were written during the 'pre-mobile' phase of technology development. Therefore, the policies do not consider the inclusion of mobile phones and their potential to expand access to learning opportunities improve the quality of education and promote equity in education. As noted in the UNESCO 2012 report on mobile learning, one of the pioneer m-learning projects in Kenya, SEMA Project, failed because there was no authoritative policy and guidelines for the use of the system. There is needed to come up and administer innovative policies to support m-learning. This should be guided by the awareness of the benefits that m-learning can provide.

In countries like Kenya, mobile devices are not allowed in schools. This has implications to the kind of learning that can take place and the tools to use for learning. Such policies must now take cognizance of the benefits that accrue with integrating mobile learning to class room learning. They must include clear guidelines and principles to ensure appropriate use of wireless technologies.

### **5.3 Limitations to the study**

As Al-Yaseen et al (2010) notes, evaluation of information systems is a complex and challenging activity. First and foremost, mobile learning is a young field (Traxler, 2007). Further, few systems have been implemented in Kenya and are at infancy stages. The sample selected therefore was not random because of the accessibility problem of the organizations that are implementing the system. Moreover, the researcher could not access data from the sample selected since some of the providers did not want to share what they perceived as proprietary data.

Whereas prototyping is considered the best method to validate a framework, it was not used to validate the framework due to time and resource constraints. The framework contains exogenous and endogenous factors which require considerable time and resources to implement on a prototype. However, an equally rigorous validation technique of hypothesis testing was adopted.

The framework was based on measures of outcomes. The framework could be improved if there was data to triangulate with actual learner performance. This will involve a test evaluation to access the quality of course tests and administrative data such as completion rates and actual cost data.

The researcher was not able to test every variable in limited time and resources available. Further, the systems tested were at the trial stage. However, the research undertaken proved the value of the framework as a tool for research and confirmed the validity of the framework design.

#### **5.4 Directions for future research**

The Mobile Learning Impact Framework (MLIF) has not addressed the role of age as a factor for learning success. This is borne from the fact that there could be differences between young and adult learners which might influence development of m-learning systems. Further, there is need for further research on gender disparity in the access to m-learning. UNESCO (2012) asserts that there is gender disparity in access due to economic disparities.

The framework has also not looked at m-learning Ethics more so on Security and Privacy issues. The learning systems may need to ensure security and privacy of information of individual nature is kept safe and confidential. At times, m-learning has been viewed as being intrusive to privacy of learners.

There is an emerging school of thought about the importance of access to mobile phones over ownership. In a GSMA 2010 report, the rate of access to mobile phones as opposed to ownership, are even higher in developing countries and one mobile phone is often shared within and between families.

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## **APPENDIX A: DEFINITION OF TERMS**

### **Electronic learning (e-learning, eLearning)**

Electronic learning is learning supported by digital electronic tools and media. Electronic learning is the basis for *mobile* learning, but lacks some of the additional characteristics of *mobile* learning (see the definition for mobile learning).

### **JAVA**

**Java** is a programming language a general-purpose, concurrent, class-based, object-oriented language that is specifically designed to have as few implementation dependencies as possible.

### **Learner centered**

According to Sharples et. al, (2002) in “student-centred environments . . . the learner define how to proceed, based on individual needs, and that learning is highly tuned to the situation in which it takes place . . . [it is] deepened through exploration, interpretation and negotiation. For the purposes of this investigation, learner centred approaches will be defined as approaches in which learners are “in control of the activity, able to test ideas by performing experiments, ask questions, collaborate with other people, seek out new knowledge, and plan new actions”.

### **Learning**

Koole and Ally (2005) writes that learning is, “an internal process and the amount learned depends on the capacity of the user, the amount of effort expended during the learning process, the quality of the processing, and the user’s existing knowledge structure” Learning is a highly complex process that involves all of these descriptions; it is a highly personal and internal process that involves a change in the learner’s conceptions, attitudes, or abilities.

**Mobile device**–For this investigation a mobile device is a portable, electronic tool that permits users to interact with others or access information remotely using wireless networking capabilities (Ally, 2005). These devices must have means for inputting, processing, storing, and outputting information (Ally, 2005).

### **Personal digital assistants (PDAs)**

Personal Digital Assistants are general tools, designed initially to support personal information management. They offer features such as a diary, address book and note-taking facilities. PDAs most often differ from laptops and desktop computers in that they have much less processing power, fewer applications, and less robust input and output capacity. They are often small enough to fit into a shirt pocket. PDAs vary in their ability to offer wireless networking.

### **Situated learning**

Some constructivists support the tenets of *contextualism* in which they argue that both learning and assessment of learning should be done in realistic settings involving realistic tasks. This is what some theorists refer to as *situated cognition* (Smith & Ragan, 1999). This investigation will refer to situated learning as learning that is grounded in authentic needs, outcomes, and environments.

### **Ubiquitous computing**

Ubiquitous means access of learning resources is truly independent of time and space. Ally (2005) writes that ubiquitous computing refers to “computing technology that is invisible to the user because of wireless connectivity of the mobile device”. Computers in cars, therefore, satisfy the criteria of transparency and, to an extent, of omnipresence in the sense that they are found in a large variety of machines that people use every day.

**Wireless networking**—In this investigation, wireless networking refers to the ability of devices to connect to the Internet or send signals to other devices without being connected by physical wires.

**WiFi** is the consumer-friendly name given to the 802.11 family of wireless protocols by the WiFi alliance.

Questionnaire ID .....

## **APPENDIX B: QUESTIONNAIRE FORM**

Questionnaire for Masters Research titled “A Framework for Evaluating Mobile Learning (M-Learning) Systems in Kenya”

Dear Respondent,

I am a student pursuing Master of Science (Information Systems) at the University of Nairobi. I am undertaking a research on **A Framework for Evaluating Mobile Learning (M-Learning) Systems in Kenya**. I would greatly appreciate if you would respond to the questions in the attached questionnaire sincerely and honestly. The information that you provide will help me to give better understanding about Mobile Learning in Kenya in order to ensure its effectiveness as well as improving its system and services. Your responses and information will be kept strictly confidential and will only be used for academic purposes only.

Thank you very much for your cooperation.

**Jesse N. Mutua**



Name of institution: .....

Course name: .....

### Section 1: Learner Characteristics

Please read the following questions and give your response to each. You can use a tick (✓) or a cross (×).

1. Which mobile device(s) do you own?

A **personal digital assistant (PDA)** is a lightweight consumer electronic device that looks like a hand-held computer but instead performs specific tasks; can serve as a diary or a personal database or a telephone or an alarm clock etc.

- Mobile phone
- PDA / pocket PC / palmtop
- Both mobile and PDA
- Other
- None

2. Where did you study the mobile learning course?

- At home
- At the office
- At Work
- At School
- While travelling

3. What was the mode of learning using the mobile devices?

- SMS
- Mobile browser
- SMS and mobile browser
- Other (Specify) .....

4. Which activity do you most engage in on your mobile device?

- SMS
- Phone calls

- Email and entertainment
- Other (Specify) .....

5. How often do you have your mobile device with you?

- Infrequently
- Sometimes
- Always

**Section 2: Learner Knowledge and skills**

Please read the following statements and then provide your level of agreement/disagreement using the scale:

**1 = I strongly agree 2 = I agree 3 = I'm uncertain 4 = I disagree 5 = I strongly disagree**

		1	2	3	4	5
6.	Ownership of the mobile device increased my motivation to learn and made me more responsible					
7.	Before I enrolled for the course, I was adequately prepared to use information technology (IT) as needed in my courses					
8.	Before I undertook the course, I had a good understanding of basic mobile techniques such as browsing and downloading files					
9.	I need further training to use the mobile learning system					

**Section 3: User friendliness**

Please read the following statements and then provide your level of agreement/disagreement using the scale:

**1 = I strongly agree 2 = I agree 3 = I'm uncertain 4 = I disagree 5 = I strongly disagree**

		1	2	3	4	5
10.	It was easy to use the equipment in this mobile learning course.					
11.	This mobile learning experience was enjoyable.					
12.	According to my experience I would take another mobile learning course if relevant to my learning needs.					
13.	I would recommend mobile learning as a method of study to others.					

#### Section 4: Didactic efficiency

**Didactic learning** is how we traditionally learn in school – through lecture, reading, and observation. Students memorize facts.

Please read the following statements and then provide your level of agreement/disagreement using the scale:

**1 = I strongly agree 2 = I agree 3 = I'm uncertain 4 = I disagree 5 = I strongly disagree**

		1	2	3	4	5
14.	I believe mobile learning increases the quality of electronic learning.					
15.	Course learning objectives can be met by mobile learning.					
16.	Mobile learning allowed me to control how and when to learn.					
17.	Downloading course content/questions was easy.					
18.	Using the mobile learning improved my course/class performance					
19.	Communication with and feedback from the tutor was easy in this course.					
20.	Mobile learning is convenient for communication with other course students.					
21.	It is easier to study this course with mobile access only					

#### Section 5: Technical feasibility

Please read the following statements and then provide your level of agreement/disagreement using the scale:

**1 = I strongly agree 2 = I agree 3 = I'm uncertain 4 = I disagree 5 = I strongly disagree**

		1	2	3	4	5
22.	Navigation through the mobile learning course was easy.					
23.	For mobile learning to be effective it is necessary to use graphics and illustrations.					
24.	Evaluation and questioning in the mobile course was effective.					

**Section 6: Functionalities and Quality of video/SMS's**

Please read the following statements and then provide your level of agreement/disagreement using the scale:

**1 = I strongly agree 2 = I agree 3 = I'm uncertain 4 = I disagree 5 = I strongly disagree**

		1	2	3	4	5
25.	I never experienced any problems in viewing/ downloading the video/audio files /SMS					
26.	The video/audio/SMS files were of high quality					
27.	It was easy to stream/receive videos/audio/SMS files					

**Section 7: Cost effectiveness**

Please read the following statements and then provide your level of agreement/disagreement using the scale:

**1 = I strongly agree 2 = I agree 3 = I'm uncertain 4 = I disagree 5 = I strongly disagree**

		1	2	3	4	5
28.	Mobile learning increases access to education and training.					
29.	The cost of downloading the mobile course material/questions was affordable.					
30.	The cost of communicating in the mobile learning course with the tutor and other students was affordable.					

**Section 8: Other Comments**

Please provide any other comments about the course.

.....

.....

.....

.....

.....  
.....  
**Section 9: Personal Background**

1. What is your occupation?

- Manager
- Teacher or trainer
- Student
- Other (Specify) .....

2. What is your age (years)?

- Under 15
- 15 - 25
- 25 – 30
- 31 – 40
- 41 – 50
- Over 50

3. What is your gender?

- Male     Female

4. What is your level of education?

- Primary School
- O' / A Level
- Diploma
- Bachelors
- Post-Graduate
- Other (Specify) .....

## APPENDIX C: LETTER OF AUTHORIZATION TO UNDERTAKE RESEARCH



### UNIVERSITY OF NAIROBI COLLEGE OF BIOLOGICAL AND PHYSICAL SCIENCES SCHOOL OF COMPUTING AND INFORMATICS

Telephone: 4417870/444919/4461544  
Telegrams: "Varsity" Nairobi  
Email: [Director@schip.unbi.ac.ke](mailto:Director@schip.unbi.ac.ke)

P. O. Box 30197  
00100 GPO  
Nairobi, Kenya

Our Ref: UON/SCIMSC/IS/2010

01 February 2012

To Whom It May Concern

Dear Sirs/Madam

#### JESSE NGUGI MUTUA – REG. NO. P58/61305/2010

The above named is a bona fide student pursuing a Master of Science in Information Systems degree at the School of Computing and Informatics, University of Nairobi. He is currently carrying out his research on the project entitled: "A Framework for Evaluating Mobile Learning systems (M-Learning) in Kenya".

We would be grateful if you could assist Mr. Mutua as he gathers data for his research. If you have any queries about the exercise please do not hesitate to contact us. The information you provide will be solely for the project.

Yours faithfully

School of Computing & Informatics  
University of NAIROBI  
P. O. Box 30197  
NAIROBI

PROF. W. OKELO-ODONGO  
DIRECTOR  
SCHOOL OF COMPUTING AND INFORMATICS