LEARNER CHARACTERISTICS, BEHAVIOUR, TECHNOLOGY USE AND ADOPTION OF MOBILE LEARNING AMONG COMMUNITY HEALTH CARE TRAINEES, AMREF HEALTH AFRICA, KENYA.

By

Augustine Mwangi Gatotoh

A Thesis Submitted for the Award of the Degree of Doctor of Philosophy in Distance Education of the University of Nairobi

2017

DECLARATION

This thesis is my original work and has not been presented to any other university for the award of a degree.

Signature…… Date…….

Augustine Mwangi Gatotoh

Registration Number L80/50671/2016

This thesis has been submitted for examinations with our approval as the university supervisors

Signature…… Date…….

Professor Christopher Mwangi Gakuu

School of Open and Distance Learning,

University of Nairobi.

Signature…… Date…….

Dr. Peter Njenga Keiyoro

Senior Lecturer,

School of Open and Distance Learning,

University of Nairobi.

DEDICATION

This work is dedicated to my wife Agnes and my children Nelson John and Angel Suzanne.

ACKNOWLEDGMENT

I wish to acknowledge the University of Nairobi for enabling me to undertake this study. I am grateful to my supervisors, Professor Christopher Gakuu and Dr. Peter Keiyoro for offering their invaluable academic and intellectual insights throughout this study. I am indebted to my colleagues in the ODeL Campus; Professor Harriet Kidombo, Professor David Macharia, Dr. Juliana Mutoro, Dr. Naomi Gikonyo, Dr. Anne Nderitu and Dr. Lydia Wambugu and Ms. Mary Ngechu and former colleague Dr. Hellen Kabue for their encouragement throughout this study. I thank the Chair, Department of Open Learning Programmes, Dr. John Mbugua and Dr. Dorothy Kyalo, Dean, School of Open and Distance Learning for their administrative support.

I also wish to acknowledge the Amref Health Africa team; Dr Josephat Nyagero and Diana Mukami for their support during the conceptualization and approval stages, Jackline Kiarie, Bernard Kikechi and Anthony Kipkorir the key informants on the mLearning project, for providing the information necessary for the development this thesis.

I thank the library staff at Amref Health Africa Headquarters, and the University of Nairobi for their support during the course of this study. In particular, I am indebted to Mr. Peter Matanji Senior Librarian and Mr. David Mulonzia librarian, University of Nairobi for their unlimited support in sourcing for relevant journal articles. I extend my appreciation to the research assistants; Robert Kasisi, Elias Owino, Elija Oyallo and Pellen Mungai. I thank the respondents for taking their time to participate in this research. I also thank my family and friends for encouraging me during the course of this study. All those who have not been mentioned but played a role in my academic pursuit are most appreciated.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

CHEWs	Community Health Extension Workers
CHVs	Community Health Volunteers
CHWs	Community Health Workers
HELP	Health Enablement and Learning Platform
ICT	Information and Communication Technology
IDT	Innovation Diffusion Theory
IMS	Information Management System (IMS)
IS	Information System
IVR	Interactive Voice Response
MLMS	Mobile Learning Management
NACOSTI	National Commission for Science, Technology and Innovation
NEPAD	New Partnership for Africa's Development
ODeL	Open, Distance and eLearning
PDAs	Personal Digital Assistants
SMS	Short Message Service
SPSS	Statistical Package for Social Science
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UNESCO	United Nations Educational, Scientific and Cultural Organization
UTAUT	Unified Theory of Acceptance and Use of Technology
WAP	Wireless Application Protocol

ABSTRACT

Mobile technology has gained increased focus in academic circles as a way of enabling learning that is not confined to time and place. As the benefits of mobile learning (mLearning) are being clarified so too will researchers need to understand the determinants of its adoption by the end user. The adoption of mobile technology for teaching and learning largely depends on whether learners believe that it fits in their particular learning needs. However, despite the interest and the potential of mobile learning, researchers have a limited knowledge of the factors that may influence learner adoption. Investigating learner adoption of mobile learning is an essential issue in the expansion of mLearning. This research explores learner behaviour, technology use and adoption of mobile learning among trainees in the mHealth training programme. This study based its unit of analysis on the mHealth programme run by Amref Health Africa in Kenya. The study objectives were to determine the influence of learner characteristics, self-efficacy, attitude, technology use on adoption of mLearning. The study adopted a mixed methods research approach. This involved combining of qualitative and quantitative data in the study. The study was guided by the pragmatism paradigm. This paradigm was selected because it applies to mixed methods arguing that inquirers draw liberally from both quantitative and qualitative assumptions when they engage in the research. The target population of the study was the 3081 trainees of the two phases of mHealth programme. To achieve the expected threshold for a sample size, the researcher draws the sample size using the formula suggested by Yamane (1967) for calculating sample sizes. A 95% confidence level and P = 0.5 are assumed for the equation $n = N/1 + N(e)^2$. The application of this formula yielded a sample of 354 for this study. The data was collected from six counties of the thirteen counties where the mHealth programme took place stratified as follows; urban (Nairobi and Kisumu) rural (Kakamega and Kitui) nomadic (Kajiado, and Samburu). The data was collected using by questionnaires, focused group discussions and interviews. The instruments were piloted and Cronbach's Alpha (α) used to test for internal consistency. The instruments were found to be reliable with a reliability index above .70. Validity of the instruments was checked by the supervisors and other research experts at the ODeL campus of the University of Nairobi. Both inferential and descriptive statistics were used for data analysis. Frequencies, percentages, means and standard deviations were used to describe key variable outcomes while regression analysis and Pearson correlation was conducted to test the hypothesis. The qualitative data was interpreted and presented thematically. The results showed that age and gender did not have a significant influence on adoption of mLearning while level of education, work experience and period of exposure to mLearning all influenced adoption. Overall, learner self-efficacy, attitude, behavioural intention and technology use had a positive and significant influence on adoption of mobile learning. Institutional factors were also found to have a significant influence on adoption of mLearning. The study concludes that adoption of mLearning is best influenced by collective determinants other than isolated determinants. The findings of this study are useful in providing guidance to mLearning content developers, researchers, practitioners and educators for designing mLearning courses that are learner friendly and thus may lead to higher adoption. The study recommends that institutions wishing to offer mLearning need to ensure that their mobile learning solutions address the determinants of adoption collectively for better results in adoption of mLearning.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Education has undergone a major paradigm shift due to integration of Information and Communication Technology (ICT) in teaching and learning Obiadazie (2014). Emerging global developments open up opportunities for educationists to design and implement teaching learning content based on mobile technologies (Rahamat, Shah, Din & Aziz, 2017). Mobile technology is an integral part of everyday life and has transformed the way individuals interact with each other and with their social-economic environment (Taleb & Sohrabi, 2012). The utilization of mobile technology is extensive within the areas of business and finance such as mobile commerce (m-commerce), mobile banking (m-banking) (Bankole, Bankole & Brown, 2011), medicine and mobile health (mHealth) (Doyle 2014; Chang, Ghose, Littman-Quinn, Anolik, Kyer, Mazhani, & Kovarik, 2012) and in education mobile learning (mLearning) (González, Martín, Llamas, Martínez, Vegas, & Hernández, 2017).

Consistent with the advancement of technological innovation, eLearning methods have evolved and are transforming instructional design for efficient and effective teaching and learning. Education technology has also adopted connectivity pedagogy (Anderson, 2011). Moreover, mobile learning is one of the medium for this pedagogy which is an integral part of Open Distance and eLearning (ODeL). Notably, mobile phones are personalised gadgets; therefore, the characteristics of the end user are paramount in their adoption. For mLearning, Learners' characteristics have an impact of learners' adoption and use of technology (Laukkanen & Pasanen 2008; Pollara, & Broussard, 2011).

Mobile learning presents unique educational benefits that initiate a kind of highly situated, personal, and collaborative learner-centred environment (Kukulska-Hulme, 2009; Cavus & Ibrahim 2009). Indeed, mLearning has changed the way learners access content as well as revolutionised how learners interact with one another and with the facilitators (Cavus & Ibrahim, 2009).

The current study is premised on the high penetration rates of mobile telephony in Africa and Kenya in particular which stood at 83.9% in 2015 (Communications Authority of Kenya 2015). There is need to leverage on this new technology across the key economic sectors including education. According to the World Bank, (2012) individuals in East Africa have better access to mobile telephony in comparison with bank accounts, clean water or even electricity. The acceptance of mobile devices makes them appropriate for use in educational contexts (Negas & Ramos 2011; Jeng, Wu, Huang, Tan, & Yang 2010). While the fast growth in the number of mobile devices has allowed learning institutions to start exploring their use, their adoption for teaching and learning is not expansive (Wang Wu & Wang,.2009; Cheon, Lee, Crooks & Song 2012).

The advent of mLearning hence, has presented a podium for learning institutions to improve teaching and learning by integrating mLearning (Mtebe & Raisamo, 2014). In Kenya, the number of mobile users has continually increased across the country (Oluoch and Oboko, 2012). Moreover, Vosloo, (2012) and Mtebe and Raisamo, (2014) argue that mobile telephony is high. However they argue that the leverage from the mobile devices for mLearning is low.

Nonetheless, Wu, Wu, Chen, Kao, Lin and Huang (2012), indicate that there are encouraging results in application of mLearning in education observing that 86% of the 164 mLearning studies they evaluated, show positive outcomes in general. Park et al. (2012) assert that, there is an agreement that mLearning brings new prospects that can improve the learning process. The current study examines some of the learner determinants of adoption of mLearning including; Learner characteristics, self-efficacy, attitude, behavioural intention, technology use and institutional factors. This have also been studied by other researchers in different contexts. Learner characteristics (Elogie, 2015; Al-Ghaith, Sanzogni & Sandhu, 2010), self-efficacy (Schunk, 2008; Mahat, 2012), attitude, (Zhao & Cziko, 2011; Al-Fahad, 2009) behavioural intention, Kim and Kim (2012) technology use (Henderson & Yeow, 2012) and institutional factors (Franklin & Peng, 2008).

1.1.1 Learner Characteristics and Adoption of mLearning

Pappas, Mikalef, & Giannakos (2016) indicate that characteristics refer to learners' gender, age, and level of education. Elogie (2015) extend the characteristics in addition to those mentioned by Pappas et al. to include; educational experience and experience with Information and Communication Technology (ICT) used for educational purpose. Learner characteristics have an impact on the possibility of learners adopting a technology to support their studies (Al-Ghaith, Sanzogni & Sandhu, 2010; Adegbija, & Bola 2015). It is thus, imperative that instructional designers understand learner characteristics in order to develop content based on the level and learning environment of the beginner. The appropriate pedagogical approaches for mLearning should be selected based on learner characteristics (Ozdamli, 2012).

End users' characteristics including previous experience have been identified as important factors in technology adoption theories and have also been examined widely as moderators of the relationship between the various antecedents of adoption (Pappas, Mikalef & Giannakos 2016).

Although there is a general agreement that learner characteristics are likely to influence the adoption of a technology there exist, conflicting evidence with regard to the nature of influence (Pappas et al. 2016; Elogie, 2015). For example, a research carried out by Padachi, Rojid, & Seetanah (2008) revealed that there were no significant differences between technology adopters and non-adopters in terms of demographic variables.

1.1.2 Learner Self-efficacy and Mobile Learning Adoption

The second variable in this study is learner self-efficacy. The use of mobile phones in the mLearning environment is either enabled or constrained by the learner self-efficacy (Koole, 2009). Learner self-efficacy therefore becomes a critical determinant in the acceptance and subsequent adoption of Information and Communication Technology (ICT) including mLearning (Kenny et al., 2012; Mahat, 2012). Learner self-efficacy is an individual's judgment of their capability to organize and perform a course of action necessary to perform a chosen task efficiently (Schunk, 2008; Mahat, 2012). It relates to the way individuals determine the choices they make regarding the effort, perseverance and anxiety they experience when engaged with a particular task (Usher & Pajares, 2008). In the current study we define self-efficacy as the learner's ability to competently utilize the mLearning platform.

The association between self-efficacy, and adoption of mLearning has been identified researchers such as Lu and Viehland (2008), and Kenny, Park, Van Neste-Kenny, and

Burton, (2010). In their study, Lu and Viehland (2008) identify mobile self-efficacy as having the highest ranking compared to other factors related to students' acceptance of mLearning. A cross-sectional study by Kenny, et al., (2010) conducted among nursing students and staff showed that the respondents had a very high level of mobile self-efficacy thus the acceptance of its use. On the other hand, the study by Tsai, Tsai, and Hwang (2010) showed that learners have a positive self-efficacy of using Personal Digital Assistants (PDAs) in a ubiquitous learning context. These studies all point to the significance of the learners' self-efficacy in the adoption technology.

While significant research exists on learners' self-efficacy concerning computer technology and online learning (Kao & Tsai, 2009; Koh & Frick, 2009; Liang & Wu, 2010), it does not seem to have been examined in detail in mobile learning situations. Furthermore, Claggett & Goodhue, (2011) and Moos & Azevedo, (2009) allude to the importance for researchers to examine self-efficacy in order to inform the implementation of mLearning .

1.1.3 Learner Attitude and Mobile Learning Adoption

The next variable is learner attitude. Learner attitudes are a key feature of learner usage and adoption of technology. Learner attitude towards mobile learning (mLearning) is an essential consideration for successful adoption of the mobile learning process. It is an integral concern in learning environments and should include learner psychological conditions such as attitudes (Hwang, Shi, & Chu, 2011; Al-Fahad ,2009; Traxler, 2013). Indeed, learner attitude has been identified as a critical determinant of technology adoption in eLearning courses (Al-Adwan, Al-Adwan & Smedley 2013; Hussein, 2017) and in use of social software (Ahmed, Kamal, Nik Suryani & Tunku ,2011).

Learner attitude is a key feature to usage and adoption of technology in teaching and learning . Therefore, users' attitudes play a critical role in acceptance or rejection of a learning technology (Almasri ,2014). Learner attitude has also been found to relate to learner performance and has substantial influence on technology-based adoption (Zhao & Cziko, 2011; Al-Fahad, 2009).

In general, it is important to examine user attitude towards the usage of any technology prior to the development learning platforms (Al-Emran & Shaalan, 2015). Researchers, such as Al-Fahad (2009); Bechrakis, Gialamas, and Barkatsas (2011) established that learners who have favourable attitudes towards using mobile devices for educational purposes are likely to adopt mobile devices to study. Fozdar and Kumar (2007) in a study on learners' attitudes towards the effectiveness of mobile learning found that delivering education using the mobile phone could be useful in enhancing retention rates. This is because mobile phones expand the teaching learning system.

Attitude affecting usage of computers, the internet and mobile phones has been measured by several studies (Liu, Han, & Li 2010; Teo et al.; 2008; Tai & Ting, 2011). However, studies from different contexts on learners' attitudes towards the use of mLearning have produced dissimilar results. For example , Khaddage and Knezek (2013) indicated that in the United States of America, learners were more positive towards the use of mLearning technology in comparison to learners in the United Arab Emirates. Our study sought to establish the learner attitudes towards mLearning in the Kenyan context among health care trainees.

1.1.4 Behavioural Intention and Mobile Learning Adoption

The fourth variable for this study is behavioural intention. Behavioural intention to adopt mLearning is the learners' internal desire to use mobile technology. For instance, Kim and Kim (2012) reported a positive relationship between users' intention to use and their actual use of mobile services. However, the accessibility of mobile technologies is not a guarantee of their adoption for teaching and learning (Kukulska-Hulme, 2007). Liu, et al. (2010) contend that, the success of mobile learning depends on human factors in the use of mobile devices.

However, because it is virtually difficult to measure actual adoption, many studies have used intention as a proxy for actual usage to investigate diffusion of an innovation (Shin, 2011). Research investigating the factors impacting on user behaviour and mobile adoption is therefore limited (Kim & Kim 2008). This research aims fill this void by investigating the factors that influence the behavioural intention of the adoption of Mobile Technology in health education.

This study used the Unified Theory of Acceptance and Use of Technology (UTAUT), which was developed by Venkatesh et al. (2003). The model was designed through an evaluation and consolidation of the concepts of eight models that had been used to elucidate Information System (IS) usage behaviour. The theory is premised on four constructs which include performance expectancy, effort expectancy, social influence and facilitating conditions. Al-Hujran et al. (2014) contend that the constructs are direct determinants of usage of any technology.

The UTAUT theory has been used to explain the factors affecting the adoption of different technologies such as mobile services and devices adoption (Al-Hujran & Migdadi, 2013; e-government adoption (Al Awadhi & Morris, 2008; Gupta et al. 2008), and rarely in the mLearning context (Wang et al. 2009). However, as UTAUT was originally developed to explain employee technology acceptance and use in the organizational context, it is important to explore how it can be extended to other contexts such as mLearning where the use of technology is voluntary (Venkatesh et al. 2012).

1.1.5 Technology Use and Mobile Learning Adoption

The fifth variable for the study is technology use. The type of technology being used to deliver learning impacts end user adoption of that technology (Henderson & Yeow, 2012). Despite numerous opportunities offered by mobile learning in education, it is not without technology related challenges. For example, Aderinoye, Ojokheta and Olojede (2007) and Croop, (2009) contend that device related factors such as battery life, cost and access to internet affect end user adoption While mLearning offers increased flexibility, learners may be constrained by small screen sizes, limited input and output capabilities, weak processing power, and limited memory (Wang. Wu & Wang, 2009).

Other major barriers, relate to the personal nature of mobile devices. Many foresee challenges associated with creating content (Liu, Han, & Li, 2010; Vosloo, 2012). However, advancements in technology, an increase in smartphone ownership in combination with a decrease in cost, are quickly eliminating this concern. Others argue that the personal nature of mobile devices may hinder collaboration by isolating users from meaningful social interactions (Kukulska-hulme, 2007; Dieterle et al., 2007). There are still significant challenges of scale, sustainability, inclusion and equity in all their different forms in the

future, and of context and personalization in all their possibilities, of blending with other established and emerging educational technologies and of tracking the changes in technology (Traxler, 2009).

Choosing the appropriate platform is another difficulty facing course developers. If an institution decides to produce materials for one type of phone such as the iPhone, students without this type of phone must either purchase the specified device and mode of connectivity for it or opt out. Purchasing specific devices for students or expecting them to have specific devices is simply not fiscally realistic for most public institutions (Caudill, 2007).

Clearly, the presence and accessibility of mobile technologies do not guarantee their full potential will be realized in educational contexts (Liu et al. 2010). It should be noted that, the success of mobile learning depends on human factors in the use of mobile devices (Kukulska-hulme, 2007).

1.1.6 Institutional Factors and Mobile Learning Adoption

Institutional factors are critical in improving learners' attributes. Indeed, the need for institutional technical support in mobile learning is emphasised in literature (Franklin & Peng, 2008). Indeed, according to Plomp, Anderson, Law, & Quale, (2009) access to ICT infrastructure is an essential condition for successful integration of ICT in education. Notably, effective adoption and integration of ICT into teaching and learning depends mainly on the availability and accessibility of ICT resources including hardware, software.

An individual’s adoption of innovation not only depends on individual attitudes but also on organizational policies, approaches and actions. Organizations need to provide facilitating conditions, which include the extent and type of support provided to individuals that would influence their use of innovation. Facilitating conditions are believed to include the availability of training and provision of support. Organizational factors include; training, managerial support, and incentives. Organizational influences can motivate employees to adopt an innovation (Lewicka, 2011).

The mobile learning platforms is also critical in establishing whether mLearning is adopted by the end user. Tondeur, Valcke, and van Braak, (2008) argue that access to software and hardware is as imperative as is the use of appropriate programmes to support teaching and learning. Access to appropriate technology means that the user is able to get proper utilization of the technology (Friedhoff, 2008). Institutional support in provision of the infrastructure is therefore, an important aspect of mobile learning adoption. Indeed, Trinder (2012) contend that the for mLearning to thrive, institutional support for the associated technology is critical.

1.1.7 Mobile Learning Adoption

Mobile learning adoption refers to learner`s acceptance and use of mobile telephony as a learning technology. It is learning accomplished with the use of small, portable computing devices McConatha and Praul (2008). Mobile devices allow learners to more easily carry reference and communication tools with them into real-world environments. This flexibility permits frequent dialogue with experts and peers, just-in-time retrieval of information, documentation of personal experiences, and integration of course-based knowledge into aspects of the learners' daily lives-all permitting learners to receive feedback and assess their progress (Koole, 2010).

Several studies reported both competence and ease in using the devices and performing the learning tasks as indicators of adoption (Hsu, and Lin, 2008). Cavus and Ibrahim, (2009) and Al-Fahad, (2009) contend that using mobile devices for learning was convenient and allowed learning to be flexible because of the movability and convenience linked to mobile applications. Additionally, student perceptions of mobile learning were reported as positive indicators of adoption (Al-Fahad 2009; Wang 2009; Cavus & Uzunboylu, 2009;)

Other studies have shown positive outcomes in the utilization of mobile learning technologies in education and specifically in healthcare education. Kenny et al. (2009) suggest that mobile learning is in particular, promising for health care professionals who are finalising their practical in remote communities. This is because their supervisors can monitor their progress using mobile devices. In such cases, learners could have access to a variety of tools including reference guides and medical experts

1.1.8 Amref Health Africa mHealth Programme

The Health Enablement and Learning Platform (HELP) project is one of the projects within the mHealth programme under the Amrefs' Directorate of Capacity Building. Amref Health Africa is an international African organization that was founded in 1957 and is headquartered in Nairobi, Kenya with country offices in Eastern, Southern and Western African regions. The project is a joint initiative of Amref Health Africa, Accenture Foundation, Safaricom, M-Pesa Foundation and Mezzanine. The mobile learning solution was deployed via the user phones (majority being basic mobile phones) and contains key health messages required by Community Health Volunteers (CHVs) in improving their knowledge on their roles and responsibilities in order to improve the health status of the communities they serve. These

key messages are delivered via SMS and Interactive Voice Recordings (IVR) over the safaricom network. The goal of the project was to deliver an integrated mobile learning and community health services platform to empower, train and motivate community health volunteers.

The HELP project provided Ministry of Health-approved training content to CHWs, using a mobile learning methodology on basic mobile technologies that allowed all health workers access to learning opportunities and enablement tools. This complemented initial face to face training, enabling CHWs to learn at their own pace and with their own mobile devices whilst in the community, providing for both the interpersonal and community aspects of learning while the reach and continuity of mobile-based learning. At the conclusion of the project, the completion rate was 80%, and CHW feedback was very positive. Phase II build on the foundational work completed in Phase I, and scaled up the mobile training from 318 to 3081 CHVs and 60 Community Health Extension Workers (CHEWs) in three different geographic settings (nomadic, rural and urban across thirteen counties) in a two-year period starting September 2014 to August 2016 (Amref Health Africa 2015).

1.2 Statement of the Problem

Distance education has continued to open up new approaches of reaching learners which include mLearning. mLearning has the prospect of enabling learners to integrate learning activities into their everyday lives. The usage of portable devices for learning opens up opportunities for those who may otherwise not access education due to separation from learning institutions in both time and space (Umoru and Okeke, 2012; Yordanova, 2007). Moreover, mLearning brings innovative approaches and expands the learning process (Park Nam & Cha, 2012; Kalinic Arsovski, Arsovski & Rankovic 2014).

Mobile devices infuse our daily lives, providing unparalleled access to communication and information. As the power, functionality and affordability of these devices increase, so does their potential to support learning in new ways. Innovative mobile learning initiatives from around the globe have highlighted this potential (Fritschi & Wolf, 2012; Lugo & Schurmann, 2012). However, the adoption of mobile learning technologies to augment the learning process is still not widespread in spite of its potential (Vosloo, 2012; Mtebe and Raisamo, 2014; El-Hussein & Cronje, 2010). There is therefore, need for first hand research to investigate why adoption of mobile learning technologies in education is still not widespread. Lu and Viehland, (2008) and Mtebe and Raisamo, (2014) have pointed at the need to initiate a stream of research that examines the adoption of mLearning applications specifically at this early stage in its development.

The integration of technology in teaching and learning has grown as educators continue to establish ways of expanding opportunities for the learners (Collins, & Halverson, 2010; Kukulska-Hulme, & Shield, 2008). Nevertheless, investing in new technology is not only expensive but also time consuming (Birch & Burnett, 2009). The cost is even higher when the learners, who are the end users resist the new technology (Birch & Burnett, 2009; De Wit, Heerwegh, & Verhoeven, 2012). Consequently, it is important to establish user adoption when planning for new technology such as mLearning (Kim, Chan, & Gupta 2007; Wu, Wang, & Lin, 2007). Existing research on adoption of technology provide meaningful insights for introduction of mLearning, however, the findings may be too general for mLearning instructional designers (Akour, 2009; Uzunboylu & Ozdamli, 2011). Extrapolations from previous research with a different focus will however, provide precedents that are useful in this study.

Various aspects of adoption of Information and Communication Technology (ICT) in teaching and learning have been studied in Kenya; Gakuu (2006) studied the adoption of ICT in distance education among lecturers at the university, Keiyoro (2010), investigated the ICT adoption in science education at secondary school level. Mulwa (2010) on the other hand, focused on institutional and technological factors influencing adoption at the secondary school level. However, although the aforementioned studies were conducted in Kenya, and are related to adoption of technology, none of these studies specifically explored end user adoption of mobile learning. This is one of the gaps in research that the current study seeks to fill. Moreover, in spite of the wide spread usage of mobile telephony in health care service delivery there is limited evidence of what works, how, and in what contexts. The evidence for what works or does not in mHealth is yet to be vigorously assessed and established (Lester, Ritvo, Mills, et al. 2010; Cain, & Gradisar, 2010). This gap also contributed to the choice of the current study whose unit of analysis are community health trainees.

Having an understanding of the determinants of the end users' acceptance of mLearning is important. This is because one cannot realize the full potential of new technology if it has not been accepted by the end users. This study therefore, seeks to establish learner determinants of mLearning adoption. The current study will seek to answer question on the influence of learner characteristics, behaviour and technology use on adoption of mLearning. In effect, the study will address the gap in research on end user adoption of mLearning in Kenya.

1.3 Purpose of the Study

The main purpose of the study was to examine learner characteristics, learner behaviour, technology use and adoption of mobile learning among community health trainees for the

mHealth training programme by Amref Health Africa in Kenya. The study places emphasis on learner characteristics, behaviour including learner self-efficacy and attitudes, technology use as well as the institutional factors in order to find out the extent to which community health workers are ready to adopt mobile learning technologies.

1.4 Objectives of the Study

The study was guided by the following objectives:

i. To assess effect of learner characteristics on adoption of mLearning for the mHealth community health training programme in Kenya.
ii. To determine the effect of learner self-efficacy on adoption of mLearning for the mHealth community health training programme in Kenya.
iii. To evaluate the effect of learner attitudes on adoption of mLearning for the mHealth community health training programme in Kenya.
iv. To establish the effect of learner behavioural intention on adoption of mLearning for the mHealth community health training programme in Kenya.
v. To determine the effect of technology use on the adoption of mLearning for the mHealth community health training programme in Kenya.
vi. To evaluate the effect of institutional factors on adoption of mLearning for the mHealth community health training programme in Kenya.
vii. To determine the effect of combined learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use on adoption of mLearning for the mHealth community health training programme in Kenya.
viii. To determine the moderating influence of institutional factors on the effect of learner characteristics, self-efficacy, learner attitude, behaviour intention and

technology use on adoption of mLearning for the mHealth community health training programme in Kenya.

1.5 Research Questions

The study was guided by the following research questions:

i) How does the learner characteristics affect adoption of mLearning for the mHealth community health training programme in Kenya?

ii) How does the learner self-efficacy affect adoption of mLearning for the mHealth community health training programme in Kenya?

iii) How does the learner attitude affect adoption of mLearning for the mHealth community health training programme in Kenya?

iv) How does learner behavioural intention affect adoption of mLearning for the mHealth community health training programme in Kenya?

v) How does technology use affect adoption of mLearning for the Amref the mHealth community health training programme in Kenya?

vi) How do institutional factors affect adoption of mLearning for the mHealth community health training programme in Kenya?

vii) What is the combimed effect of learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use on adoption of mLearning for the mHealth community health training programme in Kenya?

viii) What is the moderating influence of institutional factors on the effect of learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use on adoption of mLearning for the mHealth community health training programme in Kenya?

1.6 Research Hypotheses

The study was guided by the following hypotheses;

$H_{1}1$:Learner characteristics have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

$H_{1}2$: Learner self-efficacy has a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

$H_{1}3$: Learner attitude has a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

$H_{1}4$: Learner behavioural intention has a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

$H_{1}5$: Technology use has a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

$H_{1}6$: Institutional factors have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

$H_{1}7$: The combined influence of learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

$H_{1}8$: The moderating effect of institutional factors on the relationship between learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

1.7 Significance of the Study

The findings from this research are expected to expand the existing body of knowledge on mLearning by providing empirical evidence on the influence of learner behaviour, technology use and technology use on learner adoption of mLearning.

It is envisaged that the results of the current study will inform the up scaling of the current mHealth initiatives in the health sector. By identifying the determinants of learner acceptance of mLearning, content developers, instructional designers and mLearning platform designers will identify important behavioural and technology related factors that determine learner adoption of mLearning. The findings of this study are expected to help improve future mLearning programmes.

The research will benefit educational institutions offering programmes by Open and Distance and eLearning (ODeL). Studying the factors influencing of adoption of mLearning in the health care training for community health trainees programme in Kenya will provide information that could inform ODeL to include mLearning across the education sector in general. By providing information on factors influencing adoption of mLearning, the study will help inform such institutions by identifying possible pitfalls and successes in initiating mLearning programmes. It is hoped that the findings of this study will also inform mLearning instructional designers and implementing faculty to design mLearning platforms and content that is acceptable to learners.

This research provides university administrators and educators with an understanding on the factors that influence student acceptance of mobile learning and the capability to build

strategies and policies that incorporate these factors into planning and design phases of mobile learning system implementations.

It is hoped that the results of the study will benefit educationists, eLearning experts, and institutions offering ODeL programmes and mLearning content developers in identify possible gaps in current programme. Such institutions may find the recommendations of the current study useful. It is also expected that the finding of this study will help inform policy makers in the field of education in general and health education as they formulate appropriate policy to guide successful implementation of mLearning. The study is expected to inform policy makers of the effectiveness of the current efforts in integrating mobile learning in health education. This research will be valuable to researchers interested in mLearning as it aims at filling the gap in research on integration of mLearning in health education. It is hoped that the findings can be generalised and applied to inform adoption of mobile learning across institutions of learning.

1.8 Scope of the Study

This study focused on learner behaviour, technology use and adoption of mobile learning for the mHealth community health training programme by Amref Health Africa in Kenya. The study sampled Community Health Workers (CHWs) (renamed Community Health Volunteers-CHVs) who have taken part in the mHealth programme across three counties. The study was conducted in six counties stratified into Urban (Nairobi and Kisumu), rural (Kitui and Kakamega), nomadic (Samburu and Kajiado). The classification of the counties was predetermined by the project and therefore, the study could only be conducted in locations where trainees participated in mLearning.

1.9 Limitations of the Study

The anticipated limitations to this study included accessing the Community Health Volunteers. The effect of this limitation was mitigated by using training records available in Amref Health Africa as well as use of the snowballing method to access the beneficiaries of the mHealth programmes. The contacts of the County Focal Persons for Community Health Strategy were also useful in providing information on county community health forums for the CHVs.

1.10 Assumptions of the Study

The study was based on the assumption that the respondents sampled for the study would cooperate and provide honest and objective information on the learner behaviour and technology use in adoption of mLearning. The study was also premised on the assumption that the selected mHealth programme is adequate to provide information for the current study. It was also assumed that the results of the current study would be generalizable and could be used to inform mLearning adoption in other sectors of education.

1.11 Definition of Significant Terms Used in the Study

Adoption of mobile learning	Refers to the learners' acceptance of mobile learning platform. Adoption in this study is seen as a continuum.
Behavioural Intention	Behavioural intention is a subset of learner behaviour that refers to the willingness or internal desire to use mobile telephony for learning.
Community Health Trainees	Community Health Trainees refers to the Community Health Volunteers (formerly Community Health Workers) who were trained using the Amref Health Africa, mHealth

	programme for phase I and II.
Institutional factors	Those factors provided for by the institution (Amref Health Africa) to enable the learner access and use the MLearning Platform. Such factors will include; training and mLearning content
Learner Attitude	Refers to the learners' mental positions towards mLearning including towards the device and content.
Learner Behaviour	These are the learner related psychological predispositions that may inform their decision to adopt mobile learning platforms including; learner self-efficacy, attitudes and behavioural intention.
Learner Characteristics	Refer to those traits of an individual such as age, gender, experience and prior knowledge which influence their adoption of mobile learning.
Learner Self-efficacy	Refer to the ability of the learner to use mLearning platforms without the need of regular technological assistance. It includes the learners' drive to use mLearning, mLearning skills and prior mLearning skills.
Lerner adoption	In this study learner adoption refers to learner acceptance and usage of the mLearning Platform, ease of use mLearning Platform, consistent use mLearning Platform, relevant skill in handling mLearning and the readiness to devote extra time for mLearning.
Mobile Health (mHealth):	Refer to the provision of health information via mobile and wireless technologies through mobile learning g platforms.

Mobile Learning (mLearning)	Refer to learning activities that use mobile devices such as the mobile phone and tablets. Mobile learning was limited to utilization of learning management system such as to accessing learning resources or collaboration facilitators and other learners on using a mobile learning platform with the intention of gaining knowledge and skills.
Technology use	As used in this study technology use refer to the mobile device related technology that may determine the individuals', adoption of mobile learning devices including; the device functionality including, its ability to connect to the internet, access to network, battery life and access to power as well as the screen size. It will also include technology medium used to deliver the mobile learning content.

1.12 Organization of the Study

The study consists of five chapters. Chapter One presents the background to the study, statement of the problem, purpose of the study, objectives of the study, hypothesis of the study, significance of the study, limitations of the study, delimitation of the study, assumptions of the study, definition of significant terms and the organization of the study. Chapter Two detailed the literature review which includes a review of literature on the concept of mobile learning, integration of mLearning in health education, mLearning content, Interactivity in mLearning, Mobile medium functionality, learner characteristics, learning outcomes as well as, theoretical and conceptual frameworks of the study. Chapter Three is the research methodology which covers the research design, target population, sample size and

sampling procedure, research instruments, study pilot, reliability of research instruments, validity of research instruments, data collection, data analysis procedures and the ethical considerations for the research. Chapter Four contains data analysis, presentation and interpretation. Chapter Five presents the summary of findings, discussions, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature on learner behaviour, technology use and adoption of mobile learning. The chapter will detail literature on the learner characteristics including, gender, age, professional experience and academic achievement. The chapter will further cover literature on learner self-efficacy including; training, feedback, frequency of use, motivation, dependency, prior knowledge. Literature on learner attitudes towards mobile learning, content and towards the support services was covered. Literature on technology use such as device functionality including connectivity and network access as well as content delivery technology used is detailed. The chapter further explores literature on institutional factors influencing adoption of mobile learning such as resources, structures, organizational culture, and content development. Review on adoption of mLearning was detailed including the indicators of adoption such as acceptance of mLearning platform, ease of use mLearning platform, consistent use mLearning platform, relevant skill in handling mLearning and readiness to devote extra time for mLearning. The chapter will also present gaps in literature and a summary of the literature.

2.2 Adoption of Mobile Technology in Learning

Mobile Learning (mLearning) refers to the acquisition of any knowledge and skill through using mobile technology, anywhere, anytime. The use of mobile learning, especially text messaging via the cell phone, could be used to informally address problem based learning Lee & Chan, (2007). Research shows the interest in and the use of mobile learning as a main trend in education (Kukulska-Hulme, 2007). Mobile learning help individuals combine formal and informal learning and accomplish their studies across life transitions (Peng, Su,

Chou & Tsai, 2009.) Mobile devices are used in language learning, literacy, medical training, music composition, and education (Taleb & Sohrabi, 2012; Bankole, Bankole & Brown, 2011; Doyle 2014). Learners found that learning with mobile devices was enjoyable and thus the likelihood of adoption (Clarke et. al., 2008; Rogers et. al., 2010, Shih et. al., 2010).

mLearning is arguably, one of the fastest growing area in the field of ICTs in education that allows learners access to education. It affords the learner the freedom of time and location presented by the two main characteristics of mobile wireless technologies; mobility and reachability (Mahat, 2012; Kesim & Agaoglu, 2007; Pegrum, 2013; Sharples, et al., 2007; Suki, & Suki, 2011 & Oluoch, 2012, Traxler, 2009). Given this unique benefit of mLearning, its adoption is vital for learning institutions (Mtebe & Raisamo, 2014)

Mobile learning addresses the urgency of individual information acquisition and learning needs. Moreover, the initiative of knowledge acquisition is based on an information seeker's request and the information is obtained immediately. Another key feature of mobile learning is that, a mobile learning setting enables information seeking and learning to occur when and where it best fits individual needs. Wireless devices also provide interactivity of the learning process besides providing broader access to experts and knowledge than is available through other distance learning technology. Indeed, Traxler, (2009) argues that mobile learning was initially considered only as a subsidiary of eLearning, mLearning but it is establishing its own identity globally with an increase in pilot studies and initiatives which are changing the way mobile learning is understood.

The education of health care professionals in the context of a rapidly changing health care system is a prime example of how the mobility of learners within a variety of real life

learning environments has posed increasing challenges and where mobile technologies have the potential to support and enhance teaching and learning. The high acuity and pace of practice in institutional environments, combined with an explosion of knowledge and technology, increasingly requires practitioners to access and process clinical data efficiently by drawing on current resources to support safe care and evidence-informed practice at the point-of-care. Moreover, the shift of client care to the community requires that the education of health care professionals take place increasingly in this more autonomous and diverse practice environment where resources are not readily accessible, where client acuity is increasing, and where more traditional methods of directly observing and working with students are not as feasible (Kenny, 2009).

Mobile learning adoption can be measured using the Technology Adopter Category Index. The Technology Adopter Category Index was developed by Rogers (2003). Five categories of adopters are defined by this index (Innovators, Early Adopters, Early Majority, Late Majority, and Laggards). The index suggest that the adoption of an innovation follows an S-curve when plotted over time.

2.3 Learner Characteristics and Mobile Learning Adoption

Demographic characteristics such as gender, age, level of education, work experience and duration of exposure to mLearning influence on adoption of technology in general and specifically mLearning (Laukkanen and Pasanen, 2008; Siddiqui, 2008). Different studies present different results on the influence of gender on adoption of technology. For instance, Wei and Zhang, (2008) point out that gender plays an important role in technology adoption and argue that when men decide to use technology, their decision is often strongly influenced by the perceived usefulness of the technology in comparison with others. They also noted that

the ease of use is the major variable influencing women's decisions to adopt technology. Chen and Wellman, (2004) in a study of internet usage in several countries including China, Korea, Italy, Japan and Mexico established that men were more likely than women to use the internet. It is therefore, clear that user context is an important variable for the outcome of gender influence on adoption of any technology.

Adoption of technology has produced different results in different environments. Studies such as (Laukkanen & Pasanen, 2008; MacGregor & Vrazalic, 2006) show that males are likely to adopt e-service in comparison with females. This is however not the case in Saudi Arabia (Siddiqui, 2008) where a bigger number of females were likely to adopt compared to males. This difference is attributed to the nature of the Saudi society where the female tend to accomplish her necessities from home using internet (Siddiqui, 2008). The aforementioned literature shows that cultural contexts play a part in the outcome of gender influence on adoption of technology.

Other gender differences regarding technology adoption are noted by Liao, Chen, & Yen, (2007) who observed that gender has a significant effect on adoption. Equally, Evans, Hopper, Knezek, and Jones, (2013) found a significant relationship between gender and smartphone usage, however, they contend that due to the small sample size, the results are not conclusive. Evans Hopper, Knezak and Johns. (2013) further indicate the need to refine the instrument used, as well as increase the sample size in order to determine more conclusively whether gender is a predictor in smartphone task choice.

On the other hand, the findings by Adegbija, and Bola (2015) showed that there is no significant difference in the extent to which male and female undergraduates perceived the

adoption of mobile technologies for learning in three Universities in Kwara State, Nigeria. As mentioned earlier, it is clear that studies on gender and technology adoption have produced conflicting results depending on the context.

Just like gender, the outcome of age and adoption of technology is based on learner context. Findings by Mac Callum (2009) indicate that younger students were more likely to perceive mLearning as a positive way to learn and therefore adopt, this may be due to the constraints that the older generation perceive when using a mobile device. Moreover, Wang, Wu and Wang (2009) also reported that there were some significant age differences in terms of the intended adoption of mLearning. Their findings show a link with computer self-efficacy whereby younger students tend to have higher computer self-efficacy, and therefore the effort they have to put into learning how to use the device does not influence their decision to adopt mLearning.

Another reason given by Wang, et al. (2009) was that younger students had higher levels of self-worth compared to mature students, and therefore, they were more inclined to making an independent decision to adopt an advanced m-learning system without being influenced by those around them. Their study further indicate that the main reason for low adoption among older users is the user friendliness of the user interface which can hamper their use. These findings imply age cannot be looked at in isolation but as part of the technology in use and the contextual environment.

The level of education has been found to be a determinant of technology adoption. For instance, Al-Ghaith, Sanzogni and Sandhu, (2010). Contend that adopter characteristics can

also be found among people who are well educated, with a high level of income, young, male, living in urban areas and have a good knowledge of the English language.

Research also show that prior exposure to Information and Communication Technology (ICT) can influence adoption of technology and related behaviour. Moreover, there is evidence that period of exposure to mLearning technology impacts on use and adoption of mLearning (Pappas et al. 2016). Liao et al. (2008) and Sun et al. (2008), find that anxiety of using an eLearning medium can be a detrimental factor for its adoption. Thus, with frequent use of a specific medium anxiety is lessened and adoption and satisfaction levels are enhanced.

2.4 Learner Self-Efficacy and Mobile Learning Adoption

In the context of mobile learning, learner's self-efficacy has an effect on their use of mobile technology (Wang, et al. 2009; Lu and Viehland, 2008). Learners with high mobile self-efficacy are generally expected to competently use a variety of different devices related to mLearning (Mahat, 2012; Claggett & Goodhue, 2011; Moos & Azevedo, 2009). Studies have also found that individuals with a relatively higher self-efficacy for mobile devices are more willing to make use of such devices to learn and vice versa. This is mainly because when a person's self-efficacy for mobile devices increases, their anxiety for using such devices reduced (Tsai et al. 2010).

A study conducted by Schunk, (2008), revealed that learner perceptions of their own self-efficacy influences their decisions about the choice of activities in which they engage in. Downey and McMurtrey, (2007 add that self-efficacy helps establish the choice of the activities one engages in as well as the effort and persistence they show. They further contend

that, individuals with high levels of efficacy will have a greater chance of succeeding in the given task

Several factors have been found to influence learners self-efficacy in the use of any technology, these factors include intrinsic motivation (Zhao, Lu, Wang & Huang 2011; Deci & Ryan, 2012); level of confidence Claggett & Goodhue, (2011); training, frequency of use, type of use, and feedback (Moos & Azevedo, 2009); user's past ICT experience (Hasan & Ahmed, 2010) and ICT anxiety. (Parayitam, Desai, Desai, & Eason; Saade & Kira, 2007; Beckers, Wicherts, & Schmidt, 2007). In the current study, we focus on four key practical attributes of learner self-efficacy; ability to navigate the mobile learning platform, their ability to use the platform independently, ability to interact with their peers and innovativeness.

Navigation efficacy is the process by which a user explores all the levels of interactivity, moving forward, backward, and through the content and interface screens. A good navigation system will leave the user with little question about where they are in the document and where they can go from there (Tucker, 2008). The user's ability to navigate through a platform is listed as a key driver of use of the platform (Pearson et al., 2007; Melia´n-Alzola and Padro ´n-Robaina, 2006). Similarly, a study by Chen (2015) found that navigation efficacy had significant effect on the learners' perceived usefulness of mLearning. Navigational efficiency, is particularly important, as restrictive visual interface is usually regarded as a major impediment for adoption (Lee and Benbasat, 2003). One way to address this challenge is to leverage multi-media input/output components, such as speech interfaces (Fan et al., 2005).

Another element of self-efficacy in mobile learning is the learners ability interact with fellow learners. A study by Huang and Liaw (2013) indicated that learner satisfaction and subsequent use of the eLearning system can be affected by interactive learning environments and perceived self-efficacy. Mobile learning systems should therefore, be carefully designed to ensure ease of interactivity for the user. The results in another study conducted by Ismail and Azizan (2012) attested that in general, interactivity is viewed as an important factor by the learners in their learning process. Specifically, interaction between students and lecturer was mostly preferred by the students, not only for learning communication, but also as a support to the SMS (Short Message Service)-based learning system. Raban and Litchfield (2007) further suggest the need develop learners' ability to self and peer evaluation, feedback, and review skills using available online tools for teaching and learning.

Additionally, studies have shown that personal innovativeness is another important variables in the new learning environment involving information technology. However, Mahat et al. (2012) suggest that it is important for researchers to investigate personal innovativeness before deciding to implement a learning process that involves the use of the mobile phone for learning purposes. Studies on personal innovativeness in technology have been conducted in various areas such as online shopping (Bigné-Alcañiz, Ruiz-Mafé, Aldás-Manzano, & Sanz-Blas, 2008), virtual learning (van Raaij & Schepers, 2008), blog (Wang, Chou, & Chang, 2010), wireless mobile services (Lu, Liu, Yu, & Wang, 2008). All these studies support the need to assess end user innovativeness as a determinant for adoption of the technology in use.

2.5 Learner Attitudes and Adoption of mLearning

Attitude is an important psychological construct that contributes towards technology adoption. Peters, (2007) found that psychological perspective in mobile communication

technology is generally concerned with people's perceptions, expectations and attitudes. In other cases users' attitudes have been shown to have a major influence on the acceptance of new technology (Venkatesh, Morris, Davis, & Davis, 2003; Zhao & Cziko, 2011).

Studies conducted in different perspectives have examined attitudes toward mobile learning (Al-Fahad 2009; Baya'a and Daher, 2009). Such studies have established that users' attitudes have an impact on adoption mLearning. Research has also shown that a positive attitude towards technology and ability to use the technology for learning are vital and measurable factors in the level of adoption (Zhao & Cziko, 2011). Al-Fahad (2009) whose main aim was to better understand and measure students' attitudes and perceptions towards the effectiveness of mobile learning, established that majority of learners supported the use of wireless networks. This increased their flexibility in accessing resources necessary for independent learning in any place and time.

There exist a link between learner attitude towards use of mobile phone for learning and motivation adoption of mLearning. Wafa and Abu-Al-Sha'r (2009) in their study of university students' attitudes towards cell phone learning environment, established that the use of cell phone in the university learning environment is highly appreciated by both graduate and undergraduate university students. The results of their study revealed that the undergraduate students have positive attitudes towards the learning environment of the cell phone. Similarly, Thatcher and Mooney (2008) analysed the use of cell phone text messaging to send questions to the lecturer during classes or between classes. Their results indicated that students strongly favoured this mode of learning. The students also suggested more future usage of mobile phones in the educational process to enrich their learning experience. Furthermore, the study by Al-Fahad, (2009) on students' attitudes towards the mobile learning in King Saud

University, Saudi Arabia, points to the fact that mobile learning is widely embraced by the student community. Students in this survey changed from passive to active learners who were behaviourally, intellectually and emotionally involved in their learning tasks. Therefore, mobile technologies can be perceived to be effective tools in improving communication and learning experiences.

Learner attitude towards the mLearning content is also a critical determinant for mLearning adoption. Baya'a and Daher (2009) conducted a research to examine the perception of the students in regard to learning of mathematics concepts using mobile phones. The study revealed that the use of the cell phone enhanced positive appreciation of the process of teaching and learning mathematics concepts . This study, showed that learner's change of attitude towards the content impacts on their adoption of the technology in question. On the other hand, Nah, White and Sussex (2008) investigated the potential of using cell phones to browse Wireless Application Protocol (WAP) site for the purpose of learning listening skills. Their study established that learners expressed positive attitudes toward the use of the WAP site. Equally, Wafa and Abu-Al-Sha'r (2009) suggest that the effects of the constant use cell phones for teaching and learning are reflected in students' tendency towards independent learning and adoption of new technology.

Additionally, Lai, Wang, and Lei (2012) identified factors that influence Hong Kong university students' adoption of technology for learning. The foremost predictors of students' technology use for learning were found to include: the compatibility of technology and students' learning styles and needs, the availability of encouragement and support from peers and facilitators, as well as the attitudes toward technology use. Similarly, Sun, Tsai, Finger, Chen, and Yeh (2008) conducted an investigation on the critical factors affecting learners'

satisfaction in eLearning. They reported learner computer anxiety, instructor attitude toward eLearning, eLearning course flexibility, eLearning course quality, perceived usefulness, perceived ease of use and diversity in assessments as the critical factors affecting learners' perceived satisfaction.

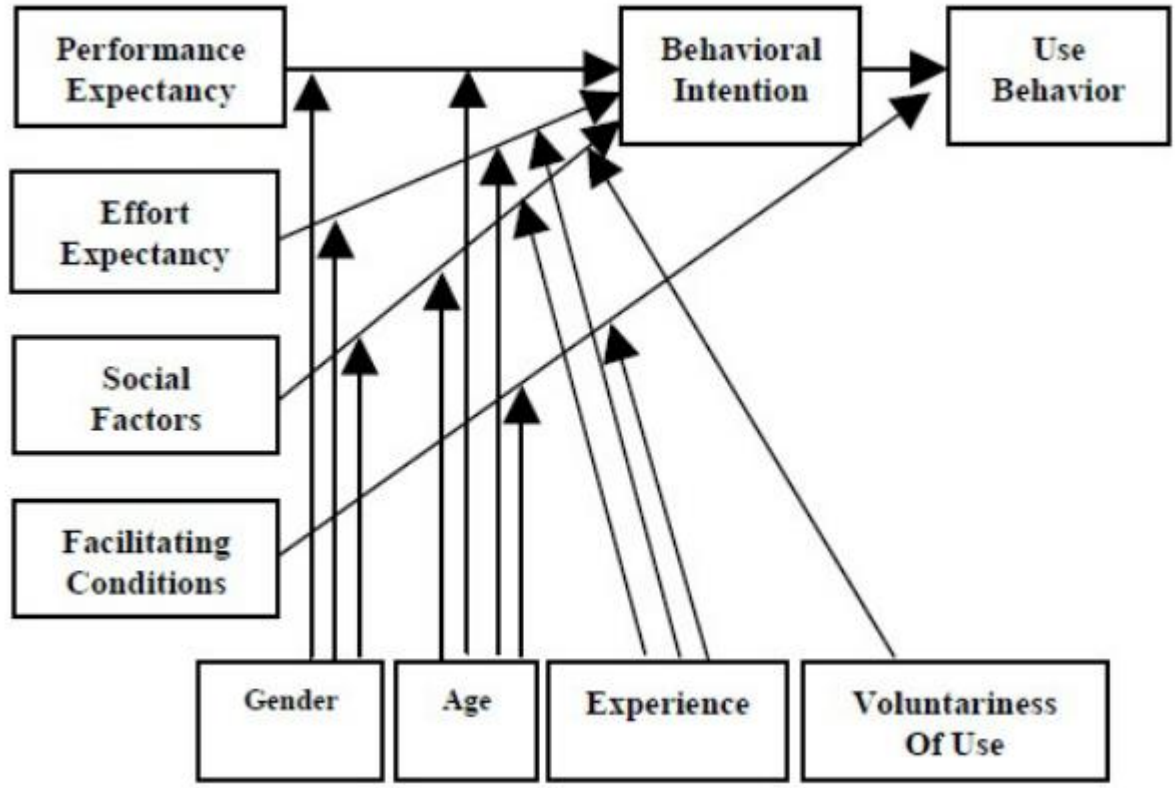
2.6 Behavioural Intention and Mobile Learning Adoption

Intention to adopt is a psychological state of the user arising right before the actual adoption of an innovation. The need to understand factors that contribute towards learners' intention to adopt and use mobile learning is, critical for successful implementation of mLearning in a given context. This will help those who are involved in mobile learning implementation to make mobile services that are relevant and acceptable (Liu, et al. 2010; Kukulska-Hulme, 2007).

To examine the indicators of behaviour intention, the Unified Theory of Acceptance and Use of Technology (UTAUT) is utilized. UTAUT is a comprehensive model that was developed by Venkatesh et al. (2003). UTAUT is considered to be one of the latest models in the theory of technology acceptance. This model was proposed as a theoretical advancement over the existing adoption and diffusion theories (Rana, Williams, Dwivedi, & Williams, 2011). As mentioned earlier, this model synthesized elements across eight well-known technology acceptance models to achieve a unified view of user acceptance (Venkatesh et al. 2003; Al-Hujran, Al-Lozi and Al-Debei, 2014). UTAUT for mobile learning proposes a framework for understanding and predicting factors that may affect individual adoption (Liu & Chen 2008).

The UTAUT consist of four key constructs: According to Venkatesh *et al.* (2003), Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions.

These four constructs are direct determinants of usage intention and behaviour. Moreover, the variables: gender, age, experience, and voluntariness of use moderate the key relationships in the model (Al-Hujran et al. 2014). The UTAUT model is shown in Figure 1.



Source: Venkatesh et al. (2003)

Figure 1: The UTAUT Model

Performance expectancy is defined as the degree to which a learner believes that using mobile learning systems is helpful, in accomplishing tasks quickly, and attain gain in learning outcomes or attain gains in job performance (Alharbi & Drew 2014; Venkatesh et al. 2003). Performance acceptance is a direct determinant of a user's behavioural intention to use an information system, thus it can be validated (Venkatesh et al. 2003). In the context of technology-mediated education, a number of researches have already empirically support a

positive relationship between performance expectancy and behavioural intention (Chiu and Wang, 2008). Hence, in terms of mobile learning, it is reasonable to include performance expectancy into this study.

Effort expectancy is conceived as the degree of ease associated with the use of the particular information system. Alharbi and Drew (2014) define effort expectancy as the degree of ease associated with the use of mobile learning-systems: the ease of using the systems, the flexibility of interaction, and interaction with mobile Learning-systems is clear and understandable. Venkatesh et al. (2003) validate effort expectancy as having a direct impact on a user's behavioural intention to use information systems. Alharbi, and Drew (2014) argue that performance expectancy, effort expectancy and social influence directly impact behavioural intention. Since effort expectancy has been established to lead to improved performance, it should have a direct effect on intention to use and ultimately actual use of technology. Additionally, Chiu and Wang (2008) indicated that effort expectancy was positively associated with performance expectancy in the e-learning context.

In their study, Alharbi and Drew (2014) defined social influence is as the degree to which a student perceives the importance of others believe he or she should use mobile Learning-system. Similar to the previous constructs, social influence is empirically tested to be used as a direct determinate of a user's intention to use an information system (Venkatesh et al. 2003).

The Technology Acceptance model includes perceived usefulness and perceived ease of use as indicators of behaviour intention. Perceived usefulness is the degree to which a person believes that a particular technology will be beneficial to their lives (Chang & Tung, 2008).

Research has shown that if a person believes a new technology will be of benefit to them, they will more likely adopt this new technology (Markauskaite, 2007). Ayoade, (2015) found out that perceived usefulness and perceived ease of use positively and significantly influence students' attitude towards mLearning and in turn Attitude positively and significantly affects intentions to use mLearning. Perceived ease of use is the measure of the degree an individual believes a particular technology is free from effort. Previous research has found a positive effect this perception has on the behaviour intention and perceived usefulness of the new technology (Chang & Tung, 2008). Other external variables on the TAM model that influence behaviour intention, include digital literacy which is the measure of an individual's ability to use digital technology, communication tools, and/or networks to access, manage, and integrate digital resources (Markauskaite, 2007). A user's perceived digital literacy has been consistently reported in the literature as having a positive relationship with the adoption of new technology (Hasan & Ahmed, 2010).

As aforementioned, determinants of adoption of diverse technologies has been studied (Al-Hujran & Migdadi, 2013; Al Awadhi & Morris, 2008; Gupta et al. 2008). However, not much has been studied specifically on mLearning context (Wang et al. 2009). This study was designed to fill that gap.

2.7 Technology Use and Adoption of Mobile Learning

Technology use characteristics affect the diffusion of an innovation and are important factors in influencing an innovation adoption. The devices can provide instant and spontaneous information (Cavus & Ibrahim, 2009; Eteokleous & Ktoridou, 2009). There are times when learners really need to get certain information fast. For example, quick answers to specific questions as definitions, formula and equation. The devices will help the learners to quickly

search for such information. Continuity is another functional aspect. Mobile learning is a learning model that allows the learners to access learning materials anywhere and anytime. To be able to continue with the learning without the constraints of time and location is an important element that affects how learners may be motivated to use their mobile applications (Lan & Sie, 2010). Learners' access to information and learning material does not necessarily stop because of their location. Indeed, learners can access and interact at various places and in a variety of situations.

In the context of medical education and health services, the requirement for mobile devices to deal with medical information and knowledge navigation is essential (Ducut & Fontelo', 2008). Kenny et. al., (2009) adds that mobile learning is particularly promising for health care professionals who are completing their practical in remote communities. Using mobile devices, supervisors can monitor, interact with, and assess a learner's progress when direct observation is not possible. In such instances, learners could have access to a variety of tools including medical reference manuals, patient histories, progress notes, and medical experts. Kho et al. (2006) reported that around 60% to 70% of the medical students and residents use mobile devices (PDAs) for educational purposes and patient care.

Research by Kuo and Yen (2009) and Lai and Chen (2011) suggests that innovation features as perceived by individuals influence of adoption of the specified technology. Specifically, research points out five characteristics that determine the rate of adoption, which include relative advantage, compatibility, complexity, trialability and observability (Chang & Tung, 2008; Lai & Chen, 2011).

Relative advantage is the extent to which an innovation is perceived as being better than its predecessor. There is a high probability of adoption of an innovation, for instance mLearning in the current study, when users perceive the innovation as useful to them. On the other hand, compatibility is the degree to which an innovation is perceived as being in line with the prevailing values, needs and past experiences of possible adopters (Atkin, Hunt, & Lin, 2015).

The third characteristic is complexity. It is described as the level to which an invention is perceived as difficult to utilize. While, trialability, is the level to which an invention is likely to be tried before its adoption. Trialability is central since users may experience trial and error beforehand, lessening the level of user anxiety when the innovation is finally adopted. Lastly, observability is the extent to which the results of an invention can be seen by others. This suggests that if there are no opportunities for observation or exposure, diffusion will take more time (Kuo & Yen, 2009; Lai & Chen, 2011).

Similarly, Song (2007) defines six categories by which course content may be delivered using mobile devices: Pushing: delivering assessments and quizzes without constraints of time and place, messaging: a one-way communication using Short Message Service (SMS), response and feedback: instant two-way communication, file exchange: students and teachers sharing information anytime, anywhere, posting: information presentation, dissemination and annotation mostly done with other devices and classroom communication: students and teachers share information in the form of asynchronous messages.

The first issue of usability is the small screen size. The current mobile devices are designed with the focus to allow users to enter and access structured data like contacts, lists, dates,

financial information, and memos, to send and receive messages, to view documents and pictures, or to access the web (Kukulska-Hulme & Traxler, 2005). A study on using a PDA for learning purposes revealed difficulties in reading due to the poor screen display (Trinder, Magill & Roy, 2005). The small, touch sensitive screens of smartphones can pose problems in navigating the screen with fingers and learners may accidentally select a function such as deleting a document. Secondly, the cognitive and ergonomic issue (Kukulska-Hulme & Traxler, 2005) which is related to the conceptions of differences between using PCs and mobile devices, print material and electronic small size depictions of large texts. Ergonomic issues include the fear of deleting diary entries from the device.

Some students identify usability barriers like small keyboards as barriers to mobile learning (Wentzel, *et al.* 2005). However, technology advancements in virtual keyboards may address this issue (Georgiev, et al., 2004). Small screen size can make viewing cumbersome, cause eyestrain, or be difficult for vision impaired individuals. In addition, web pages are not always designed for small screens (Lawrence, et al. 2008). Small keyboards, storage, and memory, and document editing capabilities may limit mobile academic activities. While some applications such as Google Docs, allow mobile document editing, small keyboard and screen size is still cumbersome (Shudong & Higgins, 2005). This suggests that student mobile activities with limited typing requirements may be ideal for mobile learning

Due to these challenges and many others, some users have negative perceptions towards using these devices for education purposes and make adopting mobile learning difficult (Wang et al. 2009; Vosloo, 2012). There is need to understand factors that contribute towards learners' intention to adopt and use mobile learning is critical for successful implementation in a given context. This will help those who are involved in mobile learning implementation

to make mobile services that are relevant and acceptable. Lawrence, et al. (2008) cites that students report the following negative issues with mobile technology: limited storage, small screens, limited access to online reference material, and slow downloading. Colleges' learning management systems (LMS) such as Blackboard present another technical issue.

2.8 Institutional Factors and Mobile Learning Adoption

There is sufficient research to support the assertion that institutional factors have an influence on adoption of technology. For instance, Yilmaz, (2011) in assessing the technology integration processes in the Turkish education system reported that in providing schools with hardware and internet connections, it is also crucial to provide the schools with technical support with regard to repair and maintenance for the continued use of ICT in schools. Access to ICT infrastructure and resources is a necessary condition to the integration of ICT in education (Plomp, Anderson, Law, & Quale, 2009). Effective adoption and integration of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware, software. Accessibility to technological resources is one of the effective ways to teachers' pedagogical use of ICT in teaching (Plomp, Anderson, Law, & Quale, 2009; Keiyoro, 2010).

It has been suggested that just providing new educational technology to students is not enough and that to get students to utilise that technology they need to be taught the required skills (Plomp, Anderson, Law, & Quale, 2009; Bird & Stubbs, 2008). Another critical role of institutions is motivating the use of technology for teaching and learning. Motivational effects have been noted among learners in institutions and in informal settings (Jones et al., 2007). The motivational quality of mobile learning is a regular theme in the literature and it has been suggested that possibly it is a result of its novelty value.

Indeed, for mobile devices to be integrated into mainstream education it will require institutions to support suitable devices and for students to be willing to adopt the use of mobile devices in educational contexts Trinder (2012). It is argued by (Cobcroft et al., 2006) that institutions should manage the support of mobile learning in a platform that can enable students to use a device of their own. Prescribing the use of particular devices which remove the personal choice which is of considerable importance in device appropriation and acceptance (Jacob and Isaac, 2007). The computing support departments of many institutions are reluctant to allow the connection of student's own devices to their network, often citing security concerns (Attewell, 2008). Computing support departments have been highlighted as a barrier to the introduction of mobile learning (Bird and Stubbs, 2008). It seems highly probably that the most sustainable model for mobile learning is to make us of the devices the student already owns (Traxler, 2008).

Institutions can also be seen as barriers for successful adoption of any technology. For instance, Bird and Stubbs (2008) contend that centralised control of IT in many institutions has been seen as a barrier to the introduction of mLearning. The problem at the institutional level may be lack of expertise to support mobile learning or the effect of institutional policies restricting user privileges to install software (Traxler, 2008).

Learning content is an important factor of mobile learning adoption that is dependent on the institution. Alvarez, Alarcon and Nussbaum (2011) argue that designing and developing learning materials that are suitable for mobile devices may present some difficulties to researchers and educators in learning institutions. There is a huge variety of mobile devices and platforms; therefore, instructional designers for mobile content will be required to make

specific adjustments at the institutional level (Güler, Kılıç, Çavuş 2014). Learning objects must be combined in some package of instructional content. Most widely used standard for content packaging is Information Management System (IMS) content Package, which provides aggregation of learning objects in learning material. Moreover, it enables the delivery of learning design packages from one program to another, facilitating easier delivery, reuse and sharing of materials (Paulins, Balina & Arhipova, 2015).

2.9 Theoretical Framework

Mobile learning is premised on a number of theories, the various functions and size of mobile devices allow them to support different teaching and learning activities (Kearney, Schuck, Burden, Aubusson, 2012; Traxler, 2009). This makes singling out theory to support mobile learning problematic indeed Sharples, Taylor, and Vavoula, (2010) suggest that mobile learning can relate to more than one theory. In this connection therefore, this study will be guided by a combination of theories including the Unified Theory of Acceptance and Use of Technology. This theory is already discussed in detail in this chapter. The theory was developed by Venkatesh et. al., (2003) by combining eight similar technology acceptance models to develop a unified model. The technology acceptance models can be used to assess and gauge students' behavioural intentions and determine the factors which most positively influence students' likelihood to adopt new technologies such as mLearning (Kallaya, Prasong, & Kittima, 2009). Other related theories include the Theory of Reasoned Action (TRA) which supports the assertion that behavioural intention leads to actual behaviour (Williams, 2009).

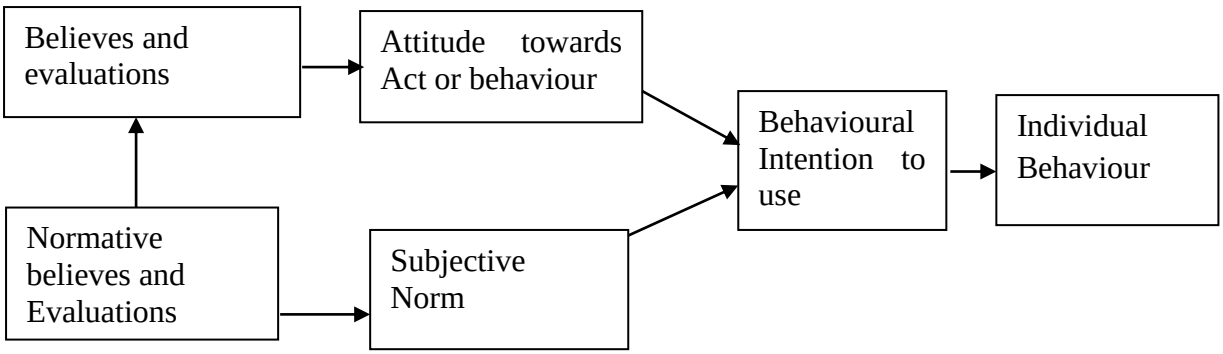
The third theory considered for the current study is the Theory of Planned Behaviour (TPB). This theory stipulates that a persons' perceived ability and resourcefulness influences their

actual use of technology (Wang, Lin, 2006). The final theory that support this study is the Innovation Diffusion Theory (IDT). This theory gives the guidelines on the process of adoption of technology (Straub, 2009; Putzer & Park, 2010). The following section describes the theories in detail.

2.9.1 Theory of Reasoned Action (TRA)

The theory of reasoned action was advanced by Ajzen (1985) The theory postulates that behavioural intentions, which are the direct predictors of behaviour, are a component of clear beliefs about the probability that accomplishment of a specific behaviour will direct one to a specific outcome. The behavioural beliefs are assumed to be the original effect on a person's attitude toward execution specified behaviour, while the normative beliefs effect the person's subjective norm about execution the behaviour (Ajzen & Fishbein, 2005).

The Theory of Reasoned Action has been extensively utilized as a model for the prediction of behaviour. The theory forecasts behavioural intentions and behaviour rather well and is useful for pointing out on how to focus on approaches for changing behaviour (Williams, 2009). The conceptual presentation of the theory is as shown in Figure 2:



Source: Fishbein and Ajzen (1975)

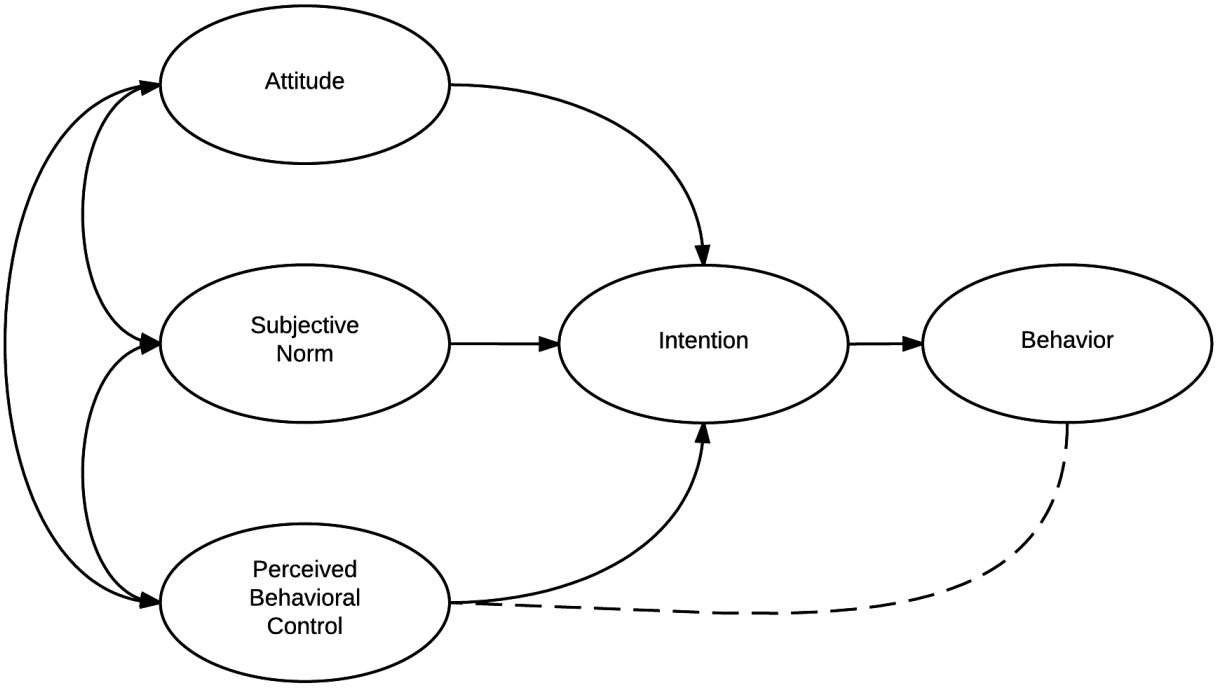
Figure 2: Theory of Reasoned Action (TRA)

The theory of reasoned action has been extensively recognised in explanations of behaviour that are founded a person's choice. The theory has however, been criticized. The main critisism is that it does not take into account external barriers that may impact on behaviour (Mac Callum, 2011).

2.9.2 Theory of Planned Behaviour (TPB)

Subject to the criticism of the Theory of Reasoned action, Ajzen (1991) proposed the Theory of Planned Behaviour (TPB). The TPB include the original two factors of the TRA model; Attitude and subjective norm, and a new factor which is perceived behaviour control. Perceived control is related a persons' perception and assessment of their ability and resources to essentially accomplish a behavioural task. It specifically relates to the control that one has when using technology.

The theory states that people act in accordance with their intentions and perceptions of control over their behaviour, while intentions are influenced by attitudes toward the behaviour, subjective norms, and perceptions of behaviour control. (Wang, Lin, 2006). The theory is modelled in Figure 3.



Source: Ajzen (1991)

Figure 3: Theory of Planned Behaviour (TPB)

The theory of planned behaviour has been successfully applied in a number of studies. For instance, the study by Miesen (2003) which examined the attitude of adults towards reading and its relation with the intended behaviour by applying the Theory of Planned Behaviour. Two of the three major predictor variables in the theory-behavioural beliefs and perceived behavioural control-and past behaviour make substantial and significant contributions to the prediction of the intention to read literary fiction in the six months to come.

The theory of planned behaviour has also been applied to explain mLearning acceptance by Cheon (2012). The findings by Cheon, showed that the TPB explained college students' acceptance of mLearning reasonably well. More specifically, attitude, subjective norm, and behavioural control positively influenced their intention to adopt mobile learning. The results

provide valuable implications for ways to increase college students' acceptance of mobile learning.

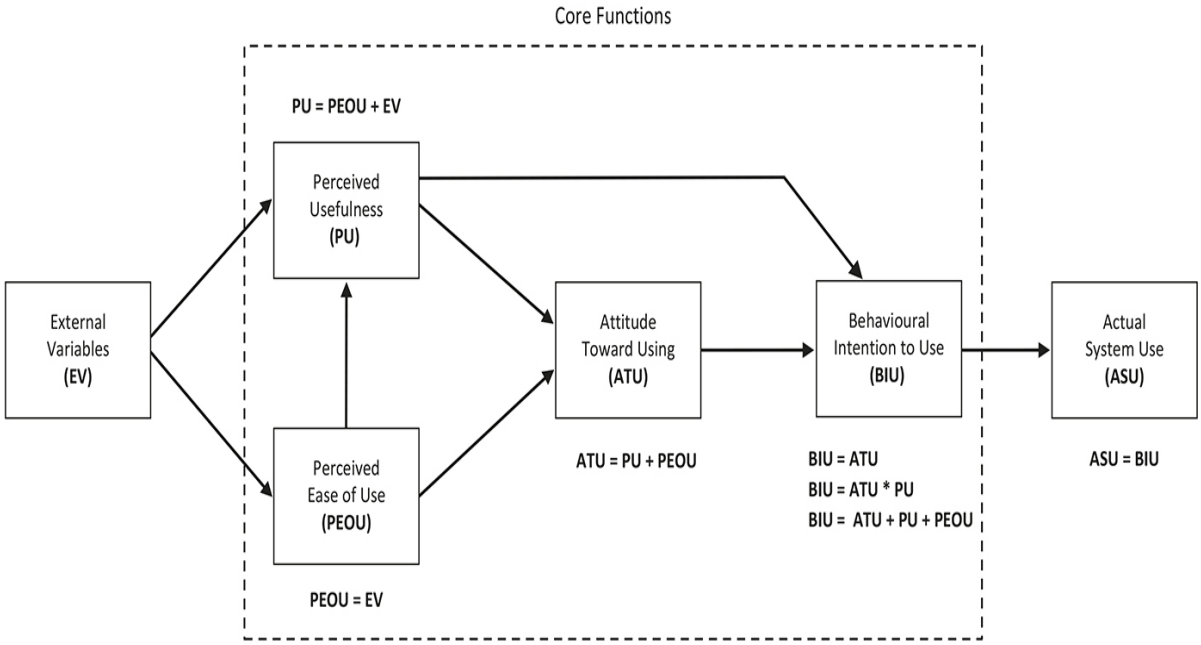
In another related study, the theory has been used to explain how students' beliefs influence students' intention to adopt mLearning. Findings from the by Tagoe and Abakah (2014) which investigated University of Ghana Distance Education students' perceptions toward mobile learning showed that most of the students had mobile phones, and used them for conversation and texting. The TPB explained the students' mLearning readiness very well. Thus, attitude, subjective norm and behavioral control influenced students' intention to adopt mLearning. The results provided valuable information on ways to implement mLearning programs incorporating the voice and needs of students.

2.9.3 Technology Acceptance Model

The Technology Acceptance Model (TAM), an adaptation of the theory of reasoned action specifically tailored for modelling user acceptance of information systems (Davis et al. 1989) Perceived usefulness and perceived ease of use are two of the main constructs of TAM. Perceived usefulness is the degree to which a person believes that using a particular technology would enhance his or her performance (Davis et al., 1989). Perceived ease of use is the degree to which a person believes that using a technology would be free from effort (Davis et al. 1989).

TAM posits that actual system use is determined by behavioural intention to use. In turn intention to use is determined by both attitude and perceived usefulness. Behavioural intention will be affected by perceived usefulness and perceived ease of use. In addition, perceived ease of use also affects perceived usefulness. External variables will influence

behavioural intention indirectly through perceived usefulness and perceived ease of use (Davis et al. 1989). Figure 4.



Source: Davis et al. (1989)

Figure 4: Original Variables in TAM and their Relationship

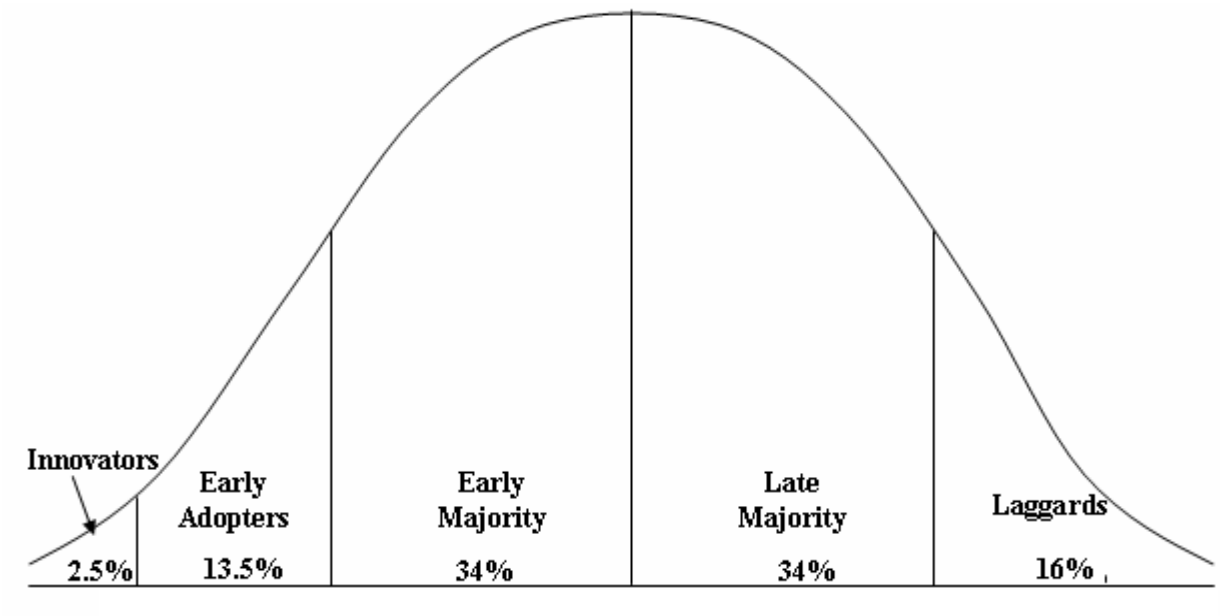
TAM has been applied to many different end-user technologies, such as e-mail (Adams et al. 1992), word processing (Davis et al. 1989) and mobile payments (Mbogo, 2010: Viehland & Leong 2008). Although many studies have explored various aspects of technology adoption, there is no research that specifically explores learner characteristics, behaviour, technology use and adoption of mobile learning. However, extrapolations from previous research with a different focus provide precedents that are useful to this study

2.9.4 Innovation Diffusion Theory (IDT)

Proposed by Rogers (1983), Innovation Diffusion Theory is an all-inclusive structure for understanding persons' adoption. this theory is chiefly significant because it has influenced many other theories of adoption and diffusion (Straub, 2009; Putzer & Park, 2010). The

theory postulates that perceived characteristics of an innovation influence a user adoption behaviour. In detail, the perceived characteristics are relative advantage, complexity, compatibility, trialability and observability. Rogers (1995) stated that these variables are typically capable of explaining 49-87% of variance of innovations adoption.

The Innovation Diffusion theory assists in understanding the user adoption of different innovations in target populations. There are five types of persons that are differentiated from one another on the basis of time dimension. The innovators are people readily willing to imbibe new ideas and products while laggards are sceptical about innovations. Rogers (1995) divided all the adopters into five categories as shown in Figure 5.



Source: Rogers (2003)

Figure 5: Adopter Categorization

Adoption of a new idea, behavior, or an innovation does not happen simultaneously in a social system; rather it is a process whereby some people are more apt to adopt the innovation than others. Researchers have found that people who adopt an innovation early have different characteristics from people who adopt an innovation later. When promoting an

innovation to a target population, it is important to understand the characteristics of the target population that will help or hinder adoption of the innovation. The categories by Rogers are; innovators, early adopters, early majority late majority, laggards (Wani, 2015).

In Innovation Diffusion Theory, the adoption process is inseparable from the diffusion process. Diffusion is described as the adoption progression across a population over time. This theory is used in a several studies, for example, Liu and Li (2010) in their study which entailed examining mobile internet diffusion, they established that motivators of service adoption of different users' groups are different.

On the other hand, Hsu et al. (2007) in their study of evaluating multimedia message service adoption, they established that users' perceptions on the service varied over different diffusion stages. Zhang et al. (2008) established that relative advantage, image, compatibility, result demonstrability, voluntariness and visibility are indirect predictors of e-mail usage. Duan et al. (2010) established that perceived compatibility and trialability have significant influences on e-learning adoption intention in their study on Chinese students' adoption of e-learning. Liao and Lu (2008) found that the predictors of e-learning websites adoption vary with different prior experience. It is clear that from the different studies, there is an agreement that the Innovation Diffusion Theory is valid for studying information systems. However, in the review, it appears that the theory has not been extended to study the adoption of mobile learning technology.

Chang and Tung (2008) combined the innovation diffusion theory and the technology acceptance model. They add two research variables; perceived system quality and computer self-efficacy to propose a new hybrid technology acceptance model to study students' behavioural intentions to use the online learning course websites. The study by Chang and

Tung is evidence that mLearning studies use combined theories to achieve their objectives. In sum, various variables relate to different theories as aforementioned

2.10 Conceptual Framework

The conceptual framework shows the relationship between the study variables Figure 6.

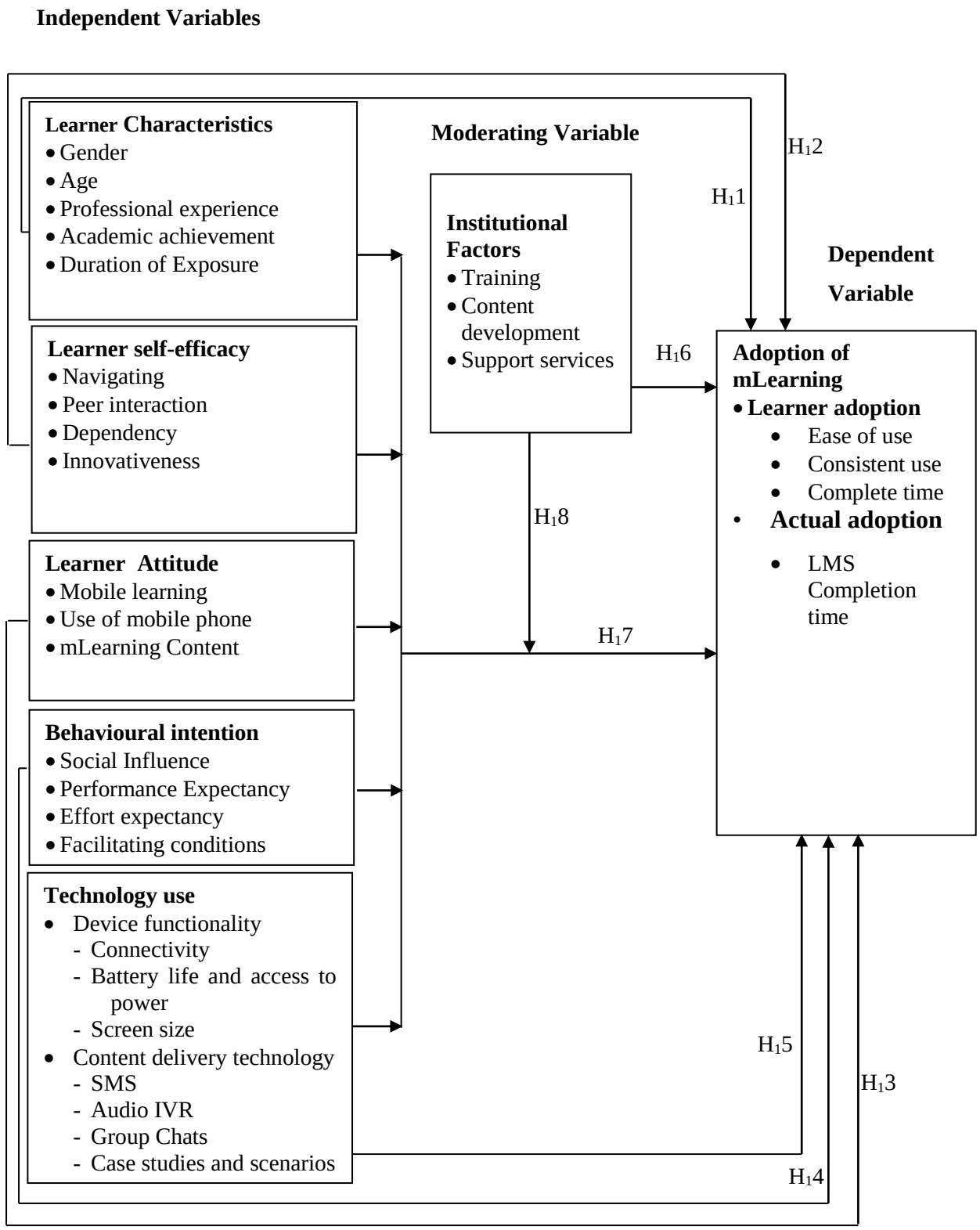


Figure 6: Conceptual Framework

Source: Author (2017)

The conceptual framework shows the conceptual relationship between the research variables; the independent variables, dependent variable and moderating variable. It also indicates the hypothesis that emanate from each relationship.

The first independent variable is learner characteristics and the indicators for this include; gender, age, professional experience, academic achievement. This is evaluated on how it relates to the dependent variable which is learner adoption of mLearning.

The second independent variable is learner self-efficacy and the indicators for this include; training, feedback, frequency of use, motivation, dependency, prior knowledge. This is evaluated on how it relates to the dependent variable which is learner adoption of mLearning.

The third independent variable is learner attitudes and the indicators for this include; attitude towards mobile learning, attitude towards content and attitude towards the support services. This then evaluated on how it relates to the dependent variable which is learner adoption of mLearning.

The fourth independent variable is learner behavioural intention to use mobile learning and the indicators for this include; facilitating conditions, social influence, performance expectancy, effort expectancy, facilitating conditions. This then evaluated on how it relates to the dependent variable which is learner adoption of mLearning.

The fifth independent variable is technology use which includes device functionality options such as; connectivity, network access, battery life and access to power and screen size. It also covers content delivery technology modes such as SMS, audio IVR, group Chats, and case

studies and scenarios. This then evaluated on how it relates to the dependent variable which is learner adoption of mLearning.

The sixth independent variable is the institutional factors with the indicators being; resources, structures, organizational culture and content development. This is then evaluated on how it relates to the dependent variable which is learner adoption of mLearning. The conceptual framework also presents the relationship between all the independent variables (learner behaviour) and the independent variable which is adoption of mLearning. Finally, the indicators of the dependent variable (Adoption of mLearning) are also shown in the conceptual framework.

2.11 Summary of Literature Review

Literature reviewed has highlighted learner behaviour and technology use components that lead to learner adoption of mobile learning. Literature indicates that personal characteristics purpose can influence the adoption of a technology Buabeng-Andoh (2012). Literature also indicate that learner self-efficacy is critical in one's ability to use technology including mobile learning Individuals with high levels of efficacy will have a greater chance of succeeding in the given task (Mac Callum & Jeffrey 2013; Usher & Pajares, 2008; Claggett & Goodhue, 2011)

The literature reviewed reveals that learner attitudes towards mobile learning, content and towards the support services strongly correlate with adoption of technology (Wei & Zhang, 2008; Ally & Stauffer, 2008; Croop, 2009). Regarding technology use the literature reviewed reveals that the use of the mobile technology in learning has both positive attributes and negative attributes. The positive attributes include the fact that devices can provide instant

and spontaneous information (Cavus & Ibrahim, 2009; Eteokleous & Ktoridou, 2009; Cohen, 2010). Among the negative attributes indicated in literature, include the fact that mobile devices have shrinking data storage solutions cost (Williams, 2009) and the low mobile device cost are the key benefits of mobile technology when compared to desktop and laptops (Avraamidou, 2008). Limited availability of broadband wireless may also prohibit access to mobile content (Croop, 2009; Lawrence, et al. 2008). Literature reviewed also indicated that an individual's adoption of innovation depends on organizational policies, approaches and actions. Organizations need to provide facilitating conditions, which include the extent and type of support provided to individuals that would influence their use of innovation (Aderinoye, et al., 2007).

Literature revealed that several factors lead to adoption of mobile learning. For instance, Al-Fahad (2009) and Wang, et al. (2009) all reported that students became more excited about the learning process and became more engaged active learners rather than passive learners.

Literature also covered the theoretical framework adopted for the current research. The literature reviewed indicate that mobile learning is a relatively new phenomenon with its theoretical basis still under development. Mobile learning therefore, can relate to more than one theory (Sharples, Taylor & Vavoula 2010; Kearney, Schuck, Burden, Aubusson, 2012).

The literature reviewed also identifies some relevant research gaps identified for this study. The summary of research gaps is presented in Table 2.1

Table 2.1: Summary of Knowledge Gap

Author(s)/Year	Study Title	Finding	Knowledge Gap
Abu-al-aish, and Love (2013)	Factors Influencing Students' Acceptance of mLearning: An Investigation in Higher Education.	A structural equation model was used to analyse the data. The results indicate that performance expectancy, effort expectancy, influence of lecturers, quality of service, and personal innovativeness were all significant factors that affect behavioural intention to use m-learning. Prior experience of mobile devices was also found to moderate the effect of these constructs on behavioural intention.	The study used lecturers as the respondents, the current study uses the learner as the end user. The focus of the study by Abu-al-aish, and Love is intention to use. The current study addresses actual use of mLearning. The key Gap in the their study is that its main focus is on the intention to use while this study focuses on actual dpotion..
Adedoja, Adelore, Egbokhare and Oluleye (2013)	Learners' Acceptance of the Use of Mobile Phones to Deliver Tutorials in a Distance	This case study focuses on students' acceptance of mobile phones for learning purposes within a project that aims to support and engage distance education	While the study focuses on the end user like the current study, it does not address the determinants of learner adoption of mLearning

Author(s)/Year	Study Title	Finding	Knowledge Gap
	Learning Context: A Case Study at the University of Ibadan.	students by using mobile phones for distance learning tutorials, rather than using technology merely to communicate information or create access to learning resources.	and only focuses learning tutorials. The current study focuses on determinants of learner adoption of mLearning.
Adegbija,. and Bola (2015)	Perception of undergraduates on the adoption of mobile technologies for learning in selected universities in Kwara state, Nigeria.	This study investigated the perception of undergraduates on the adoption of mobile technologies for learning. The results revealed among others that no significant difference existed in the undergraduates' perception on the adoption of mobile technologies for learning based on gender.	While the study by Adegbija,. and Bola is similar to the current study, in that both studies focus on the end user. The study by Adegbija,. and Bola focuses on perception of learners on the adoption of mobile technologies for learning. The current study focusses on actual adoption.
Al-Ghaith, Sanzogni, and	Factors influencing the	The study focused on factors that have influenced	The study by Al-Ghaith, Sanzogni, and

Author(s)/Year	Study Title	Finding	Knowledge Gap
Sandhu (2010)	adoption and usage of online services in Saudi Arabia.	users' behaviour to adopt or use e-services. Perceived Complexity was found to be the most significantly related factor affecting e-service adoption in Saudi Arabia, followed in turn by Privacy and Compatibility. Quality of the Internet and its relative advantage also had a notable effect on e-service usage and adoption in Saudi Arabia.	Sandhu focused on factor affecting e-service adoption in Saudi Arabia. The current study focuses on mLearning and goes beyond the determinants assessed by Al-Ghaith, Sanzogni, and Sandhu
Buabeng-Andoh (2012)	Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature.	This article reviews personal, institutional and technological factors that encourage teachers' use of computer technology in teaching and learning processes. The article concluded that knowing the extent to which these barriers affect individuals and institutions may help in	The study by Buabeng-Andoh is largely similar with the current study in terms of the variable it studies. However, the study by Buabeng-Andoh does not address the end user. Its findings are based on literature review while the current study is

Author(s)/Year	Study Title	Finding	Knowledge Gap
		taking a decision on how to tackle them	based on field data.
Keiyoro, (2010)	Factors influencing the effective use of ICT in teaching and learning science curriculum in Kenyan Secondary schools: The case of Cyber and NEPAD e-schools	Several factors determine the success or failure of use of ICT in teaching and learning science subjects in schools. The factors include that determine success include; location or school environment, access to ICT infrastructure, teacher training. The study found a weak relationship between technical support offered by e-schools and influence of use of ICT in schools.	This study focused on the use of ICT in general with a bias on Computer use. The study does not focus specifically on the learner behaviour and technology use. The current study will focus on mobile learning adoption it will also use the learner as the main unit of analysis.
Mac Callum, Jeffrey, & Kinshuk. (2014)	Factors impacting teachers' adoption of mobile learning.	Two aspects, in particular, have been consistently found to impact lecturers' adoption of technology. The first is the beliefs held by the lecturers. The second major aspect seen to influence adoption is the	This study focuses on lecturers' adoption of technology. The current study will focus on the learner and will single out Mobile learning.

Author(s)/Year	Study Title	Finding	Knowledge Gap
		skill of lecturers to use digital technology	
Miriam et al. (2010)	The Adoption of New Technology: Conceptual Model and Application	The objectives of this study are to test an innovation adoption model on a real case. One of the key findings of this study is that cooperation of partners is important in the adoption of new technology.	While this study is relevant because it focuses on adoption of new technology, it has significant Gaps in that it does not address adoption of new technology in a learning environment but in factory setting.
Mtebe, and Raisamo, (2014)	Investigating students' behavioural intention to adopt and use mobile learning in higher education in East Africa	The results showed that, four factors: performance expectancy, effort expectancy, social influence, and facilitating conditions had significant positive effects on students' mobile learning acceptance with performance expectancy being the strongest predictor.	This study focusses on students' behavioural intention to adopt and use mobile learning without considering other key variables such as institutional factors and technological factors. The current study will incorporate institutional factors and technological factors. It

Author(s)/Year	Study Title	Finding	Knowledge Gap
			will also focus on learners in a community setting.
Mulwa (2012)	The Influence of Instructional and Human factors on readiness to adopt e-Learning in Kenya: The case of Secondary Schools in Kitui District.	The study focusses on the influence of infrastructure, human resource, personal characteristic of principals, teachers and students as well as attitudes held by principals, teachers and students on adoption of ICT in secondary schools	This study focused on the use of ICT in general with a bias on Computer use. While the study focuses of personal characteristics and attitude of the learner, it does not adequately address learner behaviour and technology use for mLearning. The current study will have the learners as the main unit of analysis.
Wang, Wu and Wang. (2009)	Investigating the determinants and age and gender differences in the acceptance of mobile learning.	The results indicate that performance expectancy, effort expectancy, social influence, perceived playfulness, and self-management of learning	The findings by Wang, Wu and Wang provide several important implications for m-learning acceptance, in terms of both research

Author(s)/Year	Study Title	Finding	Knowledge Gap
		were all significant determinants of behavioural intention to use m-learning.	and practice. However, the focus of their study is limited to age and gender differences. The current study goes beyond learner characteristics.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research design which is the blueprint for conducting a study. The research design covers the research paradigm selected for the study. It also present the target population of the study which is the specific population about which information is desired is derived. It also covers the sample size and sampling procedures, data collection instruments, pilot study and tests for validity and reliability. Data collection procedures including the seeking of the research permit and mode of questionnaire administration are presented. The quantitative and qualitative techniques of analysis are also laid out. Ethical considerations for this study including confidentiality issues are discussed.

3.2 Research Paradigm

The study was guided by the pragmatism paradigm. This paradigm was selected because it applies to mixed methods. Thus, for the mixed methods researcher, pragmatism opens the door to multiple methods, different worldviews, and different assumptions, as well as different forms of data collection and analysis (Tashakkori & Teddlie, 2010).

In effect therefore, the study adopted a mixed methods research approach. Mixed methods involve combining or integration of qualitative and quantitative research and data in a research study. Qualitative data tends to be open-ended without predetermined responses while quantitative data usually includes closed-ended responses such as found on questionnaires or psychological instruments. The core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provide a more complete understanding of a research problem than either approach alone (Tashakkori & Teddlie,

2010). Mixed methods have been used in a similar study by Handal et al. (2013). The method is helpful because it makes manifest the complex interaction among variables within a particular study. Mixed methods also require the integration of different theoretical perspectives to interpret data as is the case in the current study.

3.3 Research Design

The study utilised a decripto-explanatory survey research design. This design combines both a descriptive and explanatory designs. The design facilitated detailed description and analysis of the variables under study. Combined designs enable the researcher to achieve optimal results as there is no single perfect design as is suggested by Saunders, Lewis and Thornhill (2009). While the descriptive survey design determines the status of the independent variables on the dependent variables, the main aim of an explanatory research is to identify any causal links between the factors or variables that pertain to the research problem (Fraenkel & Wallen, 2008). The descripto-explanatory survey design has been used successfully by others researchers in similar studies such as Mokaya and Kipyegon (2014) who examined determinants of employee engagement in the banking industry in Kenya and Karanja, Muathe and Thuo, (2014) who evaluated marketing capability and the performance of mobile service providers.

3.4 Target Population

The target population of the study was the 3081 community health trainees from 13 counties (Amref Health Africa, 2015). The population distribution is presented in Table 3.1.

Table 3.1: Target Population

County	
Bungoma	500
Isiolo	326
Kajiado	163
Kakamega	160
Kisii	80
Kisumu	426
Kitui	220
Migori	40
Nairobi	410
Nyamira	80
Samburu	285
Siaya	311
Vihiga	80
	3081

(Source: Amref Health Africa, 2016).

3.5 Sample Size and Sampling Procedures

Kothari and Garg (2014) state that a sample size should neither be excessively too large nor too small. They add that an optimum sample size is one which fulfils the requirements of efficiency, representativeness, reliability and flexibility. While deciding the size of the sample, the researcher must determine the desired precision and an acceptable confidence level for the estimate. The sampling procedure is the process by which a researcher uses to select the unit of analysis form the sample (Fraenkel & Wallen, 2008).

3.5.1 Sample Size

To achieve the expected threshold for a sample size, the researcher drew the sample size using the formula suggested by Yamane (1967) for calculating sample sizes. A 95% confidence level and P = .5 are assumed for Equation.

$n = N/1 + N(e)^2$

Where;

n = Sample

N = Population

e = Standard error.

Thus

$n = N/1 + N(e)^2$

$n = 3081/1 + 3081(0.05)^2$

$n = 354$

The sample attained using the Yamane's formula (354) was considered adequate for this study. This because the formula used is reliable and it produces comparable results with Cochran's formula for finite populations (Cochran 1977).

3.5.2 Sampling Procedure

The study adopted a multi-stage sampling design. In multi-stage sampling, the sample is selected in multiple steps the design is selected because it enables the researcher to utilize sequential clustering within a reasonable cost achieving desired results. This is not possible with most of other sampling designs. Kothari and Garg (2014) assert that ordinary multistage sampling is applied in big enquiries extending to a considerable large geographical area.

The first step in the sampling procedure is to establish the geographical locations. The geographic locations were purposefully selected because the mHealth programme was only conducted in those locations. The mHealth project was implemented in three different environments; rural, urban and nomadic. This study adopted the existing clustering in each cluster two counties were selected by simple random sampling. Following the random

sampling the following counties were selected: Nairobi, Kisumu, Samburu, Kajiado, Kitui and Kakamega. The population from the selected counties was 1664.

The second stage was selecting the individual respondents form within the clusters. Simple random sampling was thus each member has an equal chance of inclusion. This type of sampling is less time consuming and produces better results (Fraenkel & Wallen, 2008). Table 3.2 shows the stratification;

Table 3.2: Sample Distribution

Cluster	County	Sample
Urban	Nairobi	87
	Kisumu	91
Rural	Kitui	57
	Kakamega	34
Nomadic	Samburu	61
	Kajiado	34
Total		**354**

(Source: Amref Health Africa, 2016).

3.6 Data Collection Instruments

Projects investigating mobile learning have utilised interviews, questionnaires, diaries and focus groups to collect information (Sharples, 2009). The drawbacks with such techniques are the reliance on the memory and honesty of the participants (Nestel et al. 2005; Wali et al. 2008). To cater for such shortcomings, the current study utilized the triangulations method where in addition to the questionnaires, interviews and focus groups discussion, document analysis of actual mobile learning system was used.

3.6.1 Questionnaire for Community Health Trainees

In order to investigate the determinants of the community health trainees adoption of mobile learning, the study adapted different instruments from similar studies for each of the variables (Tsai, Tsai, & Hwang , 2010; Agarwal and Prasad 1998; Shih-hsien Yang, 2012). Notably, all the instruments adopted have been successfully used in studies such as by Mahat,, Ahmed and Wong (2012) and Mtebe & Raisamo, (2014). The questionnaire contained both open and closed questions, the closed questions was a 5–point Likert where, 5=Strongly Agree, 4=Agree, 3=Uncertain, 2= Disagree, 1= Strongly Disagree. A Likert scale has been selected because it is used to measure opinions, attitudes, values and behaviour (Kothari and Garg, 2014).

To measure self-efficacy, the tool used for this study was derived from Tsai and Tsai's (2003) on internet self-efficacy survey. However, some items were modified in order to fulfil the requirements of mobile-learning. To guide the modification, further reference is made from Shih-hsien Yang (2012); Mahat, et al (2012) for items on peer interaction. For personal innovativeness, the study adapted items by Agarwal and Prasad (1998).

In order to measure the mLearning attitude, the mLearning attitude survey was adapted from Tsai, Tsai, & Hwang's (2010) PDA attitude scale, with some additional modifications being made by the researcher to suite the current study. For the variable on learner behavioural Intention to use mLearning, the study adopted research instrument developed by Venkatesh et al. (2003).

3.6.2 Interview Guide

Structured interviews with predetermined standardised questions was used to gather data from the Community Health Extension Workers and the institutional support staff, and the community health trainees. The interview questions were drawn from the thematic areas of the questionnaire. The main objective of the use predetermined standardised questions was to triangulate the information gathered using the questionnaire and keep a focus on the variable of study (Kothari and Garg, 2014; Fraenkel & Wallen, 2008).

3.6.3 Focus Group Discussion

In order to conduct triangulation, a Focus Group Discussion (FDG) was conducted with the Community Health Volunteers. The FDG questions were drawn from the thematic areas of the questionnaire. FGDs were chosen because they can be used to explore the meanings of survey findings that cannot be explained statistically, the range of opinions/views on a topic of interest and to collect a wide variety of information (Kothari, 2014, Fraenkel & Wallen, 2008).

3.6.4 Document Analysis

To further triangulate the data, the researcher made reference to project documents such as reports and learner performance and completion rate spread sheets generated from the Mobile Learning Management System (MLMS). The MLMS documents show the learner listing which will inform research subjects sampling (Appendix VII, VIII).

Data on learner actual use of the mLearning platform was collaborated with the field data and used for analysis of the dependent variable. The MLMS documents contained information on

meaning of various codes used in the mLearning platform, learner progress on mLearning including chat count, chat score and topics covered on the mLearning platform.

3.7 Pilot Study

It was necessary to pilot test the questionnaire before using it for this study. The main purpose of the pilot study was to ensure the readability and clarity of the questionnaire items and to check if the data collected answers the study questions. (Alvin et. al. 2009, Creswell, 2008, Sekaran and Bougie, 2011; Zikmund, 2009). The pilot study also helped check the respondent understanding of questions, appropriateness of response categories, question clarity and adequacy of instructions. The pilot constituted 35 participants drawn from Golfcourse community unit in Nairobi county. Extant literature suggests that a pilot study sample should be 10% of the sample (Connelly, 2008).

The selected participants for the pilot were not to be among those included in the sampling frame (appendix vii). The main reason for this is to ensure that the respondents are not exposed to the tools prior to the main study.

3.8 Validity of Research Instruments

Instrument validity revolves around the defensibility of the inferences researchers make from the data collected through use of an instrument. Instruments should permit researchers to draw valid conclusions about the characteristics of the subjects that study. Validity is the appropriateness, correctness, meaningfulness and usefulness researchers make based on data collected (Frankel and Wallen, 2008). To ensure validity in this study, questionnaires were examined by experts to ensure consistency within the items. Content validity was established through discussion of the research instrument with peers and research supervisors to ensure

that all the variables in the research objectives were adequately captured in the questionnaire and interview schedule and focus group discussions.

3.9 Reliability of Research Instruments

It is paramount that a researcher ensures that research instruments are reliable. Reliability is the consistency of scores obtained from the data collected (Frankel and Wallen, 2008). In this study, internal consistency reliability test was used to assess the consistency of results across items within a test. A single measurement instrument was administered to a group of people on one occasion to estimate reliability. In effect, the reliability of the instrument was judged by estimating how well the items that reflect the same construct yield similar results. Cronbach's Alpha (α) was used to test for internal consistency. The threshold of acceptance was a score of at least 0.7 (Frankel and Wallen, 2008). The pilot test yielded the results shown in Table 3.3

Table 3.3: Results of Reliability Coefficients of the Pilot Study

Variable	Number of Items	Cronbach's
Learner Self-efficacy	28	0.930
Learner attitude	20	0.840
Behavioural intention	34	0.915
Institutional factors	7	0.794
Adoption of Mobile learning	4	0.850

The results of the pilot produced a computed alpha value of 0.930 for the variable on learner self-efficacy, 0.840 for the learner attitude variable, 0.915 for the behavioural intention variable, 0.794 for the institutional factors and adoption of mobile learning 0.850. Where the computed alpha value is greater than 0.70 the instruments are considered to have an acceptable level of internal reliability (Frankel and Wallen, 2008). The questionnaire was

thus considered internally consistent. Apart from the checking the internal consistency, the items were checked for clarity especially on the open-ended responses and minor corrections made.

3.10 Data Collection Procedures

Various authorizations were sought before embarking on data collection.. First, the researcher requested for a letter of introduction from University of Nairobi, secondly, authorization was sought from the research division of Amref Health Africa. Finally, a research permit was sought from the National Commission for Science, Technology and Innovation (NACOSTI). Four qualified field researches assistants were recruited and taken through a fresher training to ensure accurate data collection. The training included an orientation to the study , familiarization with the data collection sites, basic field ethics and data collection methodologies. The researcher with the help of the research assistants administered the questionnaires and conducted interviews and focused group discussions with the respondents.

3.11 Data Analysis Techniques

Data analysis entails the process of collecting, modelling, transforming and packaging collected data in a way that the results can be easily and efficiently communicated. It enables one to present useful information, suggesting conclusions in a clear manner. The output can be used to support decision making (Greener, 2008). This study gathered both quantitative and qualitative data. Prior to the analysis, the quantitative data was coded as per study variables. All the quantitative variables were organised thematically for triangulation with the quantitative outputs.

Descriptive analysis was conducted to help the researcher to significantly explain the distribution of measurements and to obtain percentages, means and standard deviations on the level of agreement or disagreement the question items (Bryman, 2003; Serakan & Bougie, 2011). Data from the Likert scale items was presented in percentages, means and standard deviations. Boone and Boone (2012) propose that in means and standard deviations can be used describe the Likert scale items. For the current study, a high standard deviation indicated high variation of learner mLearning self-efficacy. In this study, a mean score 4.00 and above was considered high, 3.00-3.99 was considered moderate and below 3.00 was considered low. This scale has been used in other studies such as Kabue (2016).

Correlation analysis which is used to establish whether there is a relationship between the dependent and the independent variables. The correlation coefficient is a measure of linear association between two variables. Values of the correlation coefficient are always between -1 and +1. A coefficient of +1.0, (a perfect positive correlation), means that changes in the independent variable will result in an identical change in the dependent variable. A coefficient of -1.0, a (perfect negative correlation), means that changes in the independent item will result in an identical change in the dependent item, but the change will be in the opposite direction. A coefficient of zero meant that there is no relationship between the two items and that a change in the independent item had have no effect in the dependent variable.

Regression analysis which refers to a set of statistical processes for estimating the relationships among variables. It was used to test the relationship between the dependent variable and the independent variables (Serakan & Bougie, 2011). More specifically, regression analysis helped in the understand of how the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed.

The dependent variable, the adoption of mLearning, was analysed in an adoption continuum of five levels; The innovator, early adopter, early majority, late majority, and laggards. These levels have a distinct natural ordering. To investigate which independent variables predicted the adoption of mLearning, regression analysis was conducted. This scale has been used successfully in other studies such as McWhorter (2012).

The study used simple regression model for hypothesis 1,2,3,4,5,and 6. Hypothesis 7 was tested using multiple regression analysis and hypothesis 8 was tested using moderated multiple regression analysis. The models for each are as follows:

i) Simple regression model

Hypothesis one: $y = \beta_0 + \beta_1 X_1 + \varepsilon$

Where

β_0 is the constant

β_1 is the coefficient for learner characteristics

X_1 is learner characteristics

Hypothesis two: $y = \beta_0 + \beta_2 X_2 + \varepsilon$

Where

β_0 is the constant

β_2 is the coefficient for learner self-efficacy

X_2 is learner self-efficacy

Hypothesis three: $y = \beta_0 + \beta_3 X_3 + \varepsilon$

Where

β_0 is the constant

β_3 is the coefficient for learner attitude

X_3 is learner attitude

Hypothesis four: $y = \beta_0 + \beta_4 X_4 + \varepsilon$

Where

β_0 is the constant

β_4 is the coefficient for behavioural intention

X_4 is behavioural intention

Hypothesis five: $y = \beta_0 + \beta_5 X_5 + \varepsilon$

Where

β_0 is the constant

β_5 is the coefficient for technology use

X_5 is technology use

Hypothesis six: $y = \beta_0 + \beta_6 X_6 + \varepsilon$

Where

β_0 is the constant

β_6 is the coefficient for learner characteristics

X_6 is learner characteristics

Where

β_0 is the constant

β_6 is the coefficient for institutional factors

X_6 is institutional factors

ii) Multiple regression model

Hypothesis seven: $y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$

Where

β_0 is the constant

β_1 is the coefficient for learner characteristics

X_1 is learner characteristics

X_2 is learner self-efficacy

X_3 is learner attitude

X_4 is behavioural intention

X_5 is technology use

iii) Moderated multiple regression model

Hypothesis eight: $y = \beta_0 + \beta_1 X_{1m} + \beta_2 X_{2m} + \beta_3 X_{3m} + \beta_4 X_{4m} + \beta_5 X_{5m} + \varepsilon$

Where

β_0 is the constant

β_1 is the coefficient for learner characteristics

X_1 is learner characteristics

X_2 is learner self-efficacy

X_3 is learner attitude

X_4 is behavioural intention

X_5 is technology use

m is the moderated effect (institutional factors)

The null hypothesis was rejected based on the significance of variables in the regression model. If the null hypothesis $H_0: \beta_i = 0$ ($where\ \beta_i = \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$) was rejected. To

test the hypotheses for the simple regression models t test statistic was used. Then X_i was taken to have a significant influence on Y. To test the hypothesis for the multiple and the moderated regression models F statistic was used; $H_0: \beta_{im} = 0$.

3.12 Ethical Considerations

It is fundamental that the researcher ensures that the participants in the research study are protected and well aware of the study they are involved in. The researcher should seek consent of the respondents, ensure that the identity of participants is protected. The respondents should be assured that any data collected from or about them will be held in confidence (Frankel and Wallen, 2008)

In this study, the researcher ensured confidentiality of the respondents by seeking consent through a letter of introduction. The researcher ensured the respondents participated on a voluntary basis. The authority to conduct the research was sought through permit from the National Commission for Science, Technology and Innovation (NACOSTI). The names of the respondents did not appear anywhere on the questionnaire as suggested by Frankel and Wallen, (2008). The researcher also ensured that all questionnaires contained a disclaimer that data collected from the participants would not be used for any other purpose other than the intended study.

Table 3.4: Operational Definition of Variables

Objective	**Hypothesis**	**Variable**	**Indicators**	**Measurement scale**	**Data collection tool**	**Data analysis**
To assess effect of learner characteristics on adoption of mLearning for the mHealth community health training programme in Kenya.	$H_1$1:Learner characteristics have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Independent variable: Learner characteristics	• Gender • Age • Professional experience • Academic achievement • Duration of exposure to mLearning	• Nominal • Ordinal • Ordinal • Ordinal • Ordinal	Questionnaire	• Percentages, Mean and Standard Deviation. • Chi-square • Simple Regression Analysis • ANOVA

Objective	**Hypothesis**	**Variable**	**Indicators**	**Measurement scale**	**Data collection tool**	**Data analysis**
To determine the effect of learner self-efficacy on adoption of mLearning for the mHealth community health training programme in Kenya.	$H_1 2$: Learner self-efficacy has a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Independent variable: Learner self-efficacy	• Navigation • Peer interaction • Dependency • Innovativeness	• Ordinal • Ordinal • Ordinal • Ordinal	• Questionnaire • FDG • Interview	• Percentages, Mean and Standard Deviation. • Simple Regression Analysis • ANOVA

Objective	**Hypothesis**	**Variable**	**Indicators**	**Measurement scale**	**Data collection tool**	**Data analysis**
To evaluate the effect of learner attitudes on adoption of mLearning for the mHealth community health training programme in Kenya	$H_1$3: Learner attitude has a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Independent variable: Learner attitude	• Towards mobile learning • Towards use of mobile phone for learning • Towards the mLearning content	• Ordinal • Ordinal • Ordinal	• Questionnaire • FDG • Interview	• Percentages, Mean and Standard Deviation. • Simple Regression Analysis • ANOVA

Objective	**Hypothesis**	**Variable**	**Indicators**	**Measurement scale**	**Data collection tool**	**Data analysis**
To establish the effect of learner behavioural intention on adoption of mLearning for the mHealth community health training programme in Kenya..	$H_1$4: Learner behavioural intention has a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Independent variable: Learner behavioural intention	• Social Influence • Performance Expectancy • Effort expectancy • Facilitating conditions	• Ordinal • Ordinal • Ordinal • Ordinal	• Questionnaire • FDG • Interview	• Percentages, Mean and Standard Deviation. • Simple Regression Analysis • ANOVA

Objective	**Hypothesis**	**Variable**	**Indicators**	**Measurement scale**	**Data collection tool**	**Data analysis**
To determine the effect of technology use on the adoption of mLearning for the mHealth community health training programme in Kenya.	$H_1$5: Technology use has a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Independent variable: Technology use	• • Device functionality • Content delivery technology	• Ordinal • Ordinal	• Questionnaire • FDG • Interview	• Percentages, Mean and Standard Deviation. • Simple Regression Analysis • ANOVA

Objective	Hypothesis	Variable	Indicators	Measurement scale	Data collection tool	Data analysis
To evaluate the effect of institutional factors on adoption of mLearning for the mHealth community health training programme in Kenya.	$H_1$6: Institutional factors have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Moderating variable: Institutional factors	• Training • Content development	• Ordinal • Ordinal	• Questionnaire • FDG • Interview	• Percentages, Mean and Standard Deviation. • Simple Regression Analysis • ANOVA
To determine the effect of combined learner characteristics, self-efficacy, learner attitude, behaviour	$H_1$7: The combined influence of learner characteristics, self-efficacy, learner attitude, behaviour	Independent variable: Combined Learner behaviour and	• Learner Characteristics • Learner Self-efficacy • Learner	• Ordinal • Ordinal	• Questionnaire • Questionnaire	• Percentages, Mean and Standard Deviation. • Multiple

Objective	Hypothesis	Variable	Indicators	Measurement scale	Data collection tool	Data analysis
intention and technology use on adoption of mLearning for the mHealth community health training programme in Kenya.	intention and technology use have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	technology use	Attitudes • Behavioural intention • Technology Use			Regression Analysis • ANOVA
To determine the moderating influence of institutional factors on the effect of learner behaviour, technology use on adoption of	$H_1$8: The moderating effect of institutional factors on the relationship between learner characteristics, learner behaviour and	Moderating variable: Institutional Factors	• Training • Content development	• Ordinal • Ordinal	• Questionnaire • Questionnaire	• Percentages, Mean and Standard Deviation. • Moderated multiple

Objective	**Hypothesis**	**Variable**	**Indicators**	**Measurement scale**	**Data collection tool**	**Data analysis**
mLearning for the mHealth community health training programme in Kenya.	technology use have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.characteristics, learner behaviour and technology use and adoption of mLearning. for the mHealth community health training programme in Kenya.					Regression Analysis • ANOVA

Objective	**Hypothesis**	**Variable**	**Indicators**	**Measurement scale**	**Data collection tool**	**Data analysis**
		Adoption of mobile learning	• Learner adoption • Actual adoption	ordinal	• Questionnaire • LMS data	• Regression Analysis • ANOVA

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION OF FINDINGS

4.1 Introduction

This chapter presents data analysis, presentation and the interpretation of the findings. Prior to the analysis, the research response rate computed and presented. Survey data was collected using questionnaires, interviews, Focus Group Discussions and document analysis on the LMS data on learner usage of the mLearning platform and personal observations of the mLearning activities for the community health trainees. The findings are presented as per the research objectives.

4.2 Questionnaire Return Rate

The analysis was based on 294 questionnaires out of 354. This represents a response rate of 83.05 %. This was considered an appropriate return rate. According to Bryman and Bell (2011) a return rate of 50% is adequate, 60% good and above 70% is considered excellent.

4.3 Learner Characteristics

For the first objective of the study, the characteristics identified for this study were; of age, gender, academic achievement, professional experience as a community health volunteer, prior experience with mLearning and duration of exposure to mLearning. This was analysed and presented in this section.

4.3.1 Age of the respondents

The researcher analysed the age of the respondents. The raw data was ranked for purposes of analysis from the lowest to the highest. The age of the respondents was therefore, presented in five categories. This descriptive analysis is presented in Table 4.1.

Table 4.1: Age of Respondents

Age in years	Frequency	Percent
24 and below	11	3.7
25-29	37	12.6
30-34	53	18.0
35-39	69	23.5
39-44	54	18.4
Above 40	70	23.8
Total	**294**	**100.0**

The age of the community health trainees was as follows; 24 years and below 3.7%, 25-29 constitute 12.6%, 30-34 were 18.0%, 35-39 constitute 23.5%, 39-44 were 18.4% and those above 44 years of age constitute 23.8 %. The results show that the majority (83.7) of the community health trainees who work as Community Health Volunteers are aged above 30 years of age.

4.3.2 Gender of respondents

The researcher analysed the gender of the respondents as presented in Table 4.2.

Table 4.2: Gender of Respondents

Gender	Frequency	Percent
Female	202	68.7
Male	92	31.3
Total	**294**	**100.0**

The results showed that there were more female (68.7%) community health trainees than the male (31.3%). This result is consistent with the national average where we have more female participation in community health volunteer work than male.

4.3.3 Level of Education

Regarding the level of education of the community health trainees participating in the mLearning programme, primary education, secondary education and professional qualification (certificate and diploma level) emerged as the main categories for consideration. The descriptive analysis is presented in Table 4.3.

Table 4.3: Academic Achievement of Respondents

Level of Education	Frequency	Percent
Primary	16	5.4
Secondary	25	8.5
Certificate Level	223	75.9
Diploma	29	9.9
Bachelor's Degree	1	.3
Total	**294**	**100.0**

The results showed that 5.4% of the participants had primary education, 8.5% had secondary education, 75.9 % had a professional certificate while 9.9% had diploma. Only one of the Community health trainees sampled for the study held a Bachelor's degree representing 0.3%. The result imply that the community health trainees level of education cut across many levels ranging from primary to degree. However most of the trainees had a certificate level training.

4.3.4 Professional Experience

The professional experience of the respondents was analysed and the descriptive analysis presented in Table 4.4.

Table 4.4: Number of Years Worked as Community Health Volunteer

No. of years	Frequency	Percent
5 years and below	149	50.7
6-10 years	112	38.1
11-15 years	30	10.2
16-20 years	3	1.0
Total	294	100.0

The results of the study show that 50.7% of the respondents had 5 years and below of experience as Community Health Volunteers. Another 38.1 percent had 6-10 years' experience with 10.2% having 11-15 years' experience and 1.0% having 16-20 years. The results show that 50.7% of the trainees had worked as Community Health Volunteers for less than 5 years while 49.3% had worked for over 5 years. This is considered a good balance given that the terms of engagement are voluntary.

4.3.5 Duration of Exposure to mLearning and Adoption of mLearning

The duration of exposure to mLearning was analysed and the descriptive analysis presented in Table 4.5.

Table 4.5: Duration of Exposure to mLearning

Months	Frequency	Percent
1-4	3	1.0
5-8	9	3.1
9-12	197	67.0
13-16	3	1.0
17-24	82	27.9
Total	294	100.0

The results in Table 4.5 indicates that 1.0% of the participants were exposed to the mLearning programme for 3 months, 3.1% were exposed for 5-8 months, 67.0 were exposed for 9-12 months and 1.0% for 13-16 months while 27.9% were exposed for 17-24. Majority

of the participants had been exposed to mLearning for between 9 and 24 months. This is largely because the two phases of the mHealth project lasted 24 months.

4.4 Tests for Statistical Assumptions

This section presents the tests for statistical assumptions. Prior to conducting statistical analysis, a researcher need to conduct tests for statistical assumptions. When these assumptions are violated the results of the analysis can be misleading or completely erroneous (Field, 2009; Bryman, 2012). This section covers the Normality test and the test for multicollinearity.

4.4.1 Normality Test

To test for the significance of departure from normality, Q-Q plots were done for each of the variables of the study. The Q-Q plot, or quantile-quantile plot, is a graphical tool to help assess if a set of data probably came from some theoretical distribution such as a Normal or exponential. It is considered an important diagnostic for checking the assumption of normality (Stine, 2017). The results for plots of learner characteristics, self-efficacy, learner attitude, behavioural intention, technology use, institutional factors and adoption of mobile learning all show that the respective indicators were approximately distributed along the normal line. This is an indication the data could be used to run regression analysis.. The plots are shown in appendix VI.

4.4.2 Test of Multicollinearity

To determine whether multicollinearity levels would pose a challenge to the analysis, collinearity diagnostics was conducted to generate the Variance Inflation Factor (VIF) value and tolerance levels. The results are presented in Table 4.6.

Table 4.6: Test of Multicollinearity

Model Coefficients	Collinearity Statistics	
	Tolerance	VIF
Learner self -efficacy	.687	1.456
mLearning Attitude	.772	1.295
Behavioural Intention	.496	2.015
Technology Use	.673	1.487
Institutional Factors	.728	1.373
Adoption of mLearning	.736	1.381

The results in Table 4.6 show that the VIF for learner self-efficacy was 1.456, mLearning attitude 1.295, behavioural intention 2.015, technology use 1.487 and 1.373 for institutional factors, 1.381 adoption of mLearning. The tolerance was .687, .772, .496, .673,.728 and 736 respectively. The results therefore, indicate that the study variables had a VIF of less than 10 and a tolerance greater than 0.1 implying the there was no multicollinearity as suggested by Bryman (2012).

4.5 Learner Characteristics and Adoption of Mobile Learning

Under objective one, the study sought to determine the relationship between learner characteristics and adoption of mLearning. A Chi square test of independence was conducted for age and gender independent of each other and adoption of mLearning. Correlation analysis was conducted for the remaining learner characteristics.

Chi square test of independence was carried out to test if either age or gender had significant influence on adoption to mLearning. The results are combined and summarised in Table 4.7.

Table 4.7: Learner Age, Gender Adoption of Mobile Learning.

	Gender	Age
Pearson Chi square statistic	5.775	19.53
P value	0.217	0.488

The results in Table 4.7 show that no relationship was found between either gender nor age and adoption of mLearning. This is because the p value for gender was 0.217 and p value for age was 0.488 which was greater than the standard p value of 0.05. These results imply that in the context of the current study, both gender and age are not significant in explaining adoption of mLearning and therefore, learners should be presented with equal opportunity regardless of age and gender.

Further, a Pearson correlation analysis was used to identify the relationships between each of the other variables; level of education, work experience and work experience. The results of this are shown in Table 4.8.

Table 4. 8: Correlation for Learner Characteristic Variables.

		Level of education	Work experience	Period of exposure	Adoption of mLearning
6.Adoption of mLearning	Correlation Coefficient	.150*	.233**	.466**	
	Sig. (2-tailed)	.012	.000	.000	.
	N	294	294	294	294

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The results in Table 4.8 indicated that the level of education was positively and significantly correlated with adoption of mobile learning ($r=.150 p < 0.05$). The analysis also established

that work experience was positively and significantly correlated with adoption of mLearning (r=.233 p < 0.01). The results also show that the period of exposure to mLearning was positively and significantly correlated with adoption of mLearning (r=.466 p < 0.01). The period of exposure to mLearning had the greatest correlation with mLearning adoption of the three sub variables of learner characteristics. This finding implies that the longer the learner is exposed to the mLearning platform the higher the adoption of mLearning.

Secondly, regression analysis was used to show the amount of variance in mLearning adoption accounted for by learner characteristics. Age and gender were excluded from the regression model. To test the hypothesis, the model $Y = \beta_o + \beta_1 X_1$ was fitted. Table 4.9 shows the regression analysis between learner characteristics and mLearning adoption.

Table 4.9: Simple regression Results of Learner Characteristics.

Model Summary						
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate		
1	.477	.227	.224	.43918		
ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.304	1	15.304	79.346	.000
	Residual	52.078	270	.193		
	Total	67.383	271			
Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.279	.115		28.390	.000
	Learner Characteristics	.153	.017	.477	8.908	.000

The results showed that learner characteristics had a significant positive effect on adoption of mLearning, F (1,270) = 79.346, p<0.001, R^2 = 0.227. The finding that R^2 = 0.227, implies

that about 23% of variation in mLearning adoption is explained by variation on learner characteristics. R = 0.477 meaning that learner characteristics contributed to about 48% of the mLearning adoption. The model equation therefore is;

$$Y = 3.279 + 0.153X_1$$

Where Y is mLearning adoption and X_1 is learner characteristics

It was hypothesized that:

$H_0$1: Learner characteristics has no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

With, $\beta = 0.153\ t = 8.908, p < 0.05$ it means that for one-unit improvement in learner characteristics, mLearning adoption increases by about 0.153. Given that the p-value is <0.05, the null hypothesis was rejected and it was concluded that learner characteristics has a significant effect on adoption of mLearning. This implies that learner characteristics such as prior exposure to mLearning are critical in mLearning adoption. This means institutions offering mLearning should have an awareness of the learner characteristics in order to meet the shortfalls.

4.6 Learner Self-Efficacy and Adoption of Mobile Learning

This section covers data analysis for objective two which sought to investigate the influence of learner self-efficacy on adoption of mLearning for the mHealth community health training programme in Kenya. Learner self-efficacy was considered likely to influence learner adoption of mLearning. The specific factors that were considered under this category were the learner's ability to navigate through the mLearning platform, peer interaction, learner

dependency and innovativeness. Both descriptive and inferential analysis were done and the results are presented in this section.

4.6.1 Descriptive Analysis

This section presents the descriptive analysis of the four sub-variables used to measure learner self-efficacy. To measure the sub-variables, the respondents were presented with statements measuring each of the subcomponents of self-efficacy and were required to indicate their opinion on each. These items were tested using a 5-point Likert scale where: SA=Strongly Agree (5), A=Agree (4), U=Uncertain (3), D=Disagree (2), SD=Strongly Disagree (1). The Likert scale items were designed as a series of questions that when combined measure a particular construct. Boone and Boone (2012) suggest that in such a case we use means and standard deviations to describe the scale. In the case of the current study, the respondent's opinion was indicated by percentages and the mean scores while the variance was indicted by the standard deviations. A high standard deviation indicated high variation of learner mLearning self-efficacy. In this study, a mean score 4.00 and above was considered high, 3.00-3.99 was considered moderate and below 3.00 was considered low, this scale has been used in other studies such as Kabue (2016). The results are indicted in Table 4.10-4.13.

Table 4.10: Navigating through the Learning Platform

No.	Statement	SD	D	U	A	SA	mean	Standard deviation
1	It is easy to navigate through SMS content	3.4%	8.8%	2.4%	29.6%	55.8%	4.26	1.086
2	It is easy to navigate through (IVR)Voice content	4.4%	5.8%	5.5%	45.7%	38.6%	4.08	1.034
3	It is easy to navigate through Group Chat	2.0%	4.1%	3.7%	36.1%	54.1%	4.36	.893
4	It is easy to navigate through case studies and scenarios	1.4%	7.1%	6.1%	41.2%	44.2%	4.20	.936
5	*I believe I will need strong level of support	9.9%	21.8%	5.8%	29.4%	33.1%	2.46	1.396
6	I am in complete control using mobile technology	3.7%	4.8%	6.5%	36.4%	48.6%	4.21	1.018
7	I need help to use mobile technology effectively	15%	18.7%	5.4%	36.4%	24.5%	3.37	1.415
	N=294, *Negative Item						$\bar{x}$= 3.849	

The results in Table 4.10 show that 29.6% and 55.8% of the respondents agree and strongly agree respectively that it was easy to navigate through SMS content for learning. A total 45.7 % and 38.6% of the respondents agree and strongly agree respectively that it was easy navigate through IVR content. Another 36.1% and 54.1% agree and strongly agree respectively that it was easy to navigate through group chat interface. Another 41.2% and 44.2% agree and strongly agree respectively, indicated that it was easy to navigate through case studies and scenarios for learning. Another 29.4% agree and 33.1% of the respondents believed that they will need strong level of support from the IT staff to be able to fully utilize mobile technology. Another 36.4% agree and 48.6% strongly agree they are in complete control using mobile technology. Finally, another 36.4% and 24.5% of the respondents agree and strongly agree respectively that they need help to use mobile technology effectively. This implies that majority of the respondents had high efficacy in all the three-main learning interface, with almost all the of the respondents had the highest efficacy in using the group

chat. This further implies that learners will enjoy and have high efficacy in a learning interface that is interactive.

With the average mean being 3.849, is an indication of a relatively high self-efficacy spread across the ability to navigate the mLearning platform. However, with a standard deviation of less than 1 in only two items group chat and case studies and scenarios, it implies there was a high variation in the other subcomponents of navigation.

This set of result where on one hand the learners felt they have high self-efficacy on navigating through the mLearning system but at the same time need support was partly validated by the interviews which showed that the respondents self-efficacy was brought about by the strong institutional support that was set up through the help desk and the use of CHWs to offer support to the learners. It further indicates that any institution offering mLearning should have a strong learner support system. The response from the focus group discussions validated this finding.

"... I enjoyed the chat…however, there were challenges with the transmission of SMS and clarity of IVR…. the help desk and the feedback meetings was useful in rectifying and improving issues raised…"

This implies that much as the learners experienced challenges with navigation of the mLearning platform, the challenges were resolved in the course of the programme thus improving their efficacy with time.

The next sub variable on self-efficacy was the peer interaction platform, the descriptive analysis in presented in Table 4.11.

Table 4.11: Peer Interaction Platform

No.	Statement	SD	D	U	A	SA	Mean	Std. Deviation
1	I enjoy the chat forums	0.3%	6.5%	1.7%	41.5%	50.0%	4.34	.831
2	Chat make interaction fun.	1.4%	7.1%	2.0%	45.6%	43.9%	4.23	.903
3	I enjoy social media	14.6%	11.6%	8.2%	39.8%	25.9%	3.51	1.372
4	Mobile technology allows interaction with peers	6.5%	11.6%	5.1%	35.4%	41.5%	3.94	1.229
5	I find mobile technology interactive	2.0%	8.8%	6.5%	32.7%	50.0%	4.20	1.033
6	mLearning encourage discussion and collaboration	0.3%	12.2%	2.0%	36.1%	49.3%	4.22	.995
7	mLearning enables interaction with the supervisors.	3.8%	10.0%	3.4%	39.7%	43.1%	4.08	1.097
N=294							$\bar{x}$= 4.074	

As shown in Table 4.11, analysis of the learner's peer interaction on the mLearning platform revealed that 41.5% and 50.0% of the respondents agree and strongly agree respectively that they enjoyed the chat forums via the mobile device. Another 45.6% and 43.9% of the respondents agree and strongly agree respectively indicating that chat messages made interaction with their colleagues fun. Another 39.8% agree and 25.9% strongly agree that they enjoyed other social media forums (such as WhatsApp, Facebook) to interact with peers about the learning content. Another 35.4% agree with 41.5% strongly agreeing that they found the mobile technology interactive. Furthermore, 32.7% agree with 50.0 % strongly agreeing that the mobile learning activities encourage discussion and collaboration among students. Finally, on peer interaction, 39.7% agree with 43.1% strongly agreeing that the mobile learning application enables more interaction with the supervisors.

with means raging between 3.51 to 4.34 and the standard deviation 0.831 and 1.372 the results indicate that majority of the respondents had high self-efficacy for peer interaction using the mLearning platform. The results were validated by the interviews with the CHWs and FDGs with the CHVs which indicated that the mLearning was highly interactive among the learners.

"... the best part of the mLearning platform was that we had access to toll-free chat which allowed us to share challenges and experiences in real time ...our supervisor were also part of the chat and they would offer professional feedback...it was fun to learn this way..."

The next sub variable on self-efficacy was the on-learner dependency. The question put to the respondents was whether they were able to use the specified platform effectively without assistance the descriptive analysis in presented in Table 4.12.

Table 4.12: Dependency and mLearning Adoption

No.	Statements	**SD**	**D**	**U**	**A**	**SA**	Mean	Std. Deviation
1	I am able to chat effectively without assistance	1.7%	4.1%	3.1%	40.4%	50.7%	4.34	.861
2	I am able to access voice content effectively without assistance	1.7%	9.3%	2.4%	36.0%	50.5%	4.24	1.002
3	I am able to access SMS content effectively without assistance	1.7%	2.4%	2.4%	35.9%	57.6%	4.45	.806
4	I am able to complete learning activities effectively without assistance	0.0%	4.2%	5.9%	37.4%	52.4%	4.38	.780
5	I am able to complete quizzes effectively without assistance	0.7%	6.2%	4.2%	37.0%	51.9%	4.33	.874
6	I am able to get feedback effectively without assistance	1.4%	2.8%	7.3%	39.6%	49.0%	4.32	.836
7	I am able to complete lessons on time without assistance	1.4%	2.7%	4.5%	40.2%	51.2%	4.37	.809
	N=294						$\bar{x}$=4.347	

Analysis of the learner's dependency as a component of self-efficacy as shown in Table 4.12 revealed that 40.4% and 50.7% of the respondents agreed and strongly agreed respectively that they able to chat effectively without assistance. Another, 36.0% and 50.5% of the respondents agreed and strongly agreed respectively that they were able to access voice content effectively from mobile device without assistance. Furthermore, another, 35.9% and 57.6% of the respondents agreed and strongly agreed respectively that they were able to access SMS content effectively without assistance. Another 37.4% agree with 52.4% strongly agreeing that they were able to complete learning activities effectively without assistance. In addition, 37.0% and 51.9% the respondents agreed and strongly agreed respectively that they were able to complete quizzes effectively without assistance. Another 39.6% agree while 49.0% strongly agreeing that they were able to get feedback effectively without assistance. Finally, 40.2% agreed while 51.2% strongly agree that they were able to complete lessons on time without assistance.

With the mean ranging between 4.24 and 4.45 and the standard deviation <1 except for the ability to access voice content effectively from mobile device without assistance which had a standard deviation of 1.002, the results imply that the almost all the learners were able to independently accomplish the mLearning tasks by themselves, this is consistent with results of the Focus Group Discussions which showed that the respondents found mLearning use easy since the technology used was highly comparable to their ordinary use of their mobile phones.

"…. mLearning is easy to use….it was just like any other use of the phone with only small differences... with the training we received it became even more easy to use …"

The final sub variable on self-efficacy was the innovativeness, the descriptive analysis in presented in Table 4.13.

Table 4.8: Innovativeness and mLearning Adoption

No.	Statement	**SD**	**D**	**U**	**A**	**SA**	Mean	Std. Deviation
1	Solving learning based challenges	4.8%	17.4%	5.5%	46.1%	26.3%	3.72	1.170
2	Exploring the new information technology	2.1%	4.1%	3.8%	45.9%	44.1%	4.26	.876
3	Enjoy to solving difficult problems	3.7%	12.2%	11.6%	40.8%	31.6%	3.84	1.113
4	Apply mLearning in other areas of life	1.4%	2.4%	7.9%	41.8%	46.6%	4.30	.823
5	Teach self about new technology	2.1%	5.6%	5.9%	44.4%	42.0%	4.19	.926
6	Feel secure about ICT ability	1.7%	7.5%	16.1%	36.6%	38.0%	4.02	1.000
7	Use of new technology	2.1%	7.2%	10.3%	38.5%	41.9%	4.11	.994
	N=294						$\bar{x}$=4.062	

The results in Table 4.13 revealed that 46.1% and 26.3% of the respondents agree and strongly agree that they manage to solve learning based challenges by themselves. Another 45.9% agree while 44.1% strongly agree that they like to explore the new information technology. Additionally, 40.8% of the respondents agree while 31.6% strongly that the more difficult the problem the more they enjoyed to solve it. It was further revealed that 41.8% of the respondents agree while 46.6% strongly agree that they would try applying mobile learning in other areas of life. Furthermore, 44.4% agree of the respondents while 42.0 % strongly agree that they could teach themselves more things they needed to know about new technology. In addition, 36.6% and 38.0% of the respondents agree and strongly agree respectively, that they felt secure about their ability to use ICT. Finally, 38.5% and 41.9% of

the respondents agree and strongly agree respectively, that they can use new technology to do whatever is possible with that technology.

The average mean for innovativeness was 4.062 meaning that the learner were highly innovative in the use of mLearning platform. The standard deviation of items 1,3 and 6 was >1 while for items 2,4,5 and 7 it was <1. This means that for the items with a standard deviation of <1 indicates that the scores are clustered closely around the mean. On the other hand, for the items where the mean is >1 it indicates that some of the responses are spread far from the mean.

4.6.2 Correlation and Simple Regression Analysis

Under objective two the study sought to determine the relationship between learner self-efficacy and mLearning adoption. Correlation and simple regression analysis are conducted. Correlation coefficient is calculated as a statistical measure of the strength of the relationship between the indicators of independent variable and dependent variable. Regression analysis was used to show the amount of variance in mLearning adoption accounted for by learner self-efficacy.

4.6.2.1 Correlation Analysis

Before testing the hypothesis, each of the indicators of learner self-efficacy a (Navigation of the mLearning platform, peer interaction, dependency and innovativeness) a correlation was conducted to measure the strength of the relationship between the indicators. The results are presented in Table 4.14.

Table 4.9: Correlation Results for Indicators of Self-Efficacy

		Navigation	Peer Interaction	Dependency	Innovativeness
Adoption of mLearning	Pearson Correlation	.209**	.240**	.408**	.403**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	294	294	294	294

**. Correlation is significant at the 0.01 level (2-tailed).

The results in Table 4.14 show that the learners' ability to navigate was found to be positively and significantly correlated with adoption of mLearning ($r=.209$, $p < 0.01$). Similarly, the analysis also showed that peer interaction while using the mLearning platform was positively and significantly correlated with adoption of mLearning ($r=.240$, $p < 0.01$). Learners' dependency in using the mLearning platform was positively and significantly correlated with adoption of mLearning ($r=.408$, $p < 0.01$). Likewise, Learners' technological innovativeness in using the mLearning platform was positively and significantly correlated with adoption of mLearning ($r=.403$, $p < 0.01$). Both dependency and innovativeness high levels of significance for adoption of mLearning, this implies that both must be put into consideration by mLearning instructional designers. The structuration designer should design platforms and content that allow for independent learning and innovation for higher adoption rates. This finding further implies that if learning institutions encourage ICT innovation, the more likely the learner are to adopt mLearning.

Next the researcher conducted a correlation on the combined indicators of self-efficacy. The results are shown in Table 4.15

Table 4.10: Correlation Results for Self-Efficacy

		self-efficacy
Adoption of mLearning	Pearson Correlation	.428**
	Sig. (2-tailed)	.000
	N	294

**. Correlation is significant at the 0.01 level (2-tailed).

The results in Table 4.15 indicate that (r=.428, $p < 0.01$). This means that learners' self-efficacy contributed to about 42.8% of the mLearning adoption. This finding implies that learner self-efficacy or learner's ability to use the mobile learning platform is an important consideration for mLearning adoption.

4.6.2.2 Simple Regression Analysis

For objective two, it was hypothesized that:

> $H_0$2: Learner self-efficacy has no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

To test the hypothesis, the model $Y = \beta_o + \beta_2 X_2$ was fitted. Table 4.16 shows the regression result analysis between learner self-efficacy and mLearning.

Table 4.11: Simple Regression Results of Learner Self-Efficacy

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.428[a]	.183	.180	.44113

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.823	1	10.823	55.620	.000[b]
	Residual	48.259	248	.195		
	Total	59.082	249			

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.223	.279		7.977	.000
	Learner Self-Efficacy	.501	.067	.428	7.458	.000

The results in Table 4.16 presents the overall result for all the indicators for self-efficacy. The results show that learner self-efficacy had a significant positive effect on mLearning adoption, F (1,248) = 55.620, p<0.001, R^2 = 0.183. The finding that R^2 = 0.183, implies that about 18% of variation in mLearning adoption is explained by variation on learner self-efficacy. The model equation therefore is;

$$Y = 2.223 + 0.501X_2$$

Where Y is mLearning adoption and X_2 is learner self-efficacy

It was hypothesized that:

> $H_0$2:Learner self-efficacy has no significant effect on adoption of mLearning for the mHealth community health training programme Kenya.

With, $\beta = 0.501, t = 7.977, p < 0.05$ it means that for one-unit increase in self-efficacy, mLearning adoption increases by about 0.501. Given that the p-value is < 0.05, the null

hypothesis was rejected and it was concluded that learner self-efficacy had a positive significant effect on mLearning adoption. This implies that institutions offering mLearning will need to ensure that the learners gain high efficacy in their ICT skills for them to achieve high adoption rates.

4.7 Learner Attitude and mLearning Adoption

This section covers data analysis for objective three which sought to investigates the influence of learner attitude on adoption of mLearning for the mHealth community health training programme in Kenya. Learner attitude was considered as likely to influence learner adoption of mLearning. Both descriptive and inferential analysis were conducted and the results are presented in this section.

4.7.1 Descriptive Analysis

In order to measure attitude three components of the learner attitude were measured on a 5-point Likert scale where: SA=Strongly Agree (5), A=Agree (4), U=Uncertain (3), D= Disagree (2), SD=Strongly Disagree (1). The items were adopted from existing scales and customised for the current study. The three learner attitude attributes considered for the current study include, attitude towards mobile learning technology, attitude towards use of mobile devices for learning, attitude towards mobile learning content. The findings are analysed and presented in Tables 4.17-4.19.

Table 4.12: Attitude Towards Mobile Learning

No.	Statement	SD	D	U	A	SA	Mean	Std. Deviation
1	mLearning promotes easy understanding of concepts	0.3%	0.3%	3.4%	42.0%	53.9%	4.49	.617
2	mLearning promotes independent learning	1.4%	0.3%	1.4%	42.1%	54.8%	4.49	.681
3	mLearning enables fast access to information	0.7%	1.0%	1.4%	31.7%	65.2%	4.60	.642
4	I enjoy using new technology to learn.	0.3%	0.3%	1.7%	31.9%	65.6%	4.62	.578
5	I believe mobile technology would enable me accomplish tasks quickly	0.0%	1.0%	1.0%	42.4%	55.5%	4.52	.577
6	I believe mobile technology offers increased access to learning	0.3%	1.0%	0.7%	38.5%	59.5%	4.56	.604
7	I feel I have the right skills to continue using mLearning	0.7%	0.3%	4.5%	35.2%	59.3%	4.52	.666
	N=294						$\bar{x}$ =4.543	

The results in Table 4.17 The results showed that 42.0% and 53.9% agreed and strongly agreed respectively that learning using a mobile device promotes easy understanding of concepts. Another 42.1% and 54.8% agreed and strongly agreed respectively that learning using a mobile device enables fast access to information. Another 31.7% Agreed and 65.2% strongly agreeing that learning using a mobile device enables fast access to information. Another 31.9% agreed and 65.6% strongly agreed that they enjoyed using new technology to learn while 42.4% agreed and 55.5% strongly agreed that they believed mobile technology would enable me accomplish tasks quickly. Likewise, 38.5% and 59.5% strongly agreed that mobile technology offers increased access to learning with 35.2% and 59.3% indicating agreed and strongly agreed respectively to the statement that they have the right skills to continue using mobile technology for learning.

Generally, all the means were above 4.5 and the standard deviation <1. This is an indication that the majority of the respondents had a positive attitude towards the use of mobile learning technology for learning purposes. This was partly validated by the Focus Group Discussions with the respondents where the learners expressed support and liking for the mLearning technology.

> *"…mLearning is a very good mode of learning…I am able to access content anytime anywhere as I undertake my daily chaos…"*

The next sub variable to be analysed was learner attitude towards use of mobile devices for learning, the findings are presented in Table 4.18.

Table 4.13: Attitude Towards Use of Mobile Devices

No.	Statement	**SD**	**D**	**U**	**A**	**SA**	Mean	Std. Deviation
1	Using a mobile device can help me to attain ideas.	0.3%	1.4%	1.0%	34.1%	63.1%	4.58	.624
2	In the mLearning environment, a mobile device can enhance my desire to learn.	1.0%	3.8%	1.0%	42.8%	51.4%	4.40	.783
3	*In the mLearning environment, the size of the mobile device makes me feel uncomfortable.	21.0%	28.2%	5.2%	22.7%	23.0%	2.99	1.509
4	I can apply mobile devices in various learning activities.	2.4%	1.7%	3.8%	42.8%	49.3%	4.35	.836
5	*It will take long for me to be comfortable using mobile technology for learning	29.7%	35.7%	5.9%	16.1%	12.6%	2.46	1.388
6	Using mobile technology for learning is a good idea	1.7%	0.3%	2.1%	33.8%	62.1%	4.54	.720
7	Using mobile technology for learning makes learning interesting	0.3%	3.5%	2.1%	35.3%	58.7%	4.49	.739
	N=294, *Negative items						$\bar{x}$=3.973	

The results in Table 4.18 revealed that the most of the learners had a positive attitude towards use of mobile devices for learning with exception for the size of the screen. 34.1% and 63.1% agreeing and strongly agreeing respectively of the respondents that using a mobile device can help them to attain more ideas. Majority of the respondents 42.8% and 51.4% agreeing and strongly agreeing respectively that in the mLearning environment, a mobile device can enhance their desire to learn.

However, 22.7% and 23.0% of the respondents agreed and strongly agreed respectively that the size of the mobile device makes them feel uncomfortable. 42.8% agreed while 49.3% strongly agreed respectively that they can apply mobile devices in various learning activities. Only16.1% and 12.6% agreed and strongly agreed respectively that it will take long for them to be comfortable using mobile technology for learning. 33.8% and 62.1% agreed and strongly agreed respectively that using mobile technology for learning is a good idea, 35.3% agreeing and 58.7% strongly agreeing with the statement that using mobile technology for learning makes learning interesting.

The next sub variable to be analysed was learner attitude towards use of mobile learning content, the findings are presented in Table 4.19.

Table 4.14: Attitude Towards Mobile Learning Content

No.	Statement	SA	A	U	D	SD	Mean	Std. Deviation
1	* mLearning content is inadequate for learning	27.4%	37.7%	11.0%	15.4%	8.6%	2.40	1.271
2	* mLearning content is not easy to understand	34.7%	41.4%	3.9%	11.9%	8.1%	2.17	1.251
3	* mLearning content should be supplemented with study modules	15.5%	23.1%	12.8%	24.5%	24.1%	3.19	1.426
4	*Content transmitted via mobile devices is too brief for my comprehension	26.0%	42.0%	6.2%	16.7%	9.0%	2.41	1.282
5	*I see using mobile technology to access content for learning taking longer than other modes of learning	39.1%	38.4%	4.1%	7.8%	10.5%	2.12	1.298
6	Interacting with learning content on mobile technology is fun	40.5%	45.7%	2.4%	7.6%	3.8%	4.12	1.031
7	I feel break down of content into small parts makes learning more meaningful	45.7%	41.6%	2.4%	4.8%	5.5%	4.17	1.069
	N=294, *Negative item						$\bar{x}$=2.94	

The results in Table 4.19 revealed that learner attitude towards mLearning content as a sub variable was generally low. The results show that 37.7% of the respondents agree with 27.4% strongly agreeing that the mLearning content is inadequate for learning. Another 41.4% agree while 34.7% strongly agree that mLearning content is not easy to understand. In addition, 23.1% agree while 15.5% strongly agree that mLearning content should be supplemented with study modules. Another 42.0% agree while 26.0% strongly agree that content transmitted via mobile devices is too brief for their comprehension. Moreover, 38.4% agree while 39.1% strongly agree that using mobile technology to access content for learning taking longer. On the other hand, 45.7% agree while 40.5% strongly agree that interacting with learning content on mobile technology is fun. Finally, 41.6% of the

respondents agree while 45.7% strongly agree that break down of content into small parts makes learning more meaningful.

The results in Table 4.19 show that the attitude towards mobile learning content was low with an average mean of 2.94 although the opinion was spread with the standard deviation for all the items >1. The implication of this finding is that there is need to improve on the way mLearning content is packaged and or offer mLearning as a component of blended learning integrating it with other modes of distance learning delivery.

4.7.2 Correlation and Regression Analysis

Under objective three the study sought to determine the relationship between learner attitude and adoption of mLearning. Correlation and simple regression analysis are conducted.

4.7.2.1 Correlation of indicators of Attitude and mLearning Adoption

Prior to testing the hypothesis each of the indicators of learner attitude towards mobile learning as identified for this study (attitude towards mLearning technology, use of mobile phone for learning and towards mLearning content) a correlation analysis was conducted. The results are presented in Table 4.20

Table 4.20: Correlation Results for Indicators of Learner Attitude

		mLearning technology	use of mobile phone for learning	mLearning Content
Adoption of mLearning	Pearson Correlation	.389**	.241**	.410**
	Sig. (2-tailed)	.000	.000	.000
	N	294	294	294

**. Correlation is significant at the 0.01 level (2-tailed).

The results in Table 4.20 show that the learners' attitude towards mLearning technology was found to be positively and significantly correlated with adoption of mLearning ($r=.389$ $p < 0.01$). Equally, the analysis also showed that learner attitude towards use of mobile phone for learning was positively and significantly correlated with adoption of mLearning ($r=.241$ $p < 0.01$). Learners' Attitude towards use of mLearning Content for learning was positively and significantly correlated with adoption of mLearning ($r=.410$ $p < 0.01$). This implies that of the three attitude indicators, attitude towards mLearning content has the highest contribution to mLearning adoption. This finding further implies that if learning institutions encourage use of mLearning content that is friendly to the end user, the more likely the learner are to adopt mLearning.

Further, a correlation of the overall mLearning attitude was done and is presented in Table 4.21.

Table 4.21: Correlation Results for Learner Attitude

		Learner Attitude
Adoption of mLearning	Pearson Correlation	.483**
	Sig. (2-tailed)	.000
	N	294

**. Correlation is significant at the 0.01 level (2-tailed).

The results in Table 4.21 indicate that ($r=.483p < 0.01$). This means that learners' attitude towards mLearning contributed to about 48.3% of the mLearning adoption. This finding

implies that learner attitude towards mLearning is an important consideration for mLearning adoption.

4.7.2.2 Simple Regression of Attitude and adoption of mLearning

For objective three, it was hypothesized that:

> $H_0$3: Learner attitude has no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

To test the hypothesis, the model $Y = \beta_o + \beta_3 X_3$ was fitted. Table 4.22 shows the regression result analysis between learner attitude and mLearning.

Table 4.15: Simple Regression for Learner Attitude

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.483[a]	.233	.230	.42638

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.466	1	13.466	74.072	.000[b]
	Residual	44.359	244	.182		
	Total	57.825	245			

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.585	.316		5.019	.000
	Learner Attitude	.643	.075	.483	8.607	.000

The results in Table 4.22 presents the overall result for all the indicators for learner attitude towards mLearning. The results show that learner attitude had a significant positive effect on adoption of mLearning, F (1,244) = 74.072, p<0.001, R^2 = 0.233. The finding that R^2 = 0.233, implies that about 23% of variation in mLearning adoption is explained by variation on

learner self-efficacy. R = 0.483 meaning that learner attitude towards mLearning contributed to about 48% of the mLearning adoption. The model equation therefore is;

$$Y = 1.585 + 0.643X_3$$

Where Y is mLearning adoption and X_3 is learner attitude towards mLearning

With, $\beta = 0.643, t = 5.019, p < 0.05$ it means that for one-unit increase in learner attitude towards mLearning, mLearning adoption increases by about 0.643. Given that the p-value is < 0.05, the null hypothesis was rejected and it was concluded that there is significant relationship between learner attitude towards mLearning and mLearning adoption. This implies that institutions offering mLearning will need to ensure that the learners develop positive attitude towards mLearning in order to achieve high adoption rates.

4.8 Behavioural Intention and Mobile Learning Adoption

Another determinant of end user adoption of mLearning was behavioural intention which was customised to measure learner future intention to adopt mLearning. Behavioural intention was measured by four indicators as follows, social influence, performance expectancy, effort expectancy and facilitating conditions. These items were tested using a 5-point Likert scale where: SA=Strongly Agree, A=Agree, U=Uncertain, D=Disagree, SD=Strongly Disagree. Both descriptive and inferential analysis were conducted and the results of the analysis are presented in this section.

4.8.1 Descriptive Analysis

Descriptive results for each of the four indicators of behavioural intention are analysed and presented in Tables 4.23-4.26.

Table 4.16: Social Influence

o.	Statement	SD	D	U	A	SA	Mean	Std. Deviation
1	In general, my peers support the use of mLearning	1.4%	3.1%	2.7%	51.7%	41.2%	4.28	.778
2	People who are important to me think that I should use mLearning.	2.0%	1.7%	3.1%	56.5%	36.7%	4.24	.770
3	The facilitators and other staff are helpful during mLearning	0.7%	2.4%	1.7%	42.8%	52.4%	4.44	.714
4	I choose the new learning style because my immediate supervisor supports it.	5.5%	14.1%	6.9%	33.7%	39.9%	3.88	1.232
5	Support from the institution influence my decision to use mLearning	4.5%	7.9%	4.1%	42.8%	40.8%	4.08	1.078
6	People who influence my behavior think I should use mLearning	3.8%	12.6%	9.8%	44.8%	29.0%	3.83	1.101
7	mLearning activities encourage discussion and collaboration among students.	1.7%	4.1%	2.7%	41.3%	50.2%	4.34	.856
	N=294						$\bar{x}$=4.16	

The results in table 4.23 show that 51.7% and 41.2% of the respondents agree and strongly agree respectively with the statement that, in general, their peers support the use of mobile devices for learning with 56.5% and 36.7% strongly agreeing and agreeing respectively to the statement that the facilitators and other staff are helpful in the use of mobile learning. Indeed, 33.7% and 39.9% of the respondents agree and strongly agree respectively that they choose the new learning style because their immediate supervisor supports it with 42.8% and 40.8% strongly agreeing and agreeing respectively that support from the institution influence their decision to use mobile devices for learning. 44.8% and 29.0% of the respondents agree and strongly agree respectively that people who influence their behaviour will think that they should use mobile learning with 41.3% and 50.2% of the respondents agreeing and strongly agreeing respectively mobile learning activities encourage discussion and collaboration among students.

Generally, the results imply that majority of the respondents had high social Influence towards adoption of mLearning meaning that the decision to adopt is influenced by the social environment with the mean ranging between 3.83 and 4.44 and a standard deviation of less than 1 or slightly above 1 for most of the items.

The second sub variable of behaviour intention to be analysed was performance expectancy, the findings are presented in Table 4.24.

Table 4.17: Performance Expectancy

No.	Statement	**SD**	**D**	**U**	**A**	**SA**	Mean	Std. Deviation
1	mLearning enables quick accomplishment of learning activities.	0.7%	0.7%	1.7%	33.3%	63.6%	4.59	.633
2	mLearning helps improve performance.	0.3%	1.4%	1.0%	44.6%	52.7%	4.48	.628
3	mLearning increases learning outcomes	0.7%	1.7%	3.4%	39.0%	55.1%	4.46	.710
4	mLearning allows fast access e information.	0.3%	1.4%	2.4%	36.1%	59.7%	4.53	.651
5	mLearning enables me to complete lessons more quickly.	0.7%	1.0%	1.7%	38.3%	58.3%	4.52	.656
6	mLearning enables quick feedback.	1.0%	2.8%	3.4%	40.3%	52.4%	4.40	.775
7	mLearning improves thinking when responding to questions.	1.0%	1.7%	1.0%	44.5%	51.7%	4.44	.703
	N=294						$\bar{x}$=4.49	

The results in Table 4.24 revealed that 33.3% and 63.6% of the respondents agree and strongly agree respectively to the statement that using mobile devices for learning will enable them to accomplish learning activities as a CHV more quickly, with 44.6% and 52.7% agreeing and strongly agreeing respectively that using mobile devices for learning helps improve performance. The results further showed that 39.0% and 55.1% of the respondents agree and strongly agree respectively that using mobile devices for learning will

allow them to have access to more information with 38.3% and 58.3% agreeing and strongly agreeing respectively that using mobile learning enables them to complete lessons more quickly. The results also show that 40.3% and 52.4% of the respondents agree and strongly agree respectively that using mobile learning enables them to get feedback more quickly while 44.5% and 51.7% agree and strongly agree respectively that the mobile learning platform helps improve the way they think when answering questions.

With the mean ranging between 4.40 and 4.59 and the standard deviation <1 for all the seven items it means that the majority of the respondents had high performance expectancy on mobile learning.

The third sub variable of behaviour intention to be analysed was effort expectancy, the findings are presented in Table 4.25.

Table 4.18: Effort Expectancy

No.	Statement	**SD**	**D**	**U**	**A**	**SA**	Mean	Std. Deviation
1	I find mLearning easy	2.1%	2.1%	2.1%	37.0%	56.8%	4.45	.813
2	Completing lessons using mLearning requires a lot of effort	18.5%	27.5%	4.5%	26.1%	23.3%	3.08	1.487
3	Interacting with supervisors and peers is easy on the mLearning platform	0.3%	3.4%	6.5%	43.3%	46.4%	4.32	.773
4	Learning to operate mLearning applications is easy for me	0.0%	1.7%	0.7%	44.9%	52.7%	4.49	.606
5	My interaction with mLearning applications is clear and understandable	0.3%	3.1%	2.4%	43.7%	50.5%	4.41	.719
6	It would be easy for me to become skillful at using mobile devices for learning	0.3%	2.7%	6.2%	36.8%	54.0%	4.41	.758
7	Access to content, quizzes, is easy using mobile devices	0.7%	4.5%	2.8%	42.7%	49.3%	4.35	.800
	N=294						$\bar{x}$=4.22	

The results in Table 4.25 reveal that 37.0% and 56.8% of the respondents agree and strongly agree respectively to that they find using mobile devices to learn easy. The next statement was stated in the reverse thus 26.1% and 23.3% of the respondents agree and strongly agree respectively. Further, it was established that 43.3% and 46.4% of the respondents agree and strongly agree respectively that interacting with supervisors and peers is easy on the mobile learning platform while 44.9% and 52.7% of the respondents agree and strongly agree respectively that Learning to operate mobile learning applications is easy. The results further showed that 43.7% and 50.5% the respondents agree and strongly agree respectively that their interaction with mobile learning applications is clear and understandable while 36.8% and 54.0% agree and strongly agree respectively that it would be easy for them to become skillful at using mobile devices for learning. 42.7% agreed and 49.3% strongly agreed that access to content, quizzes, is easy using mobile devices.

The mean was 4.32 and 4.45 except for item number 2 which had a mean of 3.08. equally the standard deviation was < 1 except for item number 2 which had a standard deviation of 1.487. These results imply that majority if the learners had high effort expectancy on mobile learning.

The fourth and final sub variable of behaviour intention to be analyzed was facilitating conditions, the findings are presented in Table 4.26.

Table 4. 19: Facilitating Conditions

No.	Statement	SD	D	U	A	SA	Mean	Std. Deviation
1	I have the necessary resources to use mLearning	4.1%	12.4%	13.8%	38.6%	31.0%	3.80	1.132
2	I have the necessary knowledge to use mLearning	1.0%	4.1%	2.4%	40.5%	52.0%	4.38	.809
3	With support, I would continue use mLearning	1.7%	2.0%	1.4%	41.2%	53.7%	4.43	.775
4	Using a mLearning is fun	2.4%	6.2%	2.1%	36.3%	52.9%	4.31	.961
5	mLearning applications are similar to other systems I use in mobile devices	5.2%	9.3%	7.6%	42.4%	35.5%	3.94	1.127
6	Availability of help when I get an mLearning problem is an important factor in lesson completion	3.1%	6.9%	3.4%	41.2%	45.4%	4.19	1.004
7	Clarity of language used in the mLearning platform is an important factor in lesson completion	0.3%	1.4%	1.7%	41.0%	55.6%	4.50	.639
	N=29						$\bar{x}$=4.22	

The results in Table 4.26 revealed that 38.6% agreed while 31.0% strongly agreed that they have the resources necessary to use mobile devices for learning, with 40.5% and 52.0% agreeing and strongly agreeing respectively that they have the necessary knowledge to use mobile devices for learning. Further, 41.2% and 53.7% agreed and strongly agreed respectively that with support, I would continue use the mobile devices for learning with 36.3% agreeing and 52.9% strongly agreeing that using a mobile device for learning is fun. The results also showed that 42.4% and 35.5% of the respondents agreed and strongly agreed respectively that mobile learning applications are similar to other systems they use in mobile devices with indicating 41.2% agree and 45.4% strongly agree on the statement that availability of help when they had an mLearning problem is an important factor in lesson completion with another 41.0% and 55.6% agreeing and strongly agreeing respectively that the clarity of language used in the mobile learning platform is an important factor in lesson completion.

With the mean ranging between 3.80 and 4.50 and the standard averaging 0.921 for the results reveal that facilitating conditions played a key role adoption of mLearning for the majority of the respondents.

4.8.2 Correlation and Simple Regression Analysis

Under objective four the study sought to determine the relationship between behavioural intention and mLearning adoption. A correlation analysis for the indicators of behavioural intention; social influence, performance expectancy, effort expectancy and facilitating conditions was conducted to assessed for their association with the dependent variable. Simple regression analysis was used to show the amount of variance in mLearning adoption accounted for by behavioural intention.

4.8.2.1 Correlation of indicators of Behavioural Intention and mLearning Adoption

Before testing the hypothesis, a correlation analysis for the indicators of behavioural intention was conducted to assessed for their association with the dependent variable. The findings are presented in Tables 4.27.

Table 4.20: Correlation Results for the Indicators of Behavioural Intention

		Social Influence (SI)	Performance Expectancy (PE)	Effort Expectancy (EE)	Facilitating Conditions (FC)
Adoption of mLearning	Pearson Correlation	.348**	.358**	.416**	.336**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	294	294	294	294

**. Correlation is significant at the 0.01 level (2-tailed).

The results in Table 4.27 show that Social Influence was positively and significantly correlated with adoption of mLearning (r=.348, p < 0.01). Equally, the analysis also showed that Performance Expectancy was positively and significantly correlated with adoption of mLearning a (r=.358, p <0.01). Effort Expectancy was positively and significantly correlated with adoption of mLearning (r=.416, p < 0.01) while Facilitating Conditions was positively and significantly correlated with adoption of mLearning (r=.336, p < 0.01). This implies that of the four indicators, effort expectancy has the highest correlation to the adoption of mLearning.

Further, a correlation of the overall behavioural intention was done and is presented in Table 4.28.

Table 4.28: Correlation Results for Learners' Behavioural Intention

		Behavioural Intention
Adoption of mLearning	Pearson Correlation	.502
	Sig. (2-tailed)	.000
	N	294

**. Correlation is significant at the 0.01 level (2-tailed).

The results in Table 4.28 indicate that (r=.502p < 0.01). This means that learners' behavioural intention contributed to about 50.2% of the mLearning adoption. This imply that learn intention to adopt mLearning contributes significantly in actual adoption and therefore needs to be put into consideration by institutions considering mLearning g adoption.

4.8.2.2 Simple Regression Results of Behavioural Intention and mLearning Adoption

For objective four, it was hypothesized that:

> $H_0$4: Learner behavioural intention has no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

Table 4.29 shows the results of simple regression analysis between learner behavioural intention and mLearning.

Table 4.21: Simple Regression for Behavioural Intention

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.502[a]	.252	.249	.43800

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.734	1	15.734	82.017	.000[b]
	Residual	46.809	244	.192		
	Total	62.544	245			

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.004	.362		2.773	.006
	Behavioural Intention	.766	.085	.502	9.056	.000

The results in Table 4.29 presents the overall result for all the indicators for behavioural intention. The results show that behavioural intention had a significant positive effect on adoption of mLearning, F (1,244) = 82.017, p<0.001, R^2 = 0.252. The finding that R^2 = 0.252, implies that about 25% of variation in mLearning adoption is explained by variation on behavioural intention. R=0.502 meaning that behavioural intention contributed to about 50 % of the mLearning adoption. The model equation therefore is;

$$Y = 1.004 + 0.766X_3$$

Where Y is mLearning adoption and X_2 is behavioural intention

With, $\beta = 0.766, t = 2.773, p < 0.05$ it means that for one-unit increase in behavioural intention, mLearning adoption increases by about 0.766. Given that the p-value is < 0.05, the

null hypothesis was rejected and it was concluded that behavioural intention had a significant effect on mLearning adoption. This implies that the higher the behavioural intention to use mLearning, the higher the chances of mLearning adoption.

4.9 Technology Use and Mobile Learning Adoption

Under objective five the study sought to determine the relationship between technology use and mLearning adoption. Technology use was measured by two indicators. Device functionality and content delivery technology. These items were tested using a 5-point Likert scale where: SA=Strongly Agree, A=Agree, U=Uncertain, D= Disagree, SD= Strongly Disagree. Both descriptive and inferential analysis were conducted and the results of the analysis are presented in this section.

4.9.1 Descriptive Analysis

The descriptive analysis of the first sub variable of technology use – device functionality is presented in Table 4.30.

Table 4.30: Device functionality

No.	Statement	**SD**	**D**	**U**	**A**	**SA**	Mean	Std. Deviation
1	The type of mobile phone one uses influences the way one accesses content.	4.8%	10.2%	2.7%	41.6%	40.6%	4.03	1.130
2	Battery life and access to power affects effective access to content	5.1%	4.8%	3.7%	36.7%	49.7%	4.21	1.069
3	The mobile phone screen size affects effective learning	6.2%	17.0%	3.1%	38.1%	35.6%	3.80	1.262
4	Phone memory affects effective access to content	7.1%	5.8%	2.0%	42.5%	42.5%	4.07	1.148
	N=294						$\bar{x}$=4.03	

The results in Table 4.30 show that 41.6% agree with an equal number strongly agreeing that the type of mobile phone one uses influences the way one accesses content. Another 36.7% and 49.7% agree and strongly agree respectively with the statement that battery life and access to power affects effective access to content with 38.1% and 35.6% indicating that they agree and strongly agree respectively with the statement that the mobile phone screen size affects effective learning. Another 42.5% agree with an equal number strongly agreeing that phone memory affects effective access to content.

The mean was between 3.80 and 4.21 with a variance of more > 1 in all the items meaning that most of the respondents felt device functionality affects adoption of mLearning but the scores were relatively spread between those who agreed and those who strongly agreed.

The next sub variable on technology use was content delivery technology, the descriptive analysis is presented in Table 4.31.

Table 4.31: Effectiveness of Content Delivery Technology

No.	Statement	**SD**	**D**	**U**	**A**	**SA**	Mean	Std. Deviation
1	Short Message Service (SMS)	1.7%	5.5%	6.2%	41.4%	45.2%	4.23	.915
2	Interactive Voice Response (IVR)	3.1%	8.2%	3.4%	47.8%	37.5%	4.09	1.005
3	Group chat	0.7%	4.5%	3.1%	36.3%	55.4%	4.41	.812
4	Case studies and scenarios	1.0%	4.1%	3.8%	46.0%	45.0%	4.30	.812
	N=294						$\bar{x}$=4.26	

On technology delivery technology, results in Table 4.31 show that 41.4% and 45.2% of the respondents agree and strongly agree respectively that Short Message Service (SMS) is effective for delivering learning content. On IVR, 47.8% and 37.5% agree and strongly agree that respectively to the statement that, IVR is effective for delivering learning content.

On group chat, 36.3% and 55.4% of the respondents indicated that they agree and strongly agree respectively that group chat is effective for learning. Another 46.0% and 45.0% agreeing and strongly agreeing respectively with the statement that case studies and scenarios are effective in delivering learning content

The average mean for three out four items was 4.26 and a standard deviation of less <1 for SMS, Group chat and case studies and scenario meaning majority of the respondents were in agreement on those items. However, for the Interactive Voice Response (IVR) the standard deviation was 1.005 meaning that there was small variation in opinion.

4.9.2 Correlation and Simple Regression Analysis

Under objective five the study sought to determine the relationship between technology use and mLearning adoption. Correlation and simple regression analysis are conducted.

4.9.2.1: Correlation of Technology Use and Adoption mLearning

Before testing the hypothesis, a correlation analysis for the two indicators of technology use (device functionality and content delivery technology) was conducted to measure the strength of the relationship between the indicators and the dependent variables. The results are presented in Table 4.32.

Table 4. 32: Correlation Analysis for Indicators of Technology Use

		Device functionality	Content delivery technology
Adoption of mLearning	Pearson Correlation	.130*	.433**
	Sig. (2-tailed)	.031	.000
	N	294	294

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The results in Table 4.32 show that device functionality was positively and significantly correlated with adoption of mLearning (r=.130, $p < 0.05$). Equally, the analysis also showed that Content delivery technology was positively and significantly correlated with adoption of mLearning (r=.433, $p < 0.01$).

This implies that of the two indicators, of technology use, content delivery technology has the highest correlation to adoption of mLearning. It is therefore, critical that institutional designers pay great attention to the packaging of the content and choice of delivery technology in order to enhance adoption of mLearning. The next analysis is a correlation of the overall technology use Table 4.33.

Table 4.3322: Correlation Analysis for Technology Use

		Technology Use
Adoption of mLearning	Pearson Correlation	.324**
	Sig. (2-tailed)	.000
	N	294

**. Correlation is significant at the 0.01 level (2-tailed).

The results in Table 4.33 indicate that (r=.324$p < 0.01$). This means that technology use contributed to about 32.4% of the mLearning adoption. This imply that technology use has a

significant relationship with actual adoption of mLearning and therefore needs to be put into consideration by institutions considering mLearning g adoption.

4.9.2.2: Simple regression Analysis for Technology Use and Adoption of mLearning

Simple regression analysis was used to show the amount of variance in mLearning adoption accounted for by technology use. For objective five, it was hypothesized that:

> $H_0$5: Technology use has no significant effect on adoption of mLearning for the mHealth community health training programme Kenya.

To test the hypothesis, the model $Y = \beta_o + \beta_5 X_5$ was fitted. Table 4.34 shows the results of regression analysis between technology use and adoption of mLearning.

Table 4.23: Simple regression analysis for Technology Use

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.324	.105	.101	.47179

a. Predictors: (Constant), x5

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.036	1	7.036	31.610	.000
	Residual	60.097	270	.223		
	Total	67.133	271			

a. Dependent Variable: y1

b. Predictors: (Constant), Technology Use

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.945	.239		12.315	.000
	Technology Use	.315	.056	.324	5.622	.000

The results in Table 4.34 presents the overall result for all the indicators for technology use. The results show that technology use had a significant positive effect on adoption of

mLearning, F (1,270) = 31.610, p<0.001, R^2 = 0.105. The finding that R^2 = 0.105, implies that about 11% of variation in mLearning adoption is explained by variation on technology being used to deliver mLearning. R = 0.324 meaning that the technology used contributed to about 32 % of the mLearning adoption. The model equation therefore is;

$$Y = 2.945 + 0.315X_5$$

Where Y is mLearning adoption and X_5 is technology use

With, $\beta = 315, t = 12.315, p < 0.05$ it means that for one-unit improvement in technology used, mLearning adoption increases by about 0.315. Given that the p-value is < 0.05, the null hypothesis was rejected and it was concluded that technology use had a significant positive effect on mLearning adoption. This implies that the more efficient the technology and the content delivery methodology, the higher the chances of adoption of mLearning.

4.10 Institutional Factors and Mobile Learning Adoption

Under objective six the study sought to determine the relationship between institutional factors (intervening variable) and mLearning adoption. The institutional factors were measured by a set of 7 items. These items were tested using a 5-point Likert scale where: SA=Strongly Agree, A=Agree, U=Uncertain, D= Disagree, SD= Strongly Disagree. Both descriptive and inferential analysis were conducted and the results of the analysis are presented in this section.

4.10.1 Descriptive Analysis

Table 4.35 presents descriptive analysis of institutional factors.

Table 4.24: Institutional Factors

No.	Statement	**SD**	**D**	**U**	**A**	**SA**	Mean	Std. Deviation
1	Access to institutional support influences use of mLearning	1.4%	3.4%	2.1%	40.5%	52.6%	4.40	.808
2	Timely feedback on the mLearning platform influences continued use of mobile devices for learning	1.0%	1.7%	1.7%	48.6%	46.9%	4.39	.705
3	Transmission of content affects progression in learning	6.2%	6.2%	2.4%	47.9%	37.3%	4.04	1.096
4	The clarity of content influence completion of lessons	1.7%	5.5%	3.1%	39.7%	50.0%	4.31	.903
5	The clarity of content influences mLearning use	1.4%	3.6%	3.6%	40.4%	50.9%	4.36	.833
6	Training on use of mLearning influences use of mobile devices for learning	1.0%	2.8%	2.1%	36.4%	57.7%	4.47	.766
7	Motivation from the institution and support staff influences use of mobile devices for learning	1.7%	4.8%	1.7%	34.3%	57.4%	4.41	.882
	N=294						$\bar{x}$= 4.32	

The analysis in Table 4.35 show that 40.5% and 52.6% of the respondents agree and strongly agree respectively, that access to institutional support influences learning using mobile devices for learning. Another 48.6% and 46.9% agreeing and strongly agreeing respectively that timely feedback on the mLearning platform influences continued use of mobile devices for learning. Another 47.9% and 37.3% agree and strongly agree respectively that transmission of content affects progression in learning with 39.7% and 50.0% indicating agree and strongly agree respectively to the item that the clarity of content influence completion of lessons. Another 40.4% and 50.9% agreeing and strongly agreeing respectively that the clarity of content influences mLearning use with 36.4% and 57.7% indicating agree and strongly agree to the statement that training on use of mLearning influences use of mobile devices for learning. Finally, 34.3% and 57.4% agree and strongly agree respectively

that motivation from the institution and support staff influences use of mobile devices for learning.

The mean raged between 4.05 and 4.47 with a standard deviation of <1 for all the items except on item number 3 on transmission of content which was 1.096. This implies that institutional factors, in the opinion of the majority respondents, influences the adoption of mLearning.

4.10.2 Simple Regression Analysis

Regression analysis was used to show the amount of variance in mLearning adoption accounted for by institutional factors.

For objective six, it was hypothesized that:

i) $H_0$6: Institutional factors have no significant effect on adoption of mLearning for the mHealth community health training programme Kenya.

To test the hypothesis, the model $Y = \beta_o + \beta_6 X_6$ was fitted. Table 4.26 shows the regression result analysis between institutional factors and adoption of mLearning.

The findings are presented in Tables 4.36.

Table 4.25: Simple regression results for Institutional Factors

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	.476[a]	.227	.224	.43553	
ANOVA					
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14.404	1	14.404	75.933	.000[b]
	Residual	49.129	259	.190		
	Total	63.533	260			
Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.111	.250		8.456	.000
	Institutional Factors	.497	.057	.476	8.714	.000

The results in Table 4.36 presents the results for the institutional factors. The results show that institutional factors had a significant positive effect on adoption of mLearning, F (1,259) = 75.933, p<0.001, R^2 = 0.227. The finding that R^2 = 0.227, implies that about 22% of variation in mLearning adoption is explained by variation on institutional factors, R = 0.476 meaning that institutional factors contributed to about 47% of the mLearning adoption. The model equation therefore is;

$$Y = 2.111 + 0.497X_6$$

Where Y is mLearning adoption and X_6 is institutional factors

With, $\beta = 0.497, t = 8.456, p < 0.05$ it means that for one-unit improvement in institutional factors, adoption of mLearning increases by about 0.497. Given that the p-value is < 0.05, the null hypothesis was rejected and it was concluded that institutional factors had a significant positive effect on mLearning adoption. This implies that the more efficient the institutional factors, the higher the chances of adoption of mLearning.

4.11 Combined effect of Learner Behaviour, Technology Use on Adoption of mLearning

Under objective seven, regression analysis was done to examine the extent to which combined influence of learner characteristics, learner self-efficacy, learner attitude, behaviour intention and technology use influence adoption of mLearning. For this objective, it was hypothesized that:

> $H_0$7: The combined influence of learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya..

To test the hypothesis, the model $Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$ was fitted. The results are presented in Table 4.37.

Table 4.26: Multiple regression Results for the Combined Variables

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.699[a]	.489	.475	.36670

ANOVA[a]						
Model			Sum of Squares	df	Mean Square	F	Sig.
1	Regression		24.420	5	4.884	36.321	.000[b]
	Residual		25.549	190	.134		
	Total		49.969	195			

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.075	.363		.206	.0837
	Learner characteristics	.126	.018	.389	7.088	.000
	Learner self-efficacy	.123	.086	.102	1.440	.0151
	Learner attitude	.152	.107	.111	1.422	.0157
	Behavioural Intention	.443	.112	.292	3.968	.000
	Technology use	.079	.063	.078	1.257	.021

The results in Table 4.37 shows that the combined influence of learner characteristics, learner behaviour and technology use had a significant positive effect on adoption of mLearning, $F(5,190) = 36.321$, $p<0.001$, $R^2 = 0.489$. The finding that $R^2 = 0.489$, implies that about 49% of variation in mLearning adoption is explained by variation on by the combined influence of learner characteristics, learner self-efficacy, behaviour intention and technology use. $R = 0.699$ meaning that the combined influence of learner characteristics, learner behaviour and technology use influence contributed to about 70% of the mLearning adoption. This high contribution implies that adoption is a result of multiple factors and therefore better results are achieved when the factors are combined. However, the model did not explain 30% of the variation meaning there are other factors not fitted in the model but are associated with adoption.

The Beta Coefficient for learner characteristics (Professional experience, academic achievement and prior exposure to mLearning) in the combined model was significant ($\beta = 0.126, t = 7.088, p < 0.05$) meaning that for every one-unit increase in learner characteristics (Professional experience, academic achievement and prior exposure to mLearning), mLearning adoption increases by about 0.126 units.

The Beta Coefficient for learner self-efficacy in the combined model was significant ($\beta = 0.123, t = 1.440, p < 0.05$) meaning that for every one-unit increase in learner self-efficacy, mLearning adoption increases by about 0.123 units.

The Beta Coefficient for learner attitude in the combined model was significant ($\beta = 0.152, t = 1.422, p < 0.05$) meaning that for every one-unit increase in learner attitude, mLearning adoption increases by about 0.152 units.

The Beta Coefficient for learner Behavioural Intention in the combined model was significant ($\beta = 0.443, t = 3968, p < 0.05$) meaning that for every one-unit increase in learner attitude, adoption of mLearning increases by about 0.443 units.

The Beta Coefficient for delivery technology use in the combined model was significant ($\beta = 0.079, t = 1.257, p < 0.05$) meaning that for every one-unit improvement in delivery technology use, adoption of mLearning increases by about 0.079 units.

The model equation therefore is;

$$Y = 0.075 + 0.126X_1 + 0.123X_2 + 0.152X_3 + 0.443X_4 + 079X_5 + \varepsilon$$

Where Y is mLearning adoption and X_1 =Learner characteristics, X_2 = Learner mLearning self-efficacy, X_3 =Learner attitude X_4= behavioural intention, X_5 = technology use. Given that the p-value is < 0.05, the null hypothesis was rejected and it was concluded that there is a significant relationship between the combined relationship between determinants of mLearning adoption and mLearning adoption. This implies learning institutions will have need to enhance the determinants of mLearning adoption jointly since they are interrelated and produce better results on adoption of mLearning when handled together.

4.12 Moderating Effect of Institutional Factors on the Relationship Between Learner Characteristics, Learner Behaviour and Technology Use and Adoption of mLearning.

Under objective eight, regression analysis was done to examine the moderating effect of institutional factors on the relationship between learner characteristics, learner behaviour and technology use and adoption of mLearning. For this objective, it was hypothesized that:

> $H_0$8: Institutional factors have no significant moderating effect on the relationship between learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use on adoption of mLearning for the mHealth community health training programme Kenya.

To test the hypothesis, the model

$Y = \beta_o + \beta_1 X_{1m} + \beta_2 X_{2m} + \beta_3 X_{3m} + \beta_4 X_{4m} + \beta_5 X_{5m} + \varepsilon$ was fitted. Table 4.38 shows the regression result analysis.

Table 4.27:Moderating Effect Multiple regression Results.

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	.726[a]	.528	.514	.35300	

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24.788	5	4.958	39.784	.000[b]
	Residual	22.181	178	.125		
	Total	46.968	183			

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.264	.170		13.347	.000
	x1.m	.026	.004	.424	6.553	.000
	x2.m	.047	.020	.287	2.376	.019
	x3.m	.026	.024	.162	1.111	.0268
	x4.m	.057	.024	.339	2.389	.018
	x5.m	.010	.014	.071	.731	.0466

a. Predictors: (Constant), x5.m, x1.m, x3.m, x2.m, x4.m

b. Dependent Variable: y1

The results in Table 4.38 show that the moderating effect of institutional factors on the relationship between learner characteristics, learner mLearning self-efficacy, learner attitude, behavioural Intention, technology use had a significant positive effect on adoption of mLearning, F (5,178) = 39.784, p<0.001, R^2 = 0.528. The finding that R^2 = 0.528, implies that about 53% of variation in mLearning adoption is explained by variation on by the combined influence of learner characteristics, learner self-efficacy, behaviour intention and technology use with the moderating effect of institutional factors.

It was observed that the percentage of variation accounted for by the model went up from 48.9% to 52.8% meaning that the moderator as a predictor accounted for 3.9% variation in adoption of mLearning. The small percentage difference can be explained by the fact that the

institutional factors were packaged uniformly for all the learners with small variations expected.

R = 0.726 meaning that the moderating effect of institutional factors on the relationship between learner characteristics, learner mLearning self-efficacy, learner attitude, behavioural Intention, technology use contributed to about 73% of the mLearning adoption.

The Beta Coefficient for learner characteristics as a predictor (Professional experience, academic achievement and prior exposure to mLearning) was significant ($\beta = 0.026, t = 6.553, p < 0.05$) meaning that for every one-unit increase in learner characteristics index (Professional experience, academic achievement and prior exposure to mLearning), mLearning adoption increases by about 0.026 units.

The Beta Coefficient for learner self-efficacy as a predictor in the presence of the moderating variable was significant ($\beta = 0.047, t = 2.376,\ p < 0.05$) meaning that for every one-unit increase in learner self-efficacy, mLearning adoption increases by about 0.123 units.

The Beta Coefficient for learner attitude as a predictor in the presence of the moderating variable was significant ($\beta = 0.026, t = 1.111, p < 0.05$) meaning that for every one-unit increase in learner attitude, mLearning adoption increases by about -0.026 units.

The Beta Coefficient for learner Behavioural Intention as a predictor in the presence of the moderating variable was significant ($\beta = 0.057, t = 2.389, p < 0.05$) meaning that for every one-unit increase in learner attitude, adoption of mLearning increases by about 0.057 units.

The Beta Coefficient for delivery technology use as a predictor in the presence of the moderating variable was significant ($\beta = 0.010, t = 0.731, p < 0.05$) meaning that for every one-unit improvement in delivery technology use, adoption of mLearning increases by about 0.010 units.

The model equation therefore is;

$$Y = 2.264 + 0.026X_{1m} + 0.047X_{2m} + 0.026X_{3m} + 0.057X_{4m} + 0.010X_{5m} + \varepsilon$$

Where Y is mLearning adoption and X_{1m} =Learner characteristics with a moderating effect, X_{2m} = Learner mLearning self-efficacy with a moderating effect, $X_3\,m$=Learner attitude with a moderating effect X_{4m}= Behavioural Intention with a moderating effect, X_{m5} = Technology use with a moderating effect.

Given that the p-value is < 0.05, the null hypothesis was rejected and it was concluded that there is a significant relationship between the moderating effect of institutional factors on the relationship between learner characteristics, learner behaviour and technology use and adoption of mLearning.

Table 39: Summary of hypothesis testing and results

Hypothesis	Finding	Conclusion
$H_0$1:Learner characteristics have no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Learner characteristics had appositive and significant positive effect on adoption of mLearning	Null hypothesis rejected
$H_0$2: Learner self-efficacy has no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Learner self-efficacy had appositive and significant positive effect on adoption of mLearning	Null hypothesis rejected
$H_0$3: Learner attitude has no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Learner attitude had appositive and significant positive effect on adoption of mLearning	Null hypothesis rejected
$H_0$4: Learner behavioural intention has no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Learner behavioural intention had appositive and significant positive effect on adoption of mLearning	Null hypothesis rejected
H_0^5: Technology use has no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	Technology use had appositive and significant positive effect on adoption of mLearning	Null hypothesis rejected
$H_0$6: Institutional factors have no significant effect on adoption of mLearning for the mHealth community	Institutional factors had appositive and significant positive effect on adoption of	Null hypothesis rejected

Hypothesis	Finding	Conclusion
health training programme in Kenya.	mLearning	
$H_1$7: The combined influence of learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	The combined influence of learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use have a significant positive effect on adoption of mLearning	Null hypothesis rejected
$H_1$8: The moderating effect of institutional factors on the relationship between learner characteristics, self-efficacy, learner attitude, behaviour intention and technology use have a significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.	The moderating effect of institutional factors on the relationship between learner characteristics, learner behaviour and technology use have a significant positive effect on adoption of mLearning	Null hypothesis rejected

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings of the study, discussions, conclusions and recommendations of the study. The study had eight objectives from which eight hypotheses were developed and tested. Each of the sections in this chapter will be organised as per the objectives.

5.2 Summary of Findings

This section summarises the findings of the study based on the findings drawn from each of the study objectives. Results for both descriptive and inferential analysis are summarised.

5.2.1 Learner Characteristics and Adoption of mLearning

The first objective of the study was to assess the effect of learner characteristics on adoption of mLearning for the mHealth community health training programme in Kenya. From this objective, it was hypothesized that learner characteristics have no significant effect on adoption of mLearning for the mHealth community health training programme in Kenya.

The descriptive analysis established that there were more female community health trainees (68.7%) than male (31.3%). trainees. The study also established that the majority (83.7%) of the trainees were above 30 years of age. The results further showed that there was no significant relationship between either age or gender on adoption of mLearning. However, the results indicated that the level of education was positively and significantly correlated with adoption of mobile learning. Likewise, the analysis also established that work experience was

positively and significantly correlated with adoption of mLearning. The results also showed that the period of exposure to mLearning was positively and significantly correlated with adoption of mLearning.

From the analysis, it was evident that, the period of exposure to mLearning had the greatest correlation with mLearning adoption of the three sub variables of learner characteristics. This finding implies that the longer the learner is exposed to the mLearning platform the higher the adoption of mLearning.

Following further analysis, the null hypothesis was rejected and it was concluded that learner characteristics have a significant positive effect on adoption of mLearning. This implies that learner characteristics such as prior exposure to mLearning are critical in mLearning adoption. This means institutions offering mLearning should have an awareness of the learner characteristics in order to meet the shortfalls such as in prior experience.

5.2.2 Learner Self-Efficacy and Adoption of mLearning

The second objective of the study was to establish the effect of learner self-efficacy on adoption of mLearning for the mHealth community health training programme Kenya. From this objective, it was hypothesized that there is no effect of learner self-efficacy on adoption of mLearning for the mHealth community health training programme Kenya.

The findings of the study revealed a high mLearning self-efficacy with an average mean of 4.082 for all the sub variables of self-efficacy. The means distributed as follows; 3.848 for navigating through the mLearning, platform, 4.074 for peer interaction, 4.347 for dependency and 4.06 for innovativeness.

The results further show that the effect of the learner self-efficacy on mLearning adoption was positive and significant and that 18% of variation in mLearning adoption is explained by variation on learner self-efficacy. The results also revealed that learners' self-efficacy contributed to about 43% of the mLearning adoption. This implies that institutions offering mLearning will need to ensure that the learners gain high efficacy in their ICT skills for them to achieve high adoption rates.

5.2.3 Learner Attitudes and Adoption of mLearning

The third objective of the study was to assess the effect of learner attitude on adoption of mLearning for the mHealth community health training. From this objective, it was hypothesized that there is no effect between learner attitude and adoption of mLearning for the mHealth community health training programme Kenya.

The results show that majority of the learners had a positive attitude towards mLearning technology and use of mobile learning devices with a mean of 4.543 and 3.973 respectively. The results however, showed a negative attitude towards the mLearning content with a mean of 2.94.

The results also show that the effect of learner attitude towards mLearning of adoption of mLearning was positive and significant and that about 23% of variation in mLearning adoption is explained by variation on learner self-efficacy. It was also revealed that learner attitude towards mLearning contributed to about 48% of the mLearning adoption. This implies that institutions offering mLearning will need to ensure that the learners develop positive attitude towards mLearning in order to achieve high adoption rates.

5.2.4 Behavioural Intention and Adoption of mLearning

The fourth objective of the study was to establish the effect of learner behavioural intention on adoption of mLearning for the mHealth community health training programme Kenya. From this objective, it was hypothesized that There is no effect of learner behavioural intention on adoption of mLearning for the mHealth community health training programme Kenya.

The descriptive results showed that all the indicators of the indicators of behaviour intention had a high mean. The mean for social influence was 4.16, performance expectancy 4.49 while effort expectancy had a mean of 4.22.

However, of the indicators of behavioural intention, Effort Expectancy was found to contribute most to adoption. The study therefore suggests that if students are to adopt mobile learning they must see it as being easy to use, and believe that it offers major benefits over existing learning methods.

In general, the results showed that the effect of behavioural intention on adoption of mLearning was positive and significant with about 25% of variation in mLearning adoption is explained by variation on behavioural intention. The results also revealed that behavioural intention contributed to about 50 % of the mLearning adoption. This implies that the higher the behavioural intention to use mLearning, the higher the chances of mLearning adoption.

5.2.5 Technology use and Adoption of mLearning

The fifth objective of the study was to establish the effect of technology use on adoption of mLearning for the mHealth community health training programme Kenya. From this

objective, it was hypothesized that there is no effect of technology use on adoption of mLearning for the mHealth community health training programme Kenya.

The descriptive results showed a mean of 4.03 for device functionality and a mean of 4.26 for content delivery technology. These results imply that technology is an important consideration for adoption of mLearning.

The results show that the effect of technology use on adoption of mLearning was positive and significant with about 11% of variation in mLearning adoption is explained by variation on technology being used to deliver mLearning. It was established that the technology used contributed to about 32 % of the mLearning adoption. This implies that the more efficient the technology, the higher the chances of adoption of mLearning.

5.2.6 Institutional Factors and Adoption of mLearning

The sixth objective of the study was the effect of institutional factors on adoption of mLearning for the mHealth community health training programme Kenya. From this objective, it was hypothesized that there is no effect of institutional factors on adoption of mLearning for the mHealth community health training programme Kenya.

The descriptive analysis showed that access to institutional factors had a mean of 4.40 and a standard deviation of .808, Timely feedback on the mLearning platform had a mean of 4.39 and a standard deviation of .705. Timely feedback on the mLearning platform had a mean of 4.39 and a standard deviation .705. Transmission of content had a mean of 4.04 and a standard deviation of 1.096. The clarity of content had a mean of 4.31 and a standard deviation of .903. Training on use of mLearning had a mean of 4.36 and a standard deviation

of .833. Motivation from the institution and support staff had a mean of 4.41 and a standard deviation of .882.

The statistical analysis shows that the effect of institutional factors on adoption of mLearning was positive and significant with about 22% of variation in mLearning adoption is explained by variation on institutional factors. The results further revealed that institutional factors contributed to about 47% of the adoption of mLearning. This implies that the more efficient the institutional factors, the higher the chances of adoption of mLearning.

5.2.7 The Combined Effect of Learner Behaviour, Technology Use and Adoption of mLearning

The seventh objective of the study was to determine the effect of the combined learner characteristics, self-efficacy, attitude behavioural intention and technology use on adoption of mLearning for the mHealth community health training programme Kenya.

From this objective, it was hypothesized that the combined effect of learner characteristics, learner behaviour, technology use had no significant effect on adoption of mLearning for the mHealth community health training programme Kenya.

The study revealed that the effect of the combined influence of learner characteristics, learner behaviour and technology use influence on adoption of mLearning was significant with, about half of the total of variation in mLearning adoption explained by variation on by the combined influence of learner characteristics, learner self-efficacy, behaviour intention and technology use.

5.2.8 The Moderating Influence of Institutional Factors on Learner Behaviour and Adoption of mLearning

The eighth objective of the study was to establish the moderating influence of institutional factors on the effect of learner behaviour, technology use on adoption of mLearning for the mHealth community health training programme Kenya.

The study showed that the moderating influence of institutional factors on the effect of learner characteristics, learner mLearning self-efficacy, learner attitude, behavioural Intention, technology use on adoption of mLearning was significant. The model went up by a four-percentage point after moderation meaning that the moderator as a predictor accounted an increase in variation in adoption of mLearning.

5.3 Discussion of Findings

This section discusses the findings of the study based on the objectives of the study. Both descriptive and inferential results discussed. The discussion presents a comparison of the findings of the current study with related studies. It further presents the premise upon which study arguments are made.

5.3.1 Learner Characteristics and Adoption of mLearning

The discussion in this section is based on the findings of objective one which focuses on the influence of learner characteristics on adoption of mLearning for the mHealth community health training programme. The sub-variables analysed in this section were age, gender, level of education, work experience, and duration of exposure to the mLearning experience.

This study did not find a significant relationship between gender and adoption of mLearning. This finding is consistent with Adegbija and Bola (2015) who find no significant difference in the extent to which male and female undergraduates perceived the adoption of mobile technologies for learning in Nigeria. The findings of this study, however, contradict the finding by Wei and Zhang (2008) and Nwagwu and Odetumibi (2011) who find gender playing an important role in technology adoption. From the findings of this study therefore, it is argued that in mLearning adoption, gender should not be considered in isolation as a determinant of technology adoption, but it ought to be put in context of the learning environment. For the current study both men and women were exposed to a similar learning environment and thus the finding.

Equally, this study did not find a significant relationship between age and adoption of mLearning. These findings are in agreement with Kennedy Dalgarno, Bennett, Gray and Chang (2008) who in a detailed study states that few differences in the use of digital technologies can be explained by age. The findings however, contradict findings by Mac Callum (2009) who found age to be a factor in adoption of mobile learning with younger students more likely to adopt. The finding in the current study can be explained by the fact that most (83.7 %) of the participants in the current study were above 30 years old and that they were exposed to similar learning environments.

The results however, show a significant effect of level of education on adoption of mLearning. This finding in agreement with Wang et al. (2008) and Marchionni and Ritchie (2007) who find that educational experience can influence the adoption of a technology. The results also show a significant relationship between both work experience and period of exposure to mLearning and adoption of mLearning. This finding is consistent with Theng

(2009) and Venkatesh et al. (2003) who found that prior experience in use of a technology playing a positive role in technology adoption. This is also supported by Kukulska-Hulme, (2007) who contend that there are indications that there are more reports of usability problems in mobile learning projects that utilise PDAs than those using mobile phones. A possible explanation for this is that because students already own mobile phones they are thus significantly familiar with its use. This argument is supported by Liao and Lu (2008) who contend that for users with prior experience, compatibility and results demonstrability are significant adoption predictors.

5.3.2 Learner Self-Efficacy and Adoption of mLearning

This section discusses the findings based on objective two which sought to investigate the influence of learner self-efficacy on adoption of mLearning for the mHealth community health training programme. The specific indicators that were considered under this variable were the learner's ability to navigate through the mLearning platform, peer interaction, learner dependency and innovativeness.

The findings of the study revealed a high mLearning self-efficacy with an average mean of 4.082 for all the sub variables of self-efficacy. The means distributed as follows; 3.848 for navigating through the mLearning, platform, 4.074 for peer interaction, 4.347 for dependency and 4.06 for innovativeness. These findings are consistent with Kenny, Park, Van Neste. - Kenny and Burton 2010; Lu and Viehland 2008; Tsai et al 2010; Mahat et al. 2012 who found that most of the students in their study had high self-efficacy for mLearning.

The finding that 18% of variation in mLearning adoption is explained by variation on learner self-efficacy is confirmed by Downey and McMurtry, (2007) and Claggett & Goodhue,

(2011) argue that individuals with high levels of efficacy will have a greater chance of succeeding in the given task. In particular, Hung (2003) and Young (2005) find personal innovativeness as one of the main factors that influence acceptance of new technology, this is consistent with the findings of the current study findings.

These findings are also in agreement with Jeffrey, (2009) whose findings suggest that students that are more self-directed or independent are more likely to succeed in the online learning context. Conversely mobile learners may be more successful if they are more self-directed and can learn independent from their educators.

5.3.3 Learner Attitudes and Adoption of mLearning

The descriptive results of this study show that majority of the learners had a positive attitude towards mLearning technology and use of mobile learning devices with a mean of 4.543 and 3.973 respectively. This finding is consistent with Al-Fahad (2009). The aim of the study by Al-Fahad was to better understand students' attitudes and perceptions towards the effectiveness of mobile learning. The study established that majority of students supported the use of wireless networks increase the flexibility of access to resources of learning independently in any place.

The results show that the association between the learner attitude towards mLearning and adoption of mLearning was positive and significant. These findings are consistent with a number of studies (Akour, 2009; Lu & Viehland, 2008; Park & Chen, 2007) that confirm a relationship between mobile self-efficacy and adoption of mobile technology. Additionally, the study finding is consistent with Wafa and Abu-Al-Sha'r (2009), whose study established that the use of the cell phone is highly appreciated by university students. Similarly, Thatcher

and Mooney (2008) analyzed a questionnaire distributed at the end of a university course with students to use cell phone text messaging to send questions to the lecturer during classes or between classes. The results indicated that students had strongly favourable perceptions of this initiative and suggested more future uses of mobile phone in the process of education to enhance the learning experience.

These results also parallel the findings observed in other studies of mobile learning (Barreh and Abas 2015) who have found that the students' overall appraisal of mLearning was favourable. These findings are also consistent with other researchers including; Thatcher and Mooney (2008), Fozdar and Lalita (2007) and Baya'a and Daher (2009) who conducted their researches on the attitude towards the use of cell phone from different perspectives. The researchers agree on the notion that students are in favour of using cell phone in the process of learning.

The results also show that learner attitude towards mLearning has a positive significant effect on adoption of mLearning and that about 23% of variation in mLearning adoption was explained by variation on learner self-efficacy. It was also revealed that learner attitude towards mLearning contributed to about 48% of the mLearning adoption. These findings are corroborated by Venkatesh, Morris, Davis, & Davis (2003), Putzer & Park (2010) and Peters (2007) who all find attitudes have to have a major influence on the adoption of new technology.

5.3.4 Behavioural Intention and Adoption of mLearning

The descriptive results showed that all the indicators of the indicators of behaviour intention had a high mean. The mean for social influence was 4.16, performance expectancy 4.49 and

effort expectancy had a mean of 4.22. This implies that the learners believe that these indicators influence their adoption of mLearning. This is consistent with Alharbi, and Drew (2014) who argue that social influence directly, performance expectancy, and effort expectancy impact on learner intention and ultimately actual use.

However, of the indicators of behavioural intention, Effort Expectancy was found to contribute most to adoption. This finding is in agreement with Alharbi, and Drew (2014) who contend that since effort expectancy has been established to lead to improved performance, it should have a direct effect on intention to use and ultimately actual use of technology. Furthermore, Chiu and Wang (2008) find that effort expectancy is positively associated with performance expectancy in the e-learning context. The study therefore, suggests that if students are to adopt mobile learning they must see it as being easy to use, and believe that it offers major benefits over existing learning methods.

In general, the results showed that behavioural intention had a positive and significant effect on adoption of mLearning and about 25% of variation in mLearning adoption was explained by variation on behavioural intention. The results also revealed that behavioural intention contributed to about 50 % of the mLearning adoption. This finding is consistent with Kim (2012) who reported a positive relationship between users' intention to use and their actual use of mobile services. This implies that the higher the behavioural intention to use mLearning, the higher the chances of mLearning adoption. The findings of this study draw similar conclusions with Mac Callum and Jeffrey (2013) that if students are to adopt mobile learning they must see it as being easy to use, and believe that it offers major benefits over existing learning methods.

5.3.5 Technology Use and Adoption of mLearning

The descriptive results showed a mean of 4.03 for device functionality and a mean of 4.26 for content delivery technology. These results imply that technology is an important consideration for adoption of mLearning. The descriptive findings of this study are consistent with other studies (Sharples, Corlett, Bull, et al., 2005; Sugden 2005; Kukulska-Hulme, 2007) on mobile devices physical attributes and adoption. In the current study, majority of the learners felt the type of phone, battery life and access to power, phone size and screen size and phone memory affected access to content with means ranging between 3.80 to 4.30. Sharples, Corlett, Bull, et al. (2005) report that students expressed discontent about the size, inadequate memory and short battery life of their devices.

The study further revealed that technology use has a positive significant effect on adoption of mLearning. This finding is consistent with Naismith & Corlett (2006) who found the type of technology in use a critical success factor in mLearning adoption whether that technology is provided for, or by the learner.

5.3.6 Institutional Factors and Adoption of mLearning

The descriptive analysis showed that all constructs for the institutional factors (access to institutional factors had a mean, timely feedback on the mLearning platform, timely feedback on the mLearning platform, transmission of content, the clarity of content, training on use of mLearning and motivation from the institution and support staff) were reported to influence adoption by majority of the learners with an average mean 4.34 of and a standard deviation ranging between .705 and 1.096. This finding is consistent with Naismith & Corlett (2006) who indicated that successful mLearning projects also need strong institutional factors,

including the design of relevant resources in mobile format, staff training and technical support.

Overall, the analysis that institutional factors have a positive significant effect on adoption of mLearning. The findings of the current study are consistent with the findings of Talukder (2012) who find that variance in adoption of technological innovation can be explained by training, managerial support, incentive.

5.3.7 The Combined Influence of Learner Behaviour, Technology Use and Adoption of mLearning

This study revealed that the learner characteristics, learner behaviour and technology use influence combined had a positive and significant effect on adoption of mLearning. About half of the total of variation in mLearning adoption was explained learner characteristics, learner self-efficacy, behaviour intention and technology use. These findings are consistent with a number of studies (Fathima & Sutton 2013; Alharbi & Drew 2014) which all suggest that adoption is a result of a collection of factors other than a result of one factor.

The finding is in agreement with different studies that found different factors to contribute to adoption in different contexts. For instance, a study conducted by Yong Liu (2010) in China, find that of all variables, the perceived long-term usefulness contributes to the most influential predictor of m-learning adoption. Another study by Liu et al. (2010) conducted in six New Zealand universities found self-efficacy, perceived usefulness, subjective norm, attitude, perceived ease of use, and perceived financial resources as influencing adoption of mLearning.

5.3.8 The Moderating Influence of Institutional Factors on Learner Behaviour and Adoption of mLearning

The study current showed that the moderating influence of institutional on learner characteristics, learner mLearning self-efficacy, learner attitude, behavioural Intention, technology use factors had a positive significant effect on adoption of mLearning.

It was observed that the percentage of variation accounted for by the model went up from 48.9% to 52.8% meaning that the moderator accounted for 3.9% variation in adoption of mLearning. The small percentage difference can be explained by the fact that the institutional factors were packaged uniformly for all the learners with small variations expected. However, it also shows that institutions play a crucial role in the adoption of technology. This result parallels other studies Tarhinia et al. (2013) who all place emphasis on the role of the institutional factors in adoption of mLearning. This finding is also corroborated by Ismail and Idrus (2010) indicating that the design of instruction is by far the most important parameter in the use of technology, critically on the ability of educationists to design and develop didactically sound m-learning opportunities and environments.

5.4 Conclusion

The following conclusions are organized by each of the research objectives. The conclusions are drawn from the key findings of the study.

5.4.1 Learner Characteristics and Adoption of mLearning

Based on this finding, it can be concluded that the learner characteristics play a role in the adoption of mLearning. It follows that, the level education affects adoption especially if the learners have huge differences in their entry behaviour as was the case in the current study.

Equally work experience influences adoption of mLearning especially in a situation where the content being learnt is directly drawn from the work experience of the learners, it can be concluded that if the learners are familiar with the content they will have higher adoption rates.

It can further be concluded that the most important of the learner characteristic is the period of exposure to mLearning technology, the longer the period of exposure, the more the person is likely to adopt mLearning. It is also concluded that institutions considering adoption of mLearning should encourage and motivate learners to adopt mLearning regardless of age and gender.

5.4.2 Learner Self-Efficacy and Adoption of mLearning

Informed by the results of the study, it is concluded that, in order to improve adoption of mLearning, institutions should ensure they design mLearning solutions that are interactive and easy to use. It is further concluded that mLearning solutions that focus on making the learner independence are likely to improve adoption of mLearning greatly. It is further concluded that learner mobile telephony and ICT skills are crucial for mLearning adoption.

5.4.3 Learner Attitudes and Adoption of mLearning

Based on the findings, it is concluded that for adoption of mobile learning to increase, learner attitude towards mobile learning in general and mLearning technology in particular must be positive. Institutions aiming at implementing mLearning should therefore focus on improving learner attitude toward using mobile technologies for learning.

5.4.4 Behavioural Intention and Adoption of mLearning

It can be concluded, that behavioural intention of the learner is an important variable that explains to a great extent, the variations in adoption of mLearning. This means that those training institutions that are able to design mLearning solutions that address learners needs such as social acceptability, are easy to operate and have a clarity of operation are likely to have high adoption of mLearning.

5.4.5 Technology use and Adoption of mLearning

Based on the study findings, it can be concluded that the type of technology in use plays an important role in influencing mobile learning adoption. This implies that instructional designers should design mLearning solutions compatible and capable of functioning well on the learners' mobile phones, the type of content delivery technology (SMS, IVR, Chat, Case studies or scenarios) being used is also an important consideration for adoption of mobile learning.

The results also suggest that the type of phone (if the content is designed for basic phones as was the case in this study) have very little contribution to adoption. Instructional designers will therefore, pay attention to device functionality and even more to how they package and deliver the message.

5.4.6 Institutional Factors and Adoption of mLearning

It is alos concluded that training institutions that offer learner support, provide timely feedback, ensure clarity of content, train and motivate learners are likely to have higher adoption of mLearning than those who do not pay attention to the aforementioned factors.

The findings encourage organizations to develop training programmes for learners enrolled in mLearning programmes and support staff so that they can use the innovation more effectively. Institutions need to design training and other educational programs that motivate learners to adopt and use innovation. To increase the adoption rate of innovation in the organization, faculty should provide continuous feedback, learner support and encouragement for such learners so that they can master the innovation skills within a short period of time.

5.4.7 The Combined Influence of Learner Behaviour, Technology Use and Adoption of mLearning

The study revealed that combination of learner characteristics, self-efficacy, learner attitude, learner behaviour and technology use have a positive significant effect on adoption of mLearning. Based on these findings, it is concluded that the factors that affect adoption of mLearning provide better results when combined, this means that institutions wishing to offer mLearning must ensure that they design mobile learning solutions that address each the factors individually and collectively for better results in adoption of mLearning.

5.4.8 The Moderating Influence of Institutional Factors on Learner Behaviour and Adoption of mLearning

The study showed that the moderating influence of institutional factors on the effect of learner characteristics, self-efficacy, learner attitude, behavioural Intention, technology use on adoption of mLearning was significant. The model went up by a four-percentage point after moderation meaning that the moderator as a predictor accounted for an increase in variation in adoption of mLearning.

It can therefore, be concluded that the small percentage difference can be explained by the fact that the institutional factors were packed uniformly for all the learners with small variations expected. It is further concluded that institutional factors cannot be overlooked in developing a model for mLearning adoption. It is further concluded the institutional factors such as training, learner support and motivation should not be considered for adoption in isolation but as part of other learner related determinants of adoption of mLearning.

5.5 Recommendations of the Study

This study provides lessons and insights on the adoption of new technologies for learning in general and mLearning in particular. On the basis of the findings, a number of practical and policy recommendations are made in this section to inform educationist, policy makers and other interested parties who may want to implement mobile learning and other technologies for learning.

i. The mLearning for mHealth was a partnership between a training institution and a mobile service provider thus the cost of SMS zero rated and chats were made using toll free codes for all the registered learners. No doubt offering network based mLearning is expensive. It is therefore recommended that the Government through the communications authority should develop policy guidelines to enable institutions that offer education to the communities enjoy subsidised rates from mobile service providers so that the cost of delivering education using mobile phones can be reasonably reduced.

ii. It emerged from this study that challenges such as poor network and system down time affected delivery of content thus the mLearning process. It is therefore recommended that instructional designers should design mLearning solutions that allow for both synchronous and asynchronous learning. This would mean that the

asynchronous solution will not require mobile provider network and can be in use network challenges notwithstanding. On the other hand, the synchronous functions can be scheduled and conducted when and where network is available.

iii. Utilizing the results of this study, it is recommended that instructional designers design mLearning solutions modelled on everyday mobile use for enhanced adoption familiarity, simplicity, learner independence, and learner efficacy emerged as plausible determinants of adoption.

iv. It is further recommended that instructional designers should appraise learner characteristics in the context of the learning environment and not as discrete determinants of adoption when developing mLearning content. For instance, both male and female learners should be presented with equal experience in the use of mobile technologies for learning provided the mLearning platform is user friendly and the mLearning environment is non discriminating.

v. Based on the finding of this study, learners had a higher preference for the delivery mode that allowed interaction and collaboration such as chats, this study recommends that instructional designers design mLearning solutions and package content that allows collaboration and interactivity. This will not only make learning fun but also has a likelihood of enhancing adoption of mLearning.

vi. It emerged from the study that institutional factors, including learner support services influenced learner adoption of mLearning. It is therefore recommended that Institutions offering mLearning should have efficient learner support systems including, an orientation package, a call centre or help desk.

vii. Continuous training emerged as an important aspect of mobile learning adoption so as to update the learners on new developments. It is therefore, recommended that

institutions intending to integrate mLearning in their delivery methodologies, should design learner training packages to continually update user knowledge.

5.6 Suggestions for Further Research

The current study focussed on learner determinants of adoption of mLearning in Kenya focusing on community health training programme in Kenya. It has however become apparent in the course of this study that there is need for further research in the following related areas:

i. There will be need to conduct a study to establish which other factors (such as facilitator related factors) would influence adoption of mLearning.

ii. This study did not focus on the impact of mLearning on the academic performance of the learners, there will thus be need for a study to establish the influence of mLearning on academic performance.

iii. This study was based on community health trainees involved in an mHealth programme. There is need for a similar study in other sectors in order to establish if the determinants of adoption are consistent across the sectors and subjects.

REFERENCES

Abas, Z. W., Loi Peng, C., &Mansor, N. (2009). A Study On Learner Readiness For Mobile Learning At Open University Malaysia. IADIS International Conference Mobile Learning 2009 (pp. 151-157).

Abu-al-aish, A., & Love, S. (2013). Factors Influencing Students' Acceptance of mLearning : An Investigation in Higher Education. *The International Review of Research in Open and Distance Learning*, 14(5), 83–108.

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS quarterly*, 227-247.

Adedoja, G., Adelore, O., Egbokhare, F., & Oluleye, A. (2013). Learners' Acceptance of the Use of Mobile Phones to Deliver Tutorials in a Distance Learning Context: A Case Study at the University of Ibadan. *The African Journal of Information Systems*, 5(3), 80–93.

Adegbija, M. V., & Bola, O. O. (2015). Perception of undergraduates on the adoption of mobile technologies for learning in selected universities in Kwara state, Nigeria. *Procedia-Social and Behavioural Sciences*, 176, 352-356.

Aderinoye, R. A., Ojokheta, K. O., & Olojede, A. A. (2007). Integrating mobile learning into nomadic education programmes in Nigeria: Issues and perspectives. *International Review of Research in Open and Distance Learning*, 8(2).

African Strategies for Health, (2012) *mHealth Compendium Report Volume II* http://www.africanstrategies4health.org/uploads/1/3/5/3/13538666/usaid_mhealth_compendium_vol._4_final.pdf retrieved 01092017

Agarwal, R., & Prasad, J. (1998). A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology. *Information Systems*

Research, 9(2), 204-215. INFORMS: Institute for Operations Research.

Ahmed, T.S., Kamal, M.B., Nik Suryani, A. and Tunku, B.T.A (2011). 'Investigating students' attitude and intention to use social software in higher institution of learning *in Malaysia', Multicultural Education and Technology Journal, Vol. 5, No. 3, 2011. pp.194–208*

Ajzen, I. (1991). The Theory of Planned Behaviour. *Organizational Behaviour and Human Decision Processes*, 50(2), 179-211.

Ajzen, I. (2005). *Attitudes, Personality, and Behaviour* (2nd ed.). Milton-Keynes, UK: Open University Press/McGraw-Hill.

Ajzen, I.: (1985) 'From Intentions to Actions: A Theory of Planned Behaviour', in J. Kuhland and J. Beckman (eds.), *Action-control:* From Cognitions to Behaviour (Springer, Heidelberg), pp. 11–39.

Akour, H. (2009). *Determinants of mobile learning acceptance: an empirical investigation in higher education* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses database. (UMI No. AAT 3408682)

Al-Adwan, A, Al-Adwan A, Smedley J. (2013) Exploring students' acceptance of e-learning using Technology Acceptance Model in Jordanian universities, *Int. J. Educ. Dev. Inf. Commun. Technol., 9 (2) (2013), pp. 4-1*

AlAwadhi, S., and Morris, A. (2008).The Use of the UTAUT Model in the Adoption of E-Government Services in Kuwait. *Proceedings of the 41st Hawaii International Conference on Systems Science* (HICSS-41 2008), Waikoloa, Big Island, Hawaii, USA.

Al-Emran, M., & Shaalan, K. (2015, August). Learners and educators attitudes towards mobile learning in higher education: State of the art. In *Advances in Computing, Communications and Informatics (ICACCI), 2015 International Conference on* (pp. 907-913). IEEE.

Al-Emran, M., & Shaalan, K. F. (2015). Attitudes Towards the Use of Mobile Learning: A Case Study from the Gulf Region. *iJIM,* 9(3), 75-78.

Al-Fahad, F. N. (2009). Students' attitudes and perceptions towards the effectiveness of mobile learning in King Saud University, Saudi Arabia. TOJET: T*he Turkish Online Journal of Educational Technology*, 8(2).

Al-Ghaith, W., Sanzogni, L., & Sandhu, K. (2010). Factors influencing the adoption and usage of online services in Saudi Arabia. *EJISDC,* 40(1), 1-32.

Alharbi S, Drew S, (2014) Mobile Learning-system usage: Scale development and empirical tests An integrated framework to measure students' behavioural intention *(IJARAI) International Journal of Advanced Research in Artificial Intelligence,* Vol. 3, No.11, 2014 Extended Paper from Science and Information Conference 2014

Al-Hujran, O., & Migdadi, M. (2013). Developing Countries. *E-Government Implementation and Practice in Developing Countries*, 242.

Al-Hujran, O., Al-Lozi E and Al-Debei M.M (2014) "Get Ready to Mobile Learning": Examining Factors Affecting College Students' Behavioural Intentions to Use MLearning in Saudi Arabia. *Jordan Journal of Business Administration,* Volume 10, No. 1, 2014

Ally, M., & Stauffer, K. (2008, March). Enhancing mobile learning delivery through exploration of the learner experience. In *Wireless, Mobile, and Ubiquitous Technology in Education, 2008. WMUTE 2008. Fifth IEEE International Conference on* (pp. 128-132). IEEE.

Almasri, A. K. M. (2014). The influence on mobile learning based on technology acceptance model (TAM), mobile readiness (MR) and perceived interaction (PI) for higher education students. *International Journal of Technical Research and Applications, 2 (1),* 5-11.

Alvarez, C., Alarcon, R., & Nussbaum, M. (2011). Implementing collaborative learning activities in the classroom supported by one-to-one mobile computing: A design-based process. *Journal of Systems and Software*, 84(11), 1961-1976.

Alvin, C.B., & Ronald, F. B. (2009). *Marketing research* (6th ed.). Prentice Hall.

Amref Health Africa (2015). *HELP (Health Enablement Learning Platform*) http://amref.org/what-we-do/capacity-building/help-/#sthash.8rkz0BCn.dpuf retrieved 29/11/2015

Anderson, T., & Dron, J. (2011). Three generations of distance education pedagogy. *The International Review of Research in Open and Distributed Learning*, *12*(3), 80-97.

Atkin, D. J., Hunt, D. S., & Lin, C. A. (2015). Diffusion theory in the new media environment: Toward an integrated technology adoption model. *Mass Communication and Society, 18* (5), 623-650.

Attewell, J., Traxler, J., Riordan, B., & Dennett, C. (2008). Towards sustainable large scale implementation of mobile learning: The mobile learning network (MoLeNET). In *The Bridge from text to context. Proceedings of the mLearn 2008 Conference* (pp. 28-35).

Avraamidou, L. (2008). Prospects for the use of mobile technologies in science education. *AACE Journal*, *16*(3), 347-365.

Ayoade O. B. (2015) Factors Influencing Students' Behavioural Intention to Adopt and use Mobile Learning in Higher Educational Institutions in Nigeria: An Example of Ekiti State University, *Ado-Ekiti International Journal of Emerging Technology and Advanced Engineering Volume* 5, Issue 4, April 2015.

Bankole, F. O., Bankole, O. O., & Brown, I. (2011). Mobile banking adoption in Nigeria. *The Electronic Journal of Information Systems in Developing Countries*, *47*.

Barreh, K. A., & Abas, Z. W. (2015). Students' Attitudes and Perceptions toward the Effectiveness of Mobile Learning in University of Djibout. *International Journal of*

Education and Research Vol. 3 No. 1 January 2015.

Baya'a, N., & Daher, W. (2009). Students' perceptions of Mathematics learning using mobile phones. *In Proceedings of the International Conference on Mobile and Computer Aided Learning* (Vol. 4, pp. 1-9).

Bechrakis, T., Gialamas, V., & Barkatsas, A. N. (2011). Survey of Attitudes Toward Statistics (SATS): An investigation of its construct validity and its factor structure invariance by gender. *International Journal of Theoretical Educational Practice,* 1(1), 1-15.

Beckers, J. J., Wicherts, J. M., & Schmidt, H. G. (2007). Computer anxiety:"trait" or "state"?. *Computers in Human Behavior*, *23*(6), 2851-2862.

Berkman, C. (2005) Internet filtering in Saudi Arabia in 2004: *http://www.opennetinitiative.net/studies/saudi/*

Bigné-Alcañiz, E., Ruiz-Mafé, C., Aldás-Manzano, J., & Sanz-Blas, S. (2008). Influence of online shopping information dependency and innovativeness on internet shopping adoption. Online Information Review, 32(5), 648-667.

Birch, D., & Burnett, B. (2009). Bringing academics on board: Encouraging institution-wide diffusion of e-learning environments. *Australasian Journal of Educational Technology*, 25(1).

Bird, P., & Stubbs, M. (2008). A bridge too far? embedding mobile learning in Uk higher education. In *Proceedings of the mLearn 2008 Conference: The bridge from text to context (7-10 October) Ironbridge, UK*.

Boone, H. N. J., & Boone, D. A.(2012). Analyzing likert data. *Journal of Extension*, *50*(2), 30.

Brown, K., Campbell, S. W., & Ling, R. (2011). Mobile phones bridging the digital divide for teens in the US?. *Future Internet*, *3*(2), 144-158.

Bryman, A., & Bell, E. (2015). *Business research methods*. Oxford University Press, USA.

Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education and Development using Information and Communication Technology*, *8*(1), 136.

Cain, & Gradisar, (2010). Electronic media use and sleep in school-aged children and adolescents: *A review. Sleep medicine*, 11(8), 735-742.

CAK (2015) Fourth Quarter Sector Statistics Report For The Financial Year 2014/2015 available;

http://www.ca.go.ke/images/downloads/STATISTICS/Sector%20Statistics%20Report%20Q4%202014-2015.pdf retrieved 14/10/2015

Carter, R. (2012). *Vocabulary: Applied linguistic perspectives*. Routledge.

Caspi, A., & Gorsky, P. (2005). Instructional media choice: factors affecting the preferences of distance education coordinators. *Journal of Educational Multimedia and Hypermedia,* 14(2), 169-198.

Caudill, J. G. (2007). The growth of m-learning and the growth of mobile computing: Parallel developments. *The International Review of Research in Open and Distributed Learning,* 8(2).

Cavus, N., & Ibrahim, D. (2009). m-Learning: An experiment in using SMS to support learning new English language words. *British journal of educational technology*, 40(1), 78-91.

Cavus, N., Bicen, H., & Akcil, U. (2008). The Opinions of Information Technology Students on Using Mobile Learning. *Online Submission*.

Chang, A. Y., Ghose, S., Littman-Quinn, R., Anolik, R. B., Kyer, A., Mazhani, L., ... & Kovarik, C. L. (2012). Use of mobile learning by resident physicians in Botswana.

Telemedicine and e-Health, 18(1), 11-13.

Chang, S. C., & Tung, F. C. (2008). An empirical investigation of students' behavioral intentions to use the online learning course websites. *British Journal of Educational Technology*, 39(1), 71-83.

Charlton, J. P. (2005). Measuring perceptual and motivational facets of computer control: the development and validation of the computing control scale. *Computers in Human Behaviour*, 21(5), 791-815. doi: 10.1016/j.chb.2004.02.027

Chen Y, M. (2015) Towards an understanding of the factors affecting m-learning acceptance: Roles of technological characteristics and compatibility, *Asia Pacific Management Review. Sep2015, Vol. 20 Issue 3, p109-119. 11p.*

Chen, C. -H. (2008). Why do teachers not practice what they believe regarding technology integration? *The Journal of Educational Research*, vol. 102, no. 1, pp. 65-75.

Chen, C-H. (2010). The implementation and evaluation of a mobile self- and peer assessment system. *Computers & Education*, 55(1), 229-236. doi: 10.1016/j. compedu. 2010.01.008

Chen, K., Chen, J. V., & Yen, D. C. (2011). Dimensions of self-efficacy in the study of smart phone acceptance. *Computer Standards & Interfaces*, 33(4), 422-431.

Chen, W. & Wellman, B. (2004) The Global Digital Divide – Within and Between Countries, *IT & Society*, 1, 7, 39-45

Cheon, J., Lee, S., Crooks, S. M., & Song, J. (2012) "An Investigation of Mobile Learning Readiness in Higher Education Based on the Theory of Planned Behaviour". *Computers & Education, vol*.59, pp.1054–1064.

Chu, H.-C., Hwang, G.-J., Huang, S.-X., & Wu, T.-T. (2008). A knowledge engineering approach to developing e-libraries for mobile learning. *The Electronic Library*, 26(3), 303 - 317.

Claggett, J. L., & Goodhue, D. L. (2011). Have is researchers lost bandura's self-efficacy concept? A discussion of the definition and measurement of computer self-efficacy. *In Proceedings of the 44th Hawaii International Conference on System Science*, Kauai, HI, January 4-7, 2011 (pp. 1-10). doi: 10.1109/HICSS.2011.219

Clark, W., Logan, K., Luckin, R., Mee, A., & Oliver, M. (2009). Beyond Web 2.0: Mapping the technology landscapes of young learners. *Journal of computer assisted learning*, 25(1), 56-69.

Cobcroft, R. S., Towers, S. J., Smith, J. E., & Bruns, A. (2006). Mobile learning in review: Opportunities and challenges for learners, teachers, and institutions.

Cochran, W. G. (2007). *Sampling techniques*. John Wiley & Sons.

Cochran, W.G.(1977). Sampling Techniques (3rd edition). *John Wiley &Sons*, New York.

Cohen, E. B. (2010). Understanding M-Learning in Terms of Informing Science. *Mobile Learning: Pilot Projects and Initiatives*, 45.

Collins, A., & Halverson, R. (2010). The second educational revolution: Rethinking education in the age of technology. *Journal of computer assisted learning*, 26(1), 18-27.

Connelly, L. M. (2008). Pilot studies. *Medsurg Nursing*, *17*(6), 411-413.

Cooper, D. R., & Schindler, P. S. (2006). Business Research Methods. New Delhi: Tata McGraw Hill.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Croop, F. J. (2008). *Student perceptions related to mobile learning in higher education* (Doctoral dissertation, Northcentral University).

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management science*, *35*(8),

982-1003.

De Wit, K., Heerwegh, D., & Verhoeven, J. C. (2012). Changes in the basic ICT skills of freshmen between 2005 and 2009: Who's catching up and who's still behind?. *Education and Information Technologies*, 17(2), 205-231.

Deci, E. L., & Ryan, R. M. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. *The Oxford handbook of human motivation*, 85-107.

Donaldson, R. L. (2010). *Student acceptance of mobile learning*. The Florida State University.

Downey, J. P., & McMurtrey, M. (2006). Introducing task-based general computer self-efficacy: An empirical comparison of three general self-efficacy instruments. *Interacting with Computers*, *19*(3), 382-396.

Doyle, G. J., Garrett, B., & Currie, L. M. (2014). Integrating mobile devices into nursing curricula: Opportunities for implementation using Rogers' Diffusion of Innovation model. *Nurse education today*, *34*(5), 775-782.

Duan, Y., He, Q., Feng, W., Li, D., & Fu, Z. (2010). A study on e-learning take-up intention from an innovation adoption perspective: A case in China. *Computers & Education*, *55*(1), 237-246.

Ducut, E., & Fontelo, P. (2008). Mobile devices in health education: Current use and practice. *Journal of computing in Higher Education*, 20(2), 59.

Duvall, P. M., Matyas, S., & Glover, A. (2007). *Continuous integration: improving software quality and reducing risk*. Pearson Education.

El-Hussein, M. O. M., & Cronje, J. C. (2010). Defining mobile learning in the higher education landscape. *Journal of Educational Technology & Society*, 13(3), 12.

Elogie, A. A. (2015). Factors Influencing the Adoption of Smartphones among

Undergraduate Students in Ambrose Alli University, Ekpoma, Nigeria.

Eteokleous, N., & Ktoridou, D. (2009). Investigating mobile devices integration in higher education in Cyprus: Faculty perspectives. *International Journal of Interactive Mobile Technologies*, *3*(1).

Evans J,. D (1996): *Straightforward Statistics for the Behavioral Sciences*. CA: Pacific Grove Brooks/Cole Pub. Co.

Evans, M., Hopper, S., Knezek, G. A., & Jones, G. (2013). Gender as a predictive factor for tasks completed using smartphones. *iConference 2013February 1215, 2013Fort Worth, TX, USA*

Fathema, N., & Sutton, K. L. (2013). Factors influencing faculty members' Learning Management Systems adoption behavior: An analysis using the Technology Acceptance Model. *International Journal of Trends in Economics Management & Technology (IJTEMT)*, *2*(6).

Fishbein, M. (1975). i Ajzen, I.(1975). *Belief, Attitude, Intention, and Behaviour*: An Introduction to Theory and Research.

Fozdar, B. I., & Kumar, L. S. (2007). Mobile learning and student retention. *International Review of Research in Open and Distance Learning*, 8(2), 1-18.

Fraenkel, J. R., & Wallen, N. E. (2008). *Introduction to qualitative research. How to Design and Evaluate Research in Education*, 7th ed. Boston, MA: McGraw-Hill International Edition.

Franklin, T., & Peng, L.-W. (2008). Mobile math: Math educators and students engage in mobile learning. *Journal of Computing in Higher Education*, 20, 69–80.

Freidhoff, J. R. (2008). Reflecting on the affordances and constraints of technologies and their impact on pedagogical goals. *Journal of Computing in Teacher Education*, 24(4), 117-122.

Fritschi, J., & Wolf, M. A. (2012). Turning on mobile learning in North America: Illustrative initiatives and policy implications. *United Nations Educational, Scientific and Cultural Organization*.

FutureLab, N. E. S. T. A. (2005). The future of mobile technology: Learning on the run. *Retrieved June*, *27*, 2006.

Gakuu, C. M. (2006). Analysis of the factors and attitudes that influence lecturers 'readiness to adopt distance education and the use of ICT in teaching: the Case of The University of Nairobi. *Unpublished PhD Thesis University of Nairobi*.

Georgiev, T., Georgieva, E., & Smrikarov, A. (2004, June). M-learning-a New Stage of E-Learning. *In International conference on computer systems and technologies-CompSysTech* (Vol. 4, No. 28, pp. 1-4).

Georgiev, Tsvetozar, Evgenia Georgieva, and Angel Smrikarov. (2004) "MLearning – a New Stage of E-Learning." *In International Conference on Computer Systems and Technologies*. Rousse, Bulgaria, June 17-18, 2004.

Goldsworthy, S., Lawrence, N., & Goodman, W. (2006). The use of Personal Digital Assistants at the point of care in an undergraduate nursing program *[Electronic version]*. *CIN*, 24(3), 138-143.

González, M. Á., González, M. Á., Martín, M. E., Llamas, C., Martínez, Ó., Vegas, J., ... & Hernández, C. (2017). Teaching and Learning Physics with smartphones. *In Blended Learning: Concepts, Methodologies, Tools, and Applications (pp. 866-885). IGI Global.*

Güler, Ç., Kılıç, E., & Çavuş, H. (2014). A comparison of difficulties in instructional design processes: Mobile vs. desktop. *Computers in Human Behavior*, *39*, 128-135.

Gupta, D. K. (2008). *Understanding terrorism and political violence: The life cycle of birth, growth, transformation, and demise*. Routledge.

Ha S, and Stoel L,. (2008) Consumer e-shopping acceptance: Antecedents in a technology acceptance model. Journal of Business Research Volume 62, Issue 5, May 2009, Pages 565-571

Handal, B., MacNish, J., & Petocz, P. (2013). Adopting mobile learning in tertiary environments: Instructional, curricular and organizational matters. *Education Sciences, 3*(4), 359-374.

Hasan, B. (2003). The influence of specific computer experiences on computer self-efficacy beliefs. *Computers in Human Behavior*, 19(4), 443-450. doi:10.1016/s0747-5632(02)00079-1

Hasan, B., & Ahmed, M. U. (2010). A path analysis of the impact of application-specific perceptions of computer self-efficacy and anxiety on technology acceptance. *Journal of Organizational and End User Computing*, 22(3), 82-95. doi: 10.4018/ joeuc. 2010070105

Hauang, S. (2003) Critical of WAP service Adoption: An Empirical Study. Electronic Commerce Research and Applications. 2(1), 42-60.

Henderson, S., & Yeow, J. (2012, January). iPad in education: A case study of iPad adoption and use in a primary school. *In System science (hicss), 2012 45th Hawaii international conference on* (pp. 78-87). IEEE.

Hsu, C. L., & Lin, J. C. C. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & management*, 45(1), 65-74.

Hsu, C.L., and Lu, H.P. 2004. "Why do People Play On-line Games? An Extended TAM with Social Influences and Flow Experience," *Information & Management* (41:7), pp 853-868.

Hsu, F. C., Luo, J. Y., Yeh, K. W., Chen, T. K., Huang, T. W., Wu, P. M., ... & Wu, M. K.

(2008). Superconductivity in the PbO-type structure α-FeSe. *Proceedings of the National Academy of Sciences*, 105(38), 14262-14264.

Hwang, G. J., Wu, P. H., & Ke, H. R. (2011). An interactive concept map approach to supporting mobile learning activities for natural science courses. *Computers & Education*, 57(4), 2272-2280.

Ismail I, Idrus R, M (2010) Role of institutions of higher learning towards a knowledge-based community utilising mobile devices. *Procedia Social and Behavioral Sciences* 2 (2010) 2766–2770

Ismail, I, and Azizan S,N,. (2012) Distance Learners' Needs on Interactivity in SMS-based Learning System, Asian Social Science, Vol 8, No 11

Jacob, S. M., & Issac, B. (2014). Mobile learning culture and effects in higher education. *arXiv preprint arXiv*:1410.4379.

Jeffrey, L. M. (2009). Learning orientations: Diversity in higher education. *Learning and Individual Differences*, *19*(2), 195-208.

Jegede, P. O. (2008). ICT attitudinal characteristics and use level of Nigeria teachers. *Issues in Informing Science and Information Technology*, 5, 261-265.

Jeng, Y.-L., Wu, T.-T., Huang, Y.-M., Tan, Q., & Yang, S. J. H. 2010, "The Add-on Impact of Mobile Applications in Learning Strategies: A Review Study." *Educational Technology & Society*, vol. 13, pp. 3–11.

Jones, A., & Issroff, K. (2007). Motivation and mobile devices: exploring the role of appropriation and coping strategies.

June Lu, Chun-Sheng Yu, Chang Liu, James E. Yao, (2003) "Technology acceptance model for wireless Internet", *Internet Research, Vol. 13 Issue: 3, pp.206-222, https://doi.org/10.1108/10662240310478222*

Kabue (2016) Relationship between customer relationship management process and

marketing effectiveness of. Commercial Banks in Kenya. *Unpublished PhD Thesis, Jomo Kenyatta University of Agriculture and Technology.*

Kalinic, Z., Arsovski, S., Arsovski, Z., & Rankovic, V. (2014). The Effectiveness and Students' Perception of an Adaptive Mobile Learning System based on Personalized Content and Mobile Web. *The New Educational Review,* 37(3), 43-53.

Kallaya, J., Prasong, P., & Kittima, M. (2009). An acceptance of mobile learning for higher education students in Thailand

Kao, C.-P., & Tsai, C.-C. (2009). Teachers' attitudes toward web-based professional development, with relation to internet self-efficacy and beliefs about web-based learning. Computers and Education, 53, 66–73.

Karanja, S. C., Muathe, S. M. A., & Thuo, J. K. (2014). Marketing Capability and the Performance of Mobile Service Provider Intermediary Organizations in Nairobi County, Kenya. *International Journal of Education and Research*, *2*(5), 499-512.

Kay, R. (2007). A Formative Analysis of Resources Used to Learn Software. Canadian *Journal of Learning and Technology*, 33(1).

Kay, R., & Knaack, L. (2008). A formative analysis of individual differences in the effectiveness of learning objects in secondary school. *Computers & Education*. 51(3), 1304-1320.

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning Technology,* 20 (1063519), 1-17. doi:10.3402/rlt.v20i0/14406.

Keegan, D. (2005, October). The incorporation of mobile learning into mainstream education and training. In *World Conference on Mobile Learning, Cape Town* (p. 11).

Keiyoro, P. N. (2010). Factors influencing the effective use of ICT in teaching and learning science curriculum in Kenyan secondary schools: The case of Cyber and NEPAD

eschools. *An Unpublished PhD Thesis of the University of Nairobi*.

Kennedy, D. M and Fox, B (2013). 'Digital natives': An Asian perspective for using learning technologies *International Journal of Education and Development using Information and Communication Technology (IJEDICT),* 2013, Vol. 9, Issue 1, pp. 64-79

Kennedy, G., Dalgarno, B., Bennett, Judd, T., Gray, K. & Chang, R. (2008). Immigrants and natives: Investigating differences between staff and students' use of technology *Proceedings ascilite Melbourne* 2008.

Kenny, R. F., Park, C. L., Van Neste-Kenny, J. M.., & Burton, P. A. (2010). Mobile Self-Efficacy in Canadian Nursing Education Programs. *Proceedings of mLearn 2010, the 9th World Conference on Mobile Learning. Valletta, Malta.*

Kenny, R.F., Park, C., Van Neste-Kenny, J.M.C., Burton, P.A. & Meiers, J. (2009). Using Mobile Learning to Enhance the Quality of Nursing Practice Education. *In M. Ally (Ed.), Empowering Learners and Educators with Mobile Learning. Athabasca, AB: Athabasca University Press.*

Kenny, R.F., Park, C., Van Neste-Kenny, J.M.C., Burton, P.A. & Qayyum A. (2012). Using Self-Efficacy to Assess the Readiness of Nursing Educators and Students for Mobile Learning. International Review of Research In Open and Distance Learning

Khaddage, F., & Knezek, G. (2013, July). iLearn via mobile technology: A comparison of mobile learning attitudes among university students in two nations. In *Advanced Learning Technologies (ICALT), 2013 IEEE 13th International Conference on* (pp. 256-258). IEEE.

Kho, A., Henderson, L. E., Dressler, D. D., & Kripalani, S. (2006). Use of handheld computers in medical education. Journal of general internal medicine, 21(5), 531-537.

Kim, D., & Kim, D. J. (2012). Effect of screen size on multimedia vocabulary learning. *British Journal of Educational Technology*, 43(1), 62-70.

Kim, H. W., Chan, H. C., & Gupta, S. (2007). Value-based adoption of mobile internet: an empirical investigation. *Decision support systems*, 43(1), 111-126.

Kim, H., Lee, I., & Kim, J. (2008). Maintaining continuers vs. converting discontinuers: relative importance of post-adoption factors for mobile data services. International *Journal of Mobile Communications*, 6(1), 108-132.

Koh, J. L., & Frick, T. W. (2009). Instructor and student classroom interactions during technology skills instruction for facilitating preservice teachers' computer self-efficacy. J*ournal of Educational Computing Research*, 40(2), 211–228.

Koole, M. L. (2009). A model for framing mobile learning. In M. Ally (Ed.), Mobile learning: Transforming the delivery of education and training (pp. 25–47). Edmonton, AB: Athabasca University Press.

Koole, M. L. (2009). A model for framing mobile learning. *Mobile learning: Transforming the delivery of education and training, 1*(2), 25-47.

Koole, M. L., McQuilkin, J. L., & Ally, M. (2010). Mobile learning in distance education: Utility or futility? *Journal of Distance Education*, 24(2), 59–82.

Kothari, C. R., Garg G., (2014). *Research Methodology Methods and Techniques 3rd Edition*. New Delhi, New Age International publishers

Kripanont, N. (2007). Examining a technology acceptance model of internet usage by academics within Thai business schools (Doctoral dissertation, Victoria University).

Kukulska-Hulme, A. (2007). Mobile usability in educational contexts: What have we learnt? *International Review of Research in Open and Distance Learning*, 8(2) pp. 1–16.

Kukulska-Hulme, A. (2009). Will mobile learning change language learning? *ReCALL*, 21(2), 157-165.

Kukulska-Hulme, A., & Shield, L. (2008). An overview of mobile assisted language learning: From content delivery to supported collaboration and interaction. *ReCALL*, 20(3), 271-

289.

Kukulska-Hulme, A., & Traxler, J. (Eds.). (2005). *Mobile learning: A handbook for educators and trainers*. Psychology Press.

Kuo, Y. F., & Yen, S. N. (2009). Towards an understanding of the behavioral intention to use 3G mobile value-added services. *Computers in Human Behaviour,* 25(1), 103-110.

Kwon, O., Choi, K., & Kim, M. (2007). User acceptance of context-aware services: self-efficacy, user innovativeness and perceived sensitivity on contextual pressure. *Behaviour & Information Technology*, 26(6), 483-498.

Lai, C., Wang, Q., & Lei, J. (2012). What factors predict undergraduate students' use of technology for learning? A case from Hong Kong. *Computers & Education*, 59(2), 569-579.

Lai, H. M., & Chen, C. P. (2011). Factors influencing secondary school teachers' adoption of teaching blogs. *Computers & Education*, 56(4), 948-960.

Lam, P., Leung-Lam, S., Lam, J., & McNaught, C. (2008). Usability and usefulness of eBooks on PPCs: How students opinions vary over time. *Paper presented at the ASCILITE,* Melbourne

Lan, Y. F., & Sie, Y. S. (2010). Using RSS to support mobile learning based on media richness theory. *Computers & Education,* 55(2), 723-732.

Laukkanen, T., & Pasanen, M. (2008). Mobile banking innovators and early adopters: How they differ from other online users? *Journal of Financial Services Marketing,* 13(2), 86-94.

Lawrence, S. H., Ramirez, U. D., Tang, L., Fazliyez, F., Kundrat, L., Markham, G. D., & Jaffe, E. K. (2008). Shape shifting leads to small-molecule allosteric drug discovery. *Chemistry & biology*, 15(6), 586-596.

Lee, M. J., & Chan, A. (2007). Pervasive, lifestyle-integrated mobile learning for distance

learners: an analysis and unexpected results from a podcasting study. Open Learning, 22(3), 201-218.

Lee, M. J., & Chan, A. (2007). Pervasive, lifestyle-integrated mobile learning for distance learners: an analysis and unexpected results from a podcasting study. *Open Learning*, 22(3), 201-218.

Lee, Y.E. and Benbasat, I. (2003), "Interface design for mobile commerce", *Communications of the ACM, Vol. 46 No. 12, pp. 49-52.*

Lester, R. T., Ritvo, P., Mills, E. J., Kariri, A., Karanja, S., Chung, M. H., ... & Marra, C. A. (2010). Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): a randomised trial. *The Lancet*, 376(9755), 1838-1845.

Lewicka, D. (2011). Creating Innovative Attitudes in an Organisation – Comparative Analysis of Tools Applied in *IBM Poland and ZPAS Group. Vol. 1, No. 1,* p1-12

Li, J. P., & Kishore, R. (2006, April). How robust is the UTAUT instrument?: a multigroup invariance analysis in the context of acceptance and use of online community weblog systems. In *Proceedings of the 2006 ACM SIGMIS CPR conference on computer personnel research: Forty four years of computer personnel research: achievements, challenges & the future* (pp. 183-189). ACM.

Liang, J-C., & Wu, S-H. (2010). Nurses' motivations for web-based learning and the role of internet self-efficacy. *Innovations in Education and Teaching International*, 47(1), 25–37.

Liao, C., Chen, J. L., & Yen, D. C. (2007). Theory of planning behaviour (TPB) and customer satisfaction in the continued use of e-service: An integrated model. *Computers in human behaviour*, 23(6), 2804-2822.

Liao, H. L., & Lu, H. P. (2008). The role of experience and innovation characteristics in the

adoption and continued use of e-learning websites. *Computers & Education*, 51(4), 1405-1416.

Liaw, S-S, HuangH-M,. (2013) Perceived satisfaction, perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments, *Computers & Education, Volume 60, Issue 1, January 2013, Pages 14-24*

Lim, C. P., & Chai, C. S. (2008). Teachers' pedagogical beliefs and their planning and conduct of computer-mediated classroom lessons. *British Journal of Educational Technology*, *vol. 39*, no. 5, pp. 807–828.

Lin, H. F., & Lee, G. G. (2006). Effects of socio-technical factors on organizational intention to encourage knowledge sharing. *Management decision*, *44*(1), 74-88.

Litchfield, A., Dyson, L., Lawrence, E. & Zmijewska, A. (2007). Directions for m-learning research to enhance active learning. In ICT: Providing choices for learners and learning. Proceedings ascilite Singapore 2007.

Liu, I. F., Chen, M. C., Sun, Y. S., Wible, D., & Kuo, C. H. (2010). Extending the TAM model to explore the factors that affect intention to use an online learning community. *Computers & Education*, 54(2), 600-610. doi:10.1016/j.compedu.2009.09.009

Liu, Y., & Chen, N. S. (2008, July). An adoption model for mobile learning. In Proceeding for the Alharbi, S., & Drew, S. (2014). Mobile learning-system usage: Scale development and empirical tests. In *Science and Information Conference* 2014 (Vol. 3, pp. 31-47).IADIS International Conference e-Commerce.

Liu, Y., & Li, H. (2010). Mobile internet diffusion in China: an empirical study. *Industrial Management & Data Systems*, *110*(3), 309-324.

Liu, Y., Han, S., & Li, H. (2010). Understanding the factors driving m-learning adoption: a literature review. *Campus-Wide Information Systems*, 27(4), 210-226.

Liu, Y., Li, H., & Carlsson, C. (2010). Factors driving the adoption of m-learning: An

empirical study. *Computers & Education*, *55*(3), 1211-1219.

Loftus, J. (2011). *Factors affecting implementation of educational media casting as an instructional resource in distance education* (Doctoral dissertation).

Lu, X., & Viehland, D. (2008). Factors influencing the adoption of mobile learning. *ACIS 2008 Proceedings*, 56.

Lugo, M. T., & Schurmann, S. (2012). Turning on mobile learning in Latin America: Illustrative initiatives and policy implications. *Paris, UNESCO. Retrieved on*, *16*(09), 2016.

Mac Callum, K. (2009). Student characteristics and variables that determine mobile learning adoption: An initial study. In *Proceedings of the universal college of learning: teaching and learning conference* (pp. 1-8).

Mac Callum, K. S. (2011). *Influences on the adoption of mobile technology by students and teachers: a thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Information Systems at Massey University, Albany, New Zealand* (Doctoral dissertation, Massey University).

Mac Callum, K., & Jeffrey, L. (2013). The influence of students' ICT skills and their adoption of mobile learning. *Australasian Journal of Educational Technology*, *29*(3).

Mac Callum, K., Jeffrey, L., & Kinshuk. (2014). Factors impacting teachers' adoption of mobile learning. *Journal of Information Technology Education:* Research, 13.

MacGregor, R.C. & Vrazalic, L. (2006) E-Commerce Adoption Barriers in Small Businesses and the Differential Effects of Gender, *Journal of Electronic Commerce in Organizations*, 4, 2, 1-24.

Mahat J, Ahmad F. M. A., Wonga, S L (2012) An Assessment of Students' Mobile Self-Efficacy, Readiness and Personal Innovativeness towards Mobile Learning in Higher Education in Malaysia, Procedia, *International Technology Conference IETC2012-*

Social and Behavioural Sciences 64 (2012) 284 – 290

Markauskaite, L. (2007). Exploring the structure of trainee teachers' ICT literacy: The main components of and relationships between, general cognitive and technical capabilities. *Education Technology Re-search Development,* 55(6), 547-572.

Mbogo, M. (2010). The impact of mobile payments on the success and growth of micro-business: The case of M-Pesa in Kenya. *Journal of Language, Technology & Entrepreneurship in Africa, 2*(1), 182-203.

McConatha, D., Praul, M., & Lynch, M. J. (2008). Mobile learning in higher education: An empirical assessment of a new educational tool. *TOJET: the Turkish Online Journal of Educational Technology,* 7(3).

McWhorter, J. (2012). *A study of early adopters of innovation*. The University of Alabama at Birmingham.

Melia ´n-Alzola, L. and Padro ´n-Robaina, V. (2006), "Tangibility as a quality factor in electronic commerce b2c", *Managing Service Quality, Vol. 16 No. 3, pp. 320-38.*

Miesen, H. W. (2003). Predicting and explaining literary reading: an application of the theory of planned behavior. *Poetics, 31*(3-4), 189-212.

Miriam C. M.O, Eduardo P.,Gondim de V., Reed N., (2010) The Adoption of New Technology: Conceptual Model and Application, *Journal of Technology Management and Innovation*. 2010, Volume 5, Issue 4

Mishra, P. (2011). Mobile Technologies in Open Schools. Vancouver, BC, Commonwealth of Learning (COL). Retrieved September 28, 2012.

Mokaya, S. O., & Kipyegon, M. J. (2014). Determinants of employee engagement in the Banking industry in Kenya; case of cooperative bank. *Journal of Human Resource Management and Labor Studies*, *2*(2), 187-200.

Moos, D. C., & Azevedo, R. (2009). Learning with computer-based learning environments: a

literature review of computer self-efficacy. *Review of Educational Research*, 79(2), 576-600.

Mtebe, J. S. and Raisamo, R. (2014) Investigating students' behavioural intention to adopt and use mobile learning in higher education in East Africa. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 2014, Vol. 10, Issue 3, pp. 4-20

Mulwa S.A. (2012). The Influence of Instructional and Human factors on readiness to adopt e-Learning in Kenya: The case of Secondary Schools in Kitui District. *Unpublished PhD thesis of the University of Nairobi*

Nah, K. C, White, P. Sussex, R. (2008). The potential of using a cell phone to access the internet for learning EFL listening skills within a Korean context. *Recall* 20 (3), 331-347.

Naismith, L., Sharples, M., & Ting, J. (2005). Evaluation of CAERUS: a context aware mobile guide. In *mLearn 2005*.

Naismith, L., Sharples, M., Vavoula, G., & Lonsdale, P. (2004). Literature review in mobile technologies and learning.

Nassuora, A. B. (2012). Students Acceptance of Mobile Learning for Higher Education in Saudi Arabia. *American Academic & Scholarly Research Journal*, 4(2

Negas, M. C., & Ramos, P. (2011, April). Critical Factors in the use of Mobile Learning by "Digital Natives" on Portuguese Teaching. In *ICIME 2011-Proceedings of the 2nd International Conference on Information Management and Evaluation: ICIME 2011 Ryerson University, Toronto, Canada, 27-28 April 2011* (p. 333). Academic Conferences Limited.

Nestel, D., Ng, A., Gray, K., Hill, R., Villanueva, E., Kotsanas, G., & Browne, C. (2010). Evaluation of mobile learning: students' experiences in a new rural-based medical

school. *BMC medical education*, *10*(1), 57.

Neyland, E. (2011). Integrating online learning in NSW secondary schools: Three schools perspectives on ICT adoption. *Australia Journal of Educational Technology*, vol. 27, no. 1, pp. 152-173

Ng, W. (2008). Transformational leadership and the integration of information and communications technology into teaching. *The Asia-Pacific Researcher*, vol. 17, no. 1, pp. 1-14.

Nwagwu W.E, & Odetumibi S. (2011). Factors Influencing the adoption of mobile telephony by students at the University of Ibadan, Nigeria. *Asian Journal of University Education* 7(2) p109-142

Nwagwu, W. E., & Ajama, M. (2011). Women's health information needs and information sources: a study of a rural oil palm business community in South-Western Nigeria.

Nyíri, K. (2002). Towards a philosophy of m-learning. In *Wireless and Mobile Technologies in Education, 2002. Proceedings. IEEE International Workshop on* (pp. 121-124). IEEE.

Obiadazie, R. E. (2014). Application of information and communication technology (ICT) in teaching and learning process of students with disabilities. *AFRREV STECH: An International Journal of Science and Technology*, *3*(1), 176-196.

Oluoch, F. O., & Oboko, R. (2013). Designing an M-learning system for Community Education and information on HIV and AIDS in Kenya. *International Journal of Societal Applications of Computer Science*, 2(3).

O'Malley, C., Vavoula, G., Glew, J. P., Taylor, J., Sharples, M., Lefrere, P, & Waycott, J. (2005). Guidelines for learning/teaching/tutoring in a mobile environment.

Ozdamli, F. (2012). Pedagogical framework of m-learning. *Procedia-Social and Behavioural Sciences*, 31, 927-931.

Ozdamli, F., & Uzunboylu, H. (2015). M-learning adequacy and perceptions of students and teachers in secondary schools. *British Journal of Educational Technology*, 46(1), 159-172.

Padachi, K., Rojid, S., & Seetanah, B. (2008). Investigating into the factors that influence the adoption of internet banking in Mauritius. *Journal of Internet business*, (5).

Pappas, I. O., Mikalef, P., & Giannakos, M. N. (2016). Video-Based Learning Adoption: A Typology of Learners. In *SE@ VBL@ LAK* (pp. 34-41).

Paraskeva, F., Bouta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education*, 50(3), 1084-1091.

Parayitam, S., Desai, K. J., Desai, M. S., & Eason, M. K. (2010). Computer attitude as a moderator in the relationship between computer anxiety, satisfaction, and stress. *Computers in Human Behavior*, 26(3), 345-352.

Park, N., Roman, R., Lee, S., & Chung, J. E. (2009). User acceptance of a digital library system in developing countries: An application of the Technology Acceptance Model *International Journal of Information Management*, 29(3), 196-209.

Park, S. Y., Nam, M. W., and Cha, S. B. (2012). University students' behavioural intention to use mobile learning: Evaluating the technology acceptance model. British Journal of Educational Technology, 43(4), 592-605.

Park, Y., & Chen, J. V. (2007). Acceptance and adoption of the innovative use of smartphone. *Industrial Management & Data Systems*, *107*(9), 1349-1365.

Paulins, N., Balina, S., & Arhipova, I. (2015). Learning content development methodology for mobile devices. Procedia Computer Science, 43, 147-153.

Pearson, J.M., Pearson, A. and Green, D. (2007), "Determining the importance of key criteria in web usability", Management Research News, Vol. 30 No. 11, pp. 816-28.

Peng, H., Su, Y. J., Chou, C., & Tsai, C. C. (2009). Ubiquitous knowledge construction: Mobile learning re-defined and a conceptual framework. *Innovations in Education and Teaching international*, 46(2), 171-183.

Peters, O. (2007). *Social psychological determinants of mobile communication technology use and adoption: A comparison of three models to explain and predict mobile communication technology behaviour.* Thesis, University of Twente

Plomp, T., Anderson, R. E., Law, N., & Quale, A. (Eds.). (2003). *Cross-National information and communication: Technology policy and practices in education*. IAP.

Pollara, P., & Broussard, K. K. (2011). Student perceptions of mobile learning: A review of current research. In Society for Information Technology & Teacher Education International Conference (pp. 1643-1650). Association for the Advancement of Computing in Education (AACE).

Porter C, and Donthu N. (2009) Using the technology acceptance model to explain how attitudes determine Internet usage: The role of perceived access barriers and demographics Journal of Business Research Volume 59, Issue 9, September 2006, Pages 999-1007

Putzer, G. J., & Park, Y. (2010). The effects of innovation factors on smartphone adoption among nurses in community hospitals. *Perspectives in Health Information Management/AHIMA, American Health Information Management Association*, *7*(Winter).

Raban, R. & Litchfield, A. (2007). Supporting peer assessment of individual contributions in groupwork. Australasian Journal of Educational Technology, 23(1), 34-47

Rana, N., Williams, M., Dwivedi, Y., & Williams, J. (2011). Diversity and diffusion of theories, models, and theoretical constructs in egovernment research. *Electronic Government,* 1-12.

Rogers, E. M. (1995). *Diffusion of Innovations 4* The Free Press New York Google Scholar.

Rogers, E. M. (2003). Elements of diffusion. *Diffusion of innovations*, *5*, 1-38.

Rogers, E. M., & Shoemaker, F. (1983). Diffusion of innovation: A cross-cultural approach. *New York*.

Rogers, Y., Connelly, K., Hazlewood, W., & Tedesco, L. (2010). Enhancing learning: a study of how mobile devices can facilitate sensemaking. *Personal and Ubiquitous Computing*, *14*(2), 111-124.

Saade, R. G., & Kira, D. (2009). Computer anxiety in e-learning: the effect of computer self-efficacy. *Journal of Information Technology Education* Volume 8, 2009, 8, 177-191.

Saunders, M., Lewis, P., & Thornhill, A. (2009). Understanding research philosophies and approaches. Research methods for business students, 4, 106-135.

Schunk, D.H. (2008) Learning theories: An educational perspective (5th ed.). Upper Saddle Hill, NJ: Pearson Education.

Sekaran, U. & Bougie, R. (2011) *Research Methods for Business*: A Skill Building Approach, 5th Ed. Wiley India Pvt. Ltd.

Seok, S. (2008). Teaching aspects of e-learning. *International journal on elearning*, *7*(4), 725.

Shah, N., & Jansen, F. (Eds.). (2011). *Digital AlterNatives with a Cause?*. Centre for Internet and Society.

Sharples, M., Arnedillo-Sánchez, I., Milrad, M., & Vavoula, G. (2009). Mobile learning. In *Technology-enhanced learning* (pp. 233-249). Springer Netherlands.

Sharples, M., Corlett, D., Bull, S., Chan, T., & Rudman, P. (2005). The Student Learning Organiser. In A. Kukulska-Hulme & J. Traxler (Eds.) Mobile Learning: *A Handbook for Educators and Trainers* (pp. 139-149). London: Routledge.

Sharples, M., Taylor, J., & Vavoula, G. (2010). A theory of learning for the mobile age. In

Medienbildung in neuen Kulturräumen (pp. 87-99). VS Verlag für Sozialwissenschaften.

Sharples, M., Taylor, J., and Vavoula, G. (2007). A Theory of Learning for the Mobile Age. R. Andrews and C. Haythornthwaite (eds), *The SAGE Handbook of E-learning Research. London, SAGE Publications*, pp. 221–247.

Shih, P.-C., Munoz, D., & Sanchez, F. (2006). The effect of previous experience with information and communication technologies on performance in a Web-based learning program. *Computers in Human behaviour,* 22(6), 962-970.

Shin, D. H., Shin, Y. J., Choo, H., & Beom, K. (2011). Smartphones as smart pedagogical tools: Implications for smartphones as u-learning devices. *Computers in Human Behaviour*, 27(6), 2207-2214.

Shudong, W., Higgins, M., & Shima, Y. (2005). Teaching English pronunciation for Japanese learners of English online. *JALT CALL Journal*, 1(1), 39-47.

Siddiqui, H. (2008) *Investigation of intention to use e-commerce in the Arab countries: A comparison of self-efficacy, usefulness, culture, gender, and socioeconomic status in Saudi Arabia and the United Arab Emirates.* Ph.D. dissertation, Nova South Eastern University, United States -- Florida.

Smith, P. J. (2005). Learning preferences and readiness for online learning. *Educational Psychology*, 25(1), 3-12.

Song, L., & Hill, J. R. (2007). A Conceptual Model for Understanding Self-Directed Learning in Online Environments. *Journal of Interactive Online Learning*, 6(1).

Stine, R. A. (2017). Explaining Normal Quantile-Quantile Plots Through Animation: The Water-Filling Analogy. *The American Statistician*, 71(2), 145-147.

Straub T, E . (2009) Understanding Technology Adoption: Theory and Future Directions for Informal Learning. *Review of Educational Research, June 2009*, Vol. 79, No. 2, pp.

625–649.

Sugden, D. (2005). Exploring the physical frontiers of e-learning. The use of personal digital assistants (PDAs) in outreach centres. *ALT-C 2005 Research Proceedings*, 6-8.

Šumak, B., Polancic, G., & Hericko, M. (2010, February). An empirical study of virtual learning environment adoption using UTAUT. In *Mobile, Hybrid, and On-Line Learning, 2010. ELML'10. Second International Conference on* (pp. 17-22). IEEE.

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & education*, 50(4), 1183-1202.

Tagoe, M., & Abakah, E. (2014). Determining distance education students' readiness for mobile learning at University of Ghana using the Theory of Planned Behavior. *International Journal of Education and Development using Information and Communication Technology*, *10*(1), 91.

Tai, Y. & Ting, Y. L. (2011). Adoption of mobile technology for language learning: Teacher attitudes and challenges. *The JALT CALL Journal*, 7(1), 3-18.

Taleb, Z., & Sohrabi, A. (2012). Learning on the move: the use of mobile technology to support learning for university students. *Procedia-Social and Behavioural Sciences*, 69, 1102-1109.

Tarhini, A., Hone, K., & Liu, X. (2013). User acceptance towards web-based learning systems: Investigating the role of social, organizational and individual factors in European higher education. *Procedia Computer Science*, *17*, 189-197.

Tashakkori, A., & Creswell, J. W. (2007). Exploring the nature of research questions in mixed methods research.

Tashakkori, A., & Teddlie, C. (2010). Putting the human back in *''human research methodology''*: The researcher in mixed methods research.

Tearle, P. (2003). ICT implementation: what makes the difference? *British Journal of Educational Technology*, 34(5), 567-583

Teddlie, C., & Tashakkori, A. (2010). Overview of contemporary issues in mixed methods research. *Handbook of mixed methods in social and behavioral research*, 1-41.

Teo, T. (2009). The impact of subjective norm and facilitating conditions on pre-service teachers' attitude toward computer use: A Structural Equation Modelling of an Extended Technology Acceptance Model. *Journal of Educational Computing Research*, 40(1), 89 - 109.

Teo, T. (2010). A path analysis of pre-service teachers' attitudes to computer use: applying and extending the technology acceptance model in an educational context. *Interactive Learning Environments*, 18(1), 65-79.

Teo, T., Lee, C. B., & Chai, C.S. (2008). Understanding pre-service teachers' computer attitudes: Applying and extending the Technology Acceptance Model (TAM). *Journal of Computer Assisted Learning*, 24(2), 128-143.

Thatcher, A. and Mooney, G. (2008). Managing Social Activity and Participation in Large Classes with Mobile Phone Technology. International *Journal of Interactive Mobile Technologies*. 2 (3), 41-51.

Theng, Y. L. (2009, June). Mobile learning for tertiary students: an exploratory study of acceptance of use. In *EdMedia: World Conference on Educational Media and Technology* (pp. 937-946). Association for the Advancement of Computing in Education (AACE).

Thomas, T. D., Singh, L., & Gaffar, K. (2013). The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana. *International Journal of Education and Development using Information and Communication Technology*, *9*(3), 71.

Thornton, P., & Houser, C. (2005). Using mobile phones in English education in Japan. *Journal of Computer Assisted Learning,* 21(3), 217-228.

Tibenderana, P. K., & Ogao, P. J. (2008, June). Acceptance and use of electronic library services in Ugandan universities. In *Proceedings of the 8th ACM/IEEE-CS joint conference on Digital libraries* (pp. 323-332). ACM.

Ting, R. Y. L. (2005, July). Mobile learning: Current trend and future challenges. In *Advanced Learning Technologies, 2005. ICALT 2005. Fifth IEEE International Conference on* (pp. 603-607). IEEE.

Tondeur, J., Valcke, M., & van Braak, J. (2008). A multidimensional approach to determinants of computer use in primary education: Teacher and school characteristics. *Journal of Computer Assisted Learning,* vol. 24, pp. 494–506.

Totolo, A. (2007). *Information technology adoption by principals in Botswana secondary schools*. The Florida State University.

Traxler, J. (2005, June). Defining mobile learning. In *IADIS International Conference Mobile Learning* (pp. 261-266).

Traxler, J. (2009) Learning in a mobile age. *International Journal of Mobile and Blended Learning*, 1(1), 1-12

Traxler, J. (2009). Current state of mobile learning. *Mobile learning: Transforming the delivery of education and training*, *1*, 9-24.

Traxler, J. M. (2008). Use of mobile technology for mobile learning and mobile libraries in a mobile society. *M-libraries: Libraries on the move to provide virtual access. London: Facet*.

Trifonova, A., & Ronchetti, M. (2004, August). A general architecture to support mobility in learning. In *Advanced Learning Technologies, 2004. Proceedings. IEEE International Conference on* (pp. 26-30). IEEE.

Trinder, J. J., Magill, J. V., & Roy, S. (2005). Portable assessment: towards ubiquitous education. *International journal of electrical engineering education*, 42(1), 73-78.

Trucano, M. (2009). Checking in with BridgeIT in Tanzania: Using mobile phones to support teachers. *EduTech: A World Bank Blog on ICT Use in Education*.

Tsai, M. J. & Tsai, C. C. (2003). Information searching strategies in web-based science learning: The role of Internet self-efficacy. *Innovations in Education and Teaching International, 40 (1), 43-50.*

Tsai, M. J. & Tsai, C. C. (2003). Information searching strategies in web-based science learning: The role of Internet self-efficacy. *Innovations in Education and Teaching International*, 40 (1), 43-50.

Tsai, P. S., Tsai, C. C., & Hwang, G. H. (2010). Elementary school students' attitudes and self-efficacy of using PDAs in a ubiquitous learning context. *Australasian Journal of Educational Technology*, 26(3), 297-308.

Tucker, S-P. (2008) E-commerce standard user interface: an E-menu system, *Industrial Management & Data Systems Vol. 108 No. 8, 2008 pp. 1009-1028*

Tzeng, J.-Y. (2009). The impact of general and specific performance and self-efficacy on learning with computer-based concept mapping. Computers in Human Behavior, 25(4), 989-996. doi: 10.1016/j.chb.2009.04.009

Umoru, T. A., & Okeke, A. U. (2012). M-learning in Nigerian universities: challenges and possibilities. In *global awareness society international 21st annual conference, New York City*.

UNESCO, (2012) *Turning on Mobile Learning* > Illustrative Initiatives and Policy Implications in Africa and the Middle East

Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research*, 78(4), 751-796. doi:

10.3102/0034654308321456

Uzunboylu, H., & Ozdamli, F. (2011). Teacher perception for m-learning: scale development and teachers' perceptions. *Journal of Computer assisted learning*, 27(6), 544-556.

Uzunboylu, H., Cavus, N., & Ercag, E. (2009). Using mobile learning to increase environmental awareness. *Computers & Education*, 52(2), 381-389.

Van Biljon, J. A. (2006). *A model for representing the motivational and cultural factors that influence mobile phone usage variety* (Doctoral dissertation)

van Raaij, E. M., & Schepers, J. J. L. (2008). The acceptance and use of a virtual learning environment in China. Computers & Education, 50(3), 838-852.

Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*, 39(2), 273-315.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478.

Viehland, D., & Leong, R. S. Y. (2007). Acceptance and use of mobile payments. *ACIS 2007 Proceedings*, 16.

Vosloo, S. (2012). *Mobile Learning and Policies: Key issues to consider mobile* learning (pp. 1–55). Paris, France. Retrieved from http:// unesdoc. unesco.org /images/0021/ 002176/217638E.pdf

Wafa' N, M., & Abu-Al-Sha'r, A. M. (2009). University Students' Attitudes towards Cell Phone Learning Environment. *iJIM*, 3(4), 35-40.

Wagner, E. D. (2005). Enabling mobile learning. *Educause Review*, 40(3), 40-53.

Walton, M. (2009). Mobile Literacies and South African Teens: Leisure reading, writing, and Mxit chatting in Nyanga and Gugulethu. Availale; http:// m4lit. files. wordpress. com/2010/03/ m4lit_ mobile_ literacies_ mwalton_ 20101. pdf

Walvis, T. (2003). Avoiding advertising research disaster: Advertising and the uncertainty

principle. *Journal of Brand Management*, 10(6).

Wang, C. Y., Chou, S. C. T., & Chang, H. C. (2010). Exploring An Individual's Intention to Use Blogs: The Roles of Social, Motivational and Individual Factors. In *PACIS* (p. 161).

Wang, C.-Y., Chou, S.-cho T., & Chang, H.-C. (2010). Exploring An Individual's Intention to Use Blogs: The Roles of Social, Motivational and Individual Factors. PACIS 2010 Proceedings, 1656-1663. Retrieved from http://aisel.aisnet.org/pacis2010/161

Wang, Y. S. (2007). Development and validation of a mobile computer anxiety scale. *British Journal of Educational Technology*, 38(6).

Wang, Y. S., Wu, M. C., & Wang, H. Y. (2009). Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British journal of educational technology*, 40(1), 92-118

Wang, Y. S., Wu, M. C., & Wang, H. Y. (2009). Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British journal of educational technology*, 40(1), 92-118.

Wang, Y.-S., Lin, H.-H., & Luarn, P. (2006). Predicting consumer intention to use mobile service. *Information Systems Journal,* 16(2), 157-179.

Wani, T. A. (2015). Innovation Diffusion Theory. *Journal of General Management Research, Vol. 3, Issue 2*, July 2015, pp. 101–118

Wei, F. H., Chen, G.-D., & Wang, C.-Y. (2007). Ubiquitous discussion forum: Introducing mobile phones and voice discussion into a web discussion forum. *Journal of Educational Multimedia and Hypermedia,* 16(2), 125-140.

Wei, L., & Zhang, M. (2008). The adoption and use of mobile phone in rural China: A case study of Hubei, China. *Telematics and Informatics, 25*(3), 169-186.

Wentzel, P. (2005). Mobile Learning in the Netherlands: Real-time Database Access in an

Educational Fieldwork Setting. *World*, *25*, 28.

Williams, P. W. (2009). *Assessing mobile learning effectiveness and acceptance* (Doctoral dissertation, The George Washington University). Retrieved from http://www.paulwwilliamsphd.com/index_files/Assessing_Mobile_Learning_Effectiveness_and_Acceptance.pdf

Wong, M. S. L. (2005). Language learning strategies and language self-efficacy: *Investigating the relationship in Malaysia. RELC journal*, 36(3), 245-269.

World Bank. Information, Communication Technologies, & infoDev (Program). (2012). *Information and communications for development 2012: Maximizing mobile*. World Bank Publications.

Wu, J. H., Wang, S. C., & Lin, L. M. (2007). Mobile computing acceptance factors in the healthcare industry: A structural equation model. *International journal of medical informatics*, 76(1), 66-77.

Wu, W. H., Wu, Y. C. J., Chen, C. Y., Kao, H. Y., Lin, C. H., & Huang, S. H. (2012). Review of trends from mobile learning studies: A meta-analysis. *Computers & Education*, 59(2), 817-827.

Wu, Y. L., Tao, Y. H., & Yang, P. C. (2008). The use of unified theory of acceptance and use of technology to confer the behavioral model of 3G mobile telecommunication users. *Journal of Statistics and Management Systems*, *11*(5), 919-949.

Yamane, Taro. (1967). *Statistics, An Introductory Analysis*, 2nd Ed., New York: Harper and Row.

Yamane, Taro. (1967). *Statistics, An Introductory Analysis*, 2nd Ed., New York: Harper and Row.

Yang S (2012) Exploring College Students' Attitudes and Self-Efficacy of Mobile Learning, *Adapazari Vol. 11, Iss. 4*

Yang, H. J., Yu, J. C., & Yang, H. H. (2008, April). A study of educational functions of mobile learning. In *WSEAS International Conference. Proceedings. Mathematics and Computers in Science and Engineering* (No. 8). World Scientific and Engineering Academy and Society.

Yang, K. (2005). Exploring factors affecting the adoption of mobile commerce in Singapore. *Telematics and Informatics*, 22(3), 257–277.

Yi, C. C., Liao, W. P., Huang, C. F. & Hwang, I. H. (2009). Acceptance of mobile learning: a specification and validation of information system success. *In proceedings in World Academy of Sciences, Engineering and Technology* 41 2070-3740.

Yildirim, S. (2007). "Current Utilization of ICT in Turkish Basic Education Schools: A Review of Teacher's ICT Use and Barriers to Integration". *International Journal of Instructional Media, vol. 34*, no.2, pp. 171-86.

Yilmaz, N. P. (2011). Evaluation of the technology integration process in the Turkish education system. *Contemporary Educational Technology,* 2(1), 37-54.

Yohanes Kristianto, Mian Ajmal, Richard Addo Tenkorang, Matloub Hussain, (2012) "A study of technology adoption in manufacturing firms", *Journal of Manufacturing Technology Management, Vol. 23 Iss: 2,* pp.198 - 211

Yordanova, K. (2007, June). Mobile learning and integration of advanced technologies in education. *In Proceedings of the 2007 international conference on Computer systems and technologies* (p. 92). ACM.

Zeng, R., & Luyegu, E. (2011). Mobile learning in higher education. In A. D. Olofsson & J. O. Lindberg (Eds.), *Informed Design of Educational Technologies in Higher Education: Enhanced Learning and Teaching* (pp. 292-306): IGI Global.

Zhang, S., Zhao, J., & Tan, W. (2008). Extending TAM for online learning systems: An intrinsic motivation perspective. *Tsinghua Science & Technology*, 13(3), 312-317.

Zhang, Y., & Wildemuth, B. (2009). Qualitative analysis of content Applications of Social Research Methods to Questions. *in Information and Library Science*. Westport, CT: Libraries Unlimited.

Zhao, L., Lu, Y., Wang, B., & Huang, W. (2011). What makes them happy and curious online? An empirical study on high school students' Internet use from a self-determination theory perspective. *Computers & Education*, 56(2), 346-356. 10.1016/j.compedu.2010.08.006

Zhao, Y., & Cziko, G. A. (2011). Teacher adoption of technology: A perceptual control theory perspective. *Journal of Technology and Teacher Education*, 9, 5-30. Norfolk, VA: SITE.

Zikmund, W. (2009). *Business Research Methods*. Texere Publishing Limited.

APPENDICES

Appendix I: Transmittal Letter

Augustine Mwangi Gatotoh

P O Box 17291-00100

NAIROBI

Dear Sir/Madam

RE: REQUEST FOR PARTICIPATION IN A RESEARCH STUDY

I am a postgraduate student at the University of Nairobi and currently conducting a research as partial requirement for the award of the degree of Doctor of Philosophy in Distance Education. My research topic is "Learner Characteristics, Behaviour, Technology Use and Adoption of Mobile Learning Among Community Health Trainees - Amref Health Africa, Kenya.''

The purpose of this letter is to request you to participate as a respondent in this study by completing the attached questionnaire as accurately as possible. All the information provided will be purely used for academic purposes and your identity will be treated with utmost confidentiality.

Thank you in advance.

Augustine Mwangi Gatotoh

Appendix II: Questionnaire for Community Health Trainees Participating in the mHealth Programme

Instructions:

Kindly respond by ticking [√] or filling in your response to the questionnaire items in the space provided.

For the open questions write your response in the open spaces […….] provided

Name of County……Community Unit……Learning Number…….…….

Section A: Learner Characteristics

1. What is your gender? 1. [ ] Male 2. Female [ ]
2. What is your age 1. [ ] 24 years and below 2. [ ] 25-29 yrs 3. [ ] 30-34 yrs 4. [ ] 35-39yrs 5 [ ] 39-44yrs 6. [ ] Above 44yrs.
3. What is your highest level of education? 1. [ ] Certificate Level 2. [ ] Diploma 3. [ ] Bachelor's Degree 4. [ ] Postgraduate Diploma 5. [ ] Master's Degree Any other, specify……..
4. For how long have you worked as a Community Health Volunteer? ……. Years
5. Have you ever used a mobile phone for learning before the mLearning programme? 1. [ ] Yes 2. [ ] No If yes, for how long……
6. For how long were you exposed to the mLearning programme? ……months.

Section B: Learner mLearning Self-Efficacy

Please rate the extent to which you agree with each of the statements below by ticking [√] only one option in the spaces provided.

Where: SA=Strongly Agree, A=Agree, U=Uncertain, D= Disagree, SD= Strongly Disagree

No.	Statement	SA	A	U	D	SD
Navigating through the learning platform						
1	It is easy to navigate through SMS content for learning	[ ]	[ ]	[ ]	[ ]	[ ]
2	It is easy to navigate through Voice content for learning	[ ]	[ ]	[ ]	[ ]	[ ]
3	It is easy to navigate through Group Chat content for learning	[ ]	[ ]	[ ]	[ ]	[ ]
4	It is easy to navigate through case studies and scenarios content for learning	[ ]	[ ]	[ ]	[ ]	[ ]
5	I believe I will need strong level of support from the IT staff to be able to fully utilise mobile technology	[ ]	[ ]	[ ]	[ ]	[ ]
6	I am in complete control when using mobile technology for learning	[ ]	[ ]	[ ]	[ ]	[ ]
7	I need someone to tell me how best to use mobile technology more effectively	[ ]	[ ]	[ ]	[ ]	[ ]
Peer interaction						
8	I enjoy the chat forums via the mobile device.	[ ]	[ ]	[ ]	[ ]	[ ]
9	Chat messages make interaction with my colleagues fun .	[ ]	[ ]	[ ]	[ ]	[ ]
10	I enjoy other social media forums (such as WhatsApp,	[ ]	[ ]	[ ]	[ ]	[ ]

No.	Statement	SA	A	U	D	SD
	Facebook) to interact with peers about the learning content					
11	Mobile technology allows interaction with peers compare to other methods of learning (such as use of study modules)	[ ]	[ ]	[ ]	[ ]	[ ]
12	I find mobile technology interactive	[ ]	[ ]	[ ]	[ ]	[ ]
13	The mobile learning activities encourage discussion and collaboration among students.	[ ]	[ ]	[ ]	[ ]	[ ]
14	The mobile learning application enables more interaction with the supervisors.	[ ]	[ ]	[ ]	[ ]	[ ]
Dependency						
15	I am able to chat effectively without assistance	[ ]	[ ]	[ ]	[ ]	[ ]
16.	I am able to access voice content effectively from mobile devices without assistance	[ ]	[ ]	[ ]	[ ]	[ ]
17	I am able to access SMS content effectively without assistance	[ ]	[ ]	[ ]	[ ]	[ ]
18	I am able to complete learning activities effectively without assistance	[ ]	[ ]	[ ]	[ ]	[ ]
19	I am able to complete quizzes effectively without assistance	[ ]	[ ]	[ ]	[ ]	[ ]
20	I am able to get feedback effectively without assistance	[ ]	[ ]	[ ]	[ ]	[ ]
21	I am able to complete lessons on time without assistance	[ ]	[ ]	[ ]	[ ]	[ ]
Innovativeness						
22	I manage to solve learning based challenges by myself.	[ ]	[ ]	[ ]	[ ]	[ ]

No.	Statement	SA	A	U	D	SD
23	I like to explore the new information technology	[ ]	[ ]	[ ]	[ ]	[ ]
24	The more difficult the problem the more I enjoy to solve it	[ ]	[ ]	[ ]	[ ]	[ ]
25	I would try applying mobile learning in other areas of life	[ ]	[ ]	[ ]	[ ]	[ ]
26	I can teach myself more things I need to know about new technology	[ ]	[ ]	[ ]	[ ]	[ ]
27	I feel secure about my ability to use ICT	[ ]	[ ]	[ ]	[ ]	[ ]
28	I can use new technology to do whatever is possible with that technology	[ ]	[ ]	[ ]	[ ]	[ ]

29. What are some of the challenges you faced while using the mLearning platform by yourself?

……..

……..

……..

……..

Section C: Learner Attitude towards mLearning

Please rate the extent to which you agree with each of the statements below by ticking [√] only one option in the spaces provided.

Where: SA=Strongly Agree, A=Agree, U=Uncertain, D= Disagree, SD= Strongly Disagree

No.	Statement	SA	A	U	D	SD
Attitude towards mobile learning technology						
1.	Learning using a mobile device promotes easy understanding of concepts	[ ]	[ ]	[ ]	[ ]	[ ]
2.	Learning using a mobile device promotes independent learning	[ ]	[ ]	[ ]	[ ]	[ ]
3.	Learning using a mobile device enables fast access to information	[ ]	[ ]	[ ]	[ ]	[ ]
4.	I enjoy using new technology to learn	[ ]	[ ]	[ ]	[ ]	[ ]
5.	I believe mobile technology would enable me accomplish tasks quickly	[ ]	[ ]	[ ]	[ ]	[ ]
6.	I believe mobile technology offers increases access to learning	[ ]	[ ]	[ ]	[ ]	[ ]
7.	I feel I have the right skills to continue using mobile technology for learning	[ ]	[ ]	[ ]	[ ]	[ ]
Attitude towards use of mobile devices for learning						
8.	Using a mobile device can help me to attain more ideas	[ ]	[ ]	[ ]	[ ]	[ ]
9.	In the mLearning environment, a mobile device can enhance my desire to learn	[ ]	[ ]	[ ]	[ ]	[ ]
10.	In the mLearning environment, the size of the mobile device makes me feel uncomfortable	[ ]	[ ]	[ ]	[ ]	[ ]

11.	I can apply mobile devices in various learning activities	[ ]	[ ]	[ ]	[ ]	[ ]
12.	It will take long for me to be comfortable using mobile technology for learning	[ ]	[ ]	[ ]	[ ]	[ ]
13.	Using mobile technology for learning is a good idea	[ ]	[ ]	[ ]	[ ]	[ ]
14.	Using mobile technology for learning makes learning interesting	[ ]	[ ]	[ ]	[ ]	[ ]
Attitude towards mobile learning Content						
15.	I feel that the mobile learning content is inadequate for learning	[ ]	[ ]	[ ]	[ ]	[ ]
16.	I feel that content provided through mobile learning is not easy to understand	[ ]	[ ]	[ ]	[ ]	[ ]
17.	Mobile learning content should be supplemented with study modules	[ ]	[ ]	[ ]	[ ]	[ ]
18.	Content transmitted via mobile devices is too brief for my comprehension	[ ]	[ ]	[ ]	[ ]	[ ]
19	I see using mobile technology to access content for learning taking longer than other modes of learning	[ ]	[ ]	[ ]	[ ]	[ ]
20	Interacting with learning content on mobile technology is fun	[ ]	[ ]	[ ]	[ ]	[ ]
21	I feel break down of content into small parts makes learning more meaningful	[ ]	[ ]	[ ]	[ ]	[ ]

22. What recommendations would you make to help improve the learner preparedness for mLearning?

……

Section D: Learner Behavioural Intention

Please rate the extent to which you agree with each of the statements below by ticking [√] only one option in the spaces provided.

Where: SA=Strongly Agree, A=Agree, U=Uncertain, D= Disagree, SD= Strongly Disagree

No.	Statement	SA	A	U	D	SD
Social Influence						
1	In general, my peers support the use of mobile devices for learning.	[ ]	[ ]	[ ]	[ ]	[ ]
2	People who are important to me think that I should use mobile devices for learning.	[ ]	[ ]	[ ]	[ ]	[ ]
3	The facilitators and other staff are helpful in the use of mobile learning	[ ]	[ ]	[ ]	[ ]	[ ]
4	I choose the new learning style because my immediate supervisor supports it	[ ]	[ ]	[ ]	[ ]	[ ]
5	Support from the institution influence my decision to use mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]
6	People who influence my behavior will think that I should use mobile learning	[ ]	[ ]	[ ]	[ ]	[ ]
7	Mobile learning activities encourage discussion and collaboration among students	[ ]	[ ]	[ ]	[ ]	[ ]
Performance Expectancy						
8	Using mobile devices for learning will enable me to accomplish activities as a CHV more quickly.	[ ]	[ ]	[ ]	[ ]	[ ]
9	Using mobile devices for learning helps improve my	[ ]	[ ]	[ ]	[ ]	[ ]

No.	Statement	SA	A	U	D	SD
	performance					
10	Using mobile devices for learning will increase my learning outcome	[ ]	[ ]	[ ]	[ ]	[ ]
11	Using mobile devices for learning will allow me to have access to more health information.	[ ]	[ ]	[ ]	[ ]	[ ]
12	Using mobile learning enables me to complete lessons more quickly.	[ ]	[ ]	[ ]	[ ]	[ ]
13	Using mobile learning enables me to get feedback more quickly.	[ ]	[ ]	[ ]	[ ]	[ ]
14	The mobile learning platform helps improve the way I think when answering questions.	[ ]	[ ]	[ ]	[ ]	[ ]
Effort expectancy						
15	I find using mobile devices to learn easy	[ ]	[ ]	[ ]	[ ]	[ ]
16	Completing lessons using mobile devices requires a lot of effort	[ ]	[ ]	[ ]	[ ]	[ ]
17	Interacting with supervisors and peers is easy on the mobile learning platform	[ ]	[ ]	[ ]	[ ]	[ ]
18	Learning to operate mobile learning applications is easy for me	[ ]	[ ]	[ ]	[ ]	[ ]
19	My interaction with mobile learning applications is clear and understandable	[ ]	[ ]	[ ]	[ ]	[ ]
20	It would be easy for me to become more skilful at using mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]

No.	Statement	SA	A	U	D	SD
21	Access to content, quizzes, is easy using mobile devices	[ ]	[ ]	[ ]	[ ]	[ ]
Facilitating conditions						
22	I have the resources necessary to use mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]
23	I have the necessary knowledge to use mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]
24	With support, I would continue to use the mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]
25	Using a mobile device for learning is fun	[ ]	[ ]	[ ]	[ ]	[ ]
26	Mobile learning applications are similar to other systems I use in mobile devices	[ ]	[ ]	[ ]	[ ]	[ ]
27	Availability of help when I get an mLearning problem is an important factor in lesson completion	[ ]	[ ]	[ ]	[ ]	[ ]
28	The clarity of language used in the mobile learning platform is an important factor in lesson completion	[ ]	[ ]	[ ]	[ ]	[ ]

29. What recommendations would you make to enable you continue using mLearning

…….

……

……

Section E: Technology Use

Please rate the extent to which you agree with each of the statements below by ticking [√] only one option in the spaces provided.

Where: SA=Strongly Agree, A=Agree, U=Uncertain, D= Disagree, SD= Strongly Disagree

No.	Statement	SA	A	U	D	SD
Device functionality						
1	The type of mobile phone one uses influences the way one accesses content.	[ ]	[ ]	[ ]	[ ]	[ ]
2	Battery life and access to power affects effective access to content	[ ]	[ ]	[ ]	[ ]	[ ]
3	The mobile phone screen size affects effective learning	[ ]	[ ]	[ ]	[ ]	[ ]
4	Phone memory affects effective access to content	[ ]	[ ]	[ ]	[ ]	[ ]
Content delivery technology						
5	Short Message Service (SMS) is effective for delivering learning content	[ ]	[ ]	[ ]	[ ]	[ ]
6	Interactive Voice Response (IVR) is effective for delivering learning content	[ ]	[ ]	[ ]	[ ]	[ ]
7	Group chat is effective for learning	[ ]	[ ]	[ ]	[ ]	[ ]
8	Case studies and scenarios are effective in delivering learning content	[ ]	[ ]	[ ]	[ ]	[ ]

9. What type of mobile phone do you use for mLearning purposes?

a. [ ] Basic phone b. [ ] Smart phone c [ ] Tablet d [ ] Others specify……

10. Does the mobile content delivery mode influence your decision to use mLearning platforms?

    a. [ ] Yes b) [ ] No

11. What technical aspects would you like improved to make mLearning more effective?

    ……..

    ……..

Section F: Institutional Factors

Please rate the extent to which you agree with each of the statements below by ticking [√] only one option in the spaces provided.

Where: SA=Strongly Agree, A=Agree, U=Uncertain, D= Disagree, SD= Strongly Disagree

No.	Statement	SA	A	U	D	SD
1.	Access to institutional support influences learning using mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]
2.	Timely feedback on the mLearning platform influences continued use of mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]
3.	Transmission of content affects progression in learning	[ ]	[ ]	[ ]	[ ]	[ ]
4.	The clarity of content influence completion of lessons	[ ]	[ ]	[ ]	[ ]	[ ]
5.	The clarity of content influences continued mLearning use	[ ]	[ ]	[ ]	[ ]	[ ]
6.	Training on use of mLearning influences use of mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]
7.	Motivation from the institution and support staff influences use of mobile devices for learning	[ ]	[ ]	[ ]	[ ]	[ ]

8. How often did you receive support from the institution (Amref) to enable you use the mLearning platform

1. [ ] Less than once a month 2. [ ] Once a month 3. [ ] A few times a month

4. [ ] A few times a week 5. [ ] Once a day 6. [ ] Several times a day

9. Explain the type of support you received from the institution (Amref) to enable you use the mLearning platform

……

……

10. Explain the type of support you received from the supervisors to enable you use the mLearning platform

……

……

Section G: Adoption of mLearning

Please rate the extent to which you agree with each of the statements below by ticking [√] only one option in the spaces provided.

Where: SA=Strongly Agree, A=Agree, U=Uncertain, D= Disagree, SD= Strongly Disagree

No.	**Statement**	**SA**	**A**	**U**	**D**	**SD**
1	I used the mLearning platform consistently	[ ]	[ ]	[ ]	[ ]	[ ]
2	I completed mLearning tasks within the allocated time	[ ]	[ ]	[ ]	[ ]	[ ]
3	I intend to continue using the mLearning platform for learning	[ ]	[ ]	[ ]	[ ]	[ ]
4	The ease of use of the mLearning platform influenced my completion of the mLearning tasks	[ ]	[ ]	[ ]	[ ]	[ ]

11. On average, how frequently do you use the mobile learning platform?

1. [ ] Less than once a month 2. [ ] Once a month 3. [ ] A few times a month

4. [ ] A few times a week 5. [ ] Once a day 6. [ ] Several times a day

12. On the average working day, how much time do you spend on mobile learning?

1. [ ] Almost never 2. [ ] Less than 30 minutes 3. [ ] 30 minutes to 1 hour

4. [ ] 1 hour – 2 hours 5. [ ] From 2 hours – 3 hours 6. [ ] More than 3 hours

13. What recommendations would you make on improving the mLearning platform to enable you get to use mLearning more?

……

……

……

Appendix III: Focused Group Discussion Schedule for Community Health Trainees Participating in the mHealth Programme

County……. Community Unit……Interview Number…….

Section A: Learner Self-Efficacy

1. How would you describe your ability to use the mobile learning platform?
2. How did you use the mLearning platform to interact with each other?
3. Describe your level of independency in using the mLearning platform
4. How did you deal with the challenges you encountered when using the mLearning platform?
5. How ready are you to continue using the mLearning platform?

Section B: Learner Attitude towards mLearning

1. In general, how do you feel about the effectiveness of mLearning?
2. What was your reaction when you introduced to learning using the mobile phone?
3. How would you describe the adequacy of content provided through mobile learning?

Section C: Learner Behavioural Intention

1. To what extent do you think the peers and other members of the community played a role in influencing you to accept mobile learning
2. How did mobile learning enable Community health trainees accomplish learning activities?
3. What was the contribution of mobile learning to the learning outcome?
4. What was the contribution of mobile learning to access to more information for the Community Health volunteers?
5. How did the interaction with the mobile learning application enhance ease of use?
6. How would you describe how the Community health trainees learned how to use the mLearning platform?
7. What conditions enabled you to use?

8. What conditions hindered you from successful adoption of mLearning?
9. How did you access support for the mobile learning platform?
10. Would you recommend the use of the mobile learning platform in the health or other sectors in future…..explain your answer.

Section D: Technology Use

1. How does the type of phone one has influence the way one accesses mLearning content?
2. How does the phone (screen size, battery life etc) influence the way one accesses mLearning content?
3. How would you describe the effectiveness of each of the content delivery platforms?

Section E: Institutional Factors

1. How would you describe the support structures (Human resource, technical, financial) put in place by each of the support partners?

Section F: Adoption of mLearning

1. How would you describe the acceptance of mLearning by Community Health Volunteers?
2. Success stories challenges and recommendations
3. What would you say are some of the successes of mLearning?
4. What are some of the key challenges of mLearning?
5. What recommendations would you make to enhance mLearning adoption?

Appendix III: Interview Guide for Community Health Extension Workers Participating in the mHealth Programme

County……. Community Unit……Interview Number…….

Section A: Learner Self-Efficacy

a) Navigating through the mLearning platform

1. How would you describe learner's ability to use the mobile learning platform?
2. Describe learners' learner support services received

b) Peer interaction

1. How did the Community Health Workers use the mLearning platform to interact with each other?
2. What support was required for peer interaction

c) Dependency

1. What is the role of training in enhancing mLearning adoption?
2. Describe the level of dependency of the learners in using the mLearning platform

d) Innovativeness

1. How did the Community Health Workers deal with problems they encountered when using the mLearning platform?
2. What would you describe as innovations you experienced from the community health trainees while using the mLearning platform?

e) Readiness to use mobile learning

1. How ready were the Community health trainees to use the mLearning platform?
2. What were some of the indicators that showed they were interested in mLearning?
3. What were some of the indicators that showed they were not interested in mLearning

Section B: Learner Attitude towards mLearning

a) Attitude towards mobile learning process

1. Do you think that mLearning helps improve the quality of learning …..Explain your response

b) Attitude towards use of mobile phone for learning

1. What was the Community Health Volunteer's reaction when you introduced learning using the mobile phone?

c) Attitude Towards mLearning Content

1. How would you describe the adequacy of content provided through mobile learning?

Section C: Learner Behavioural Intention

a) Social Influence

1. To what extent do you think the peers played a role in influencing the community heath volunteers to accept mobile learning
2. What was the impact of mLearning on competency of Community Health Volunteers?

b) Effort expectancy

1. How would you describe how the Community health trainees learned how to use the mLearning platform?

c) Facilitating conditions

1. How did the resource available hinder or support mLearning
2. How did the Community health trainees access support for the mobile learning platform

d) Behavioural intention

1. Would you recommend the use of the mobile learning platform in the health or other sectors in future…..explain your answer.

Section D: Technology Use

1. How does the type of phone one has influence the way one accesses mLearning content?
1. How would you describe the effectiveness of each of the content delivery platforms?

Section E: Institutional Factors

1. How would you describe the support structures (Human resource, technical, financial) put in place by each of the support?
2. What challenges did the CHVs report to you on the use of mLearning?
3. What type of support did you offer to the community health volunteers?

Section F: Adoption of mLearning

1. How would you describe the acceptance of mLearning by Community Health Volunteers?

Appendix IV: Interview Guide for Project Support Staff

County attached to……Area of support……Interview Number…….

Section A: Learner Self-Efficacy

a) Navigating through the mLearning platform

1. How would you describe the support you gave to the learners to enable them use the mobile learning platform?

b) Peer interaction

1. How did the Community Health Workers use the mLearning platform to interact with each other?

c) Dependency

1. What is the role of training in enhancing mLearning adoption?
2. Describe the support offered to the Community Health Workers to enable them use the mobile learning platform
3. How often did Community health trainees require help to use the mobile learning platform?

d) Innovativeness

1. How did the Community Health Workers deal with problems they encountered when using the mLearning platform?
2. What would you describe as innovations you experienced from the Community health trainees while using the mLearning platform?
3. How did the Community health trainees respond to the new technology?

e) Readiness to use mobile learning

1. In your opinion, how ready were the Community health trainees to use the mLearning platform?

2. What were some of the indicators that showed they were interested in mLearning?
3. What were some of the indicators that showed they were not interested in mLearning?

Section B: Learner Attitude towards mLearning

a) Attitude towards mobile learning process

1. Do you think that mLearning helps improve the quality of learning …..Explain your response
2. Does mLearning enhance learners' skills and competency? …..Explain your response
3. Would you encourage use of mobile devices for learning in other areas?. …..Explain your response

b) Attitude towards use of mobile phone for learning

1. What was the Community Health Volunteer's reaction when you introduced learning using the mobile phone?
2. How did the Community health trainees react to the challenges they faced with the use of the mobile phones for learning

c) Attitude Towards mLearning Content

1. How would you describe the adequacy of content provided through mobile learning?

Section C: Learner Behavioural Intention

a) Social Influence

1. To what extent do you think the peers played a role in influencing the community heath volunteers to accept mobile learning

b) Performance Expectancy

1. How did mobile learning enable Community health trainees accomplish their roles?

c) Effort expectancy

1. How would you describe how the Community health trainees learned how to use the mLearning platform?

d) Facilitating conditions

1. Describe the resources (phone, power connectivity for charging) available to the Community health trainees for mobile learning?
2. How did the resource available hinder or support mLearning
3. How would you describe the level of knowledge among Community health trainees to use mobile learning?

e) Behavioural intention

1. What suggestions would you make to enable the use of the mobile learning platform in the health or other sectors in future

Section D: Technology Use

1. Which type of mobile phone is best for mLearning purposes?

a) Device functionality

1. How does the type of phone one has influence the way one accesses mLearning content?

b) Content delivery technology

1. How would you describe the effectiveness of each of the following content delivery platforms?
    i. The SMS mode of delivery
    ii. Audio (IVR) mode of delivery
    iii. Group Chats
    iv. Gamification

Section E: Institutional Factors

1. How would you describe the support structures (Human resource, technical, financial e.tc) put in place by each of the support partners (e.g Safaricom, Amref Health Africa?)

Section F: Adoption of mLearning

1. How would you describe the acceptance of mLearning by Community Health Volunteers?

Appendix V: Document Analysis Guide

S. NO..	ITEM	SOURCE	VARIABLE	ANALYSIS
1.	LMS data sheet for Nairobi county	Amref Health Africa	Dependent	Analyse completion rates per learner using SPSS
2.	LMS data sheet for Kisumu County	Amref Health Africa	Dependent	Analyse completion rates per learner using SPSS
3.	LMS data sheet for Kakamega County	Amref Health Africa	Dependent	Analyse completion rates per learner using SPSS
4.	LMS data sheet for Kitui County	Amref Health Africa	Dependent	Analyse completion rates per learner using SPSS
5.	LMS data sheet for Kajiado County	Amref Health Africa	Dependent	Analyse completion rates per learner using SPSS
6.	LMS data sheet for Samburu County	Amref Health Africa		Analyse completion rates per learner using SPSS

Appendix VI: Research Permit

THIS IS TO CERTIFY THAT:
MR. AUGUSTINE MWANGI GATOTOH
of UNIVERSITY OF NAIROBI, 0-100
Nairobi,has been permitted to conduct
research in *All Counties*

on the topic: *LEARNER CHARACTERISTICS, BEHAVIOUR, TECHNOLOGY USE AND ADOPTION OF MOBILE LEARNING AMONG COMMUNITY HEALTH TRAINEES-AMREF HEALTH AFRICA, KENYA.*

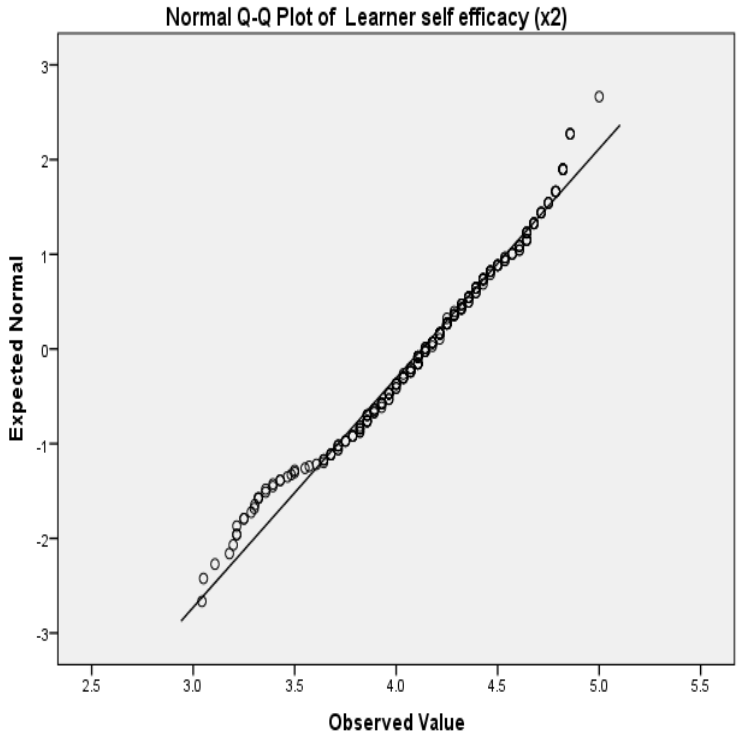
for the period ending:
13th June,2017

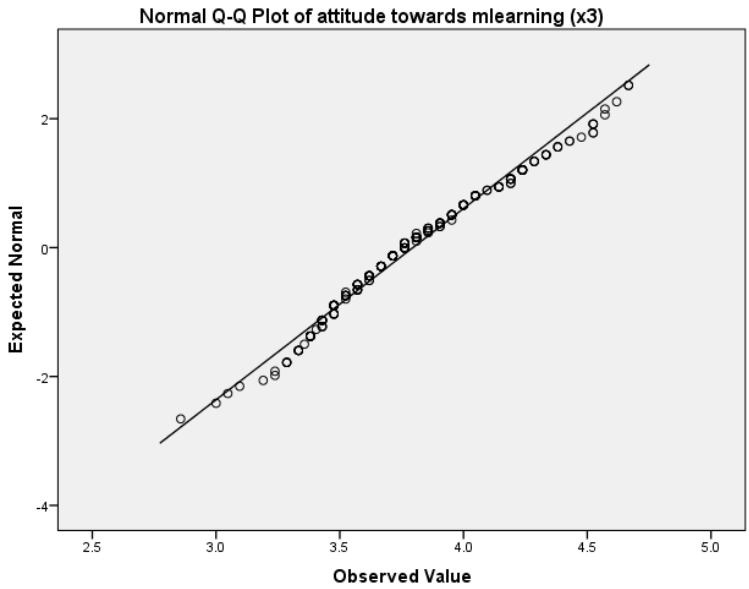
Permit No : NACOSTI/P/16/62928/11892
Date Of Issue : 15th June,2016
Fee Recieved :Ksh 2000

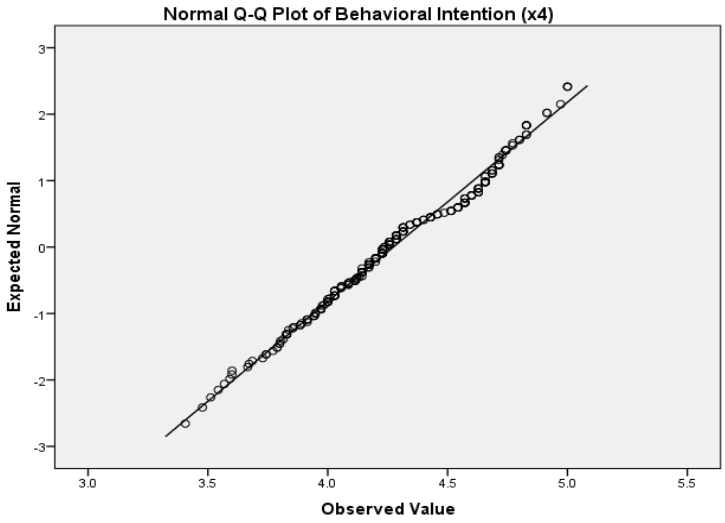
.....
Applicant's Signature

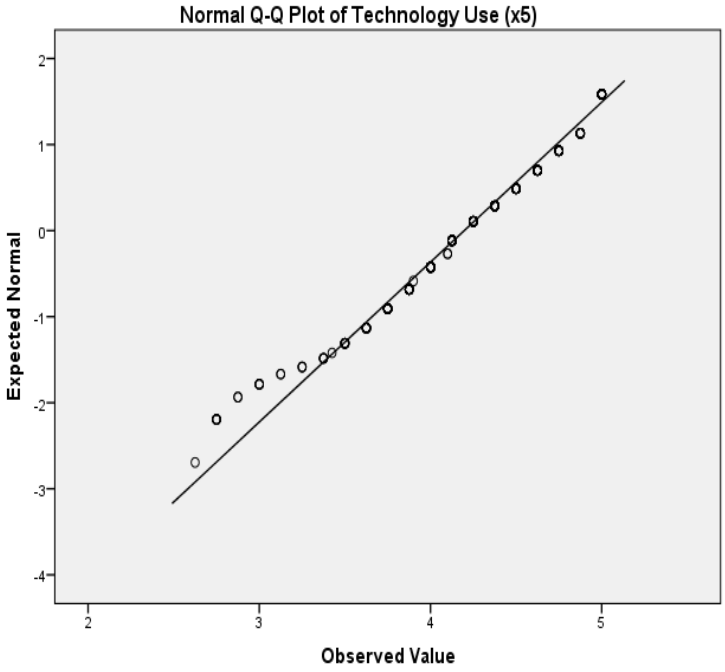
.....
Director General
National Commission for Science, Technology & Innovation

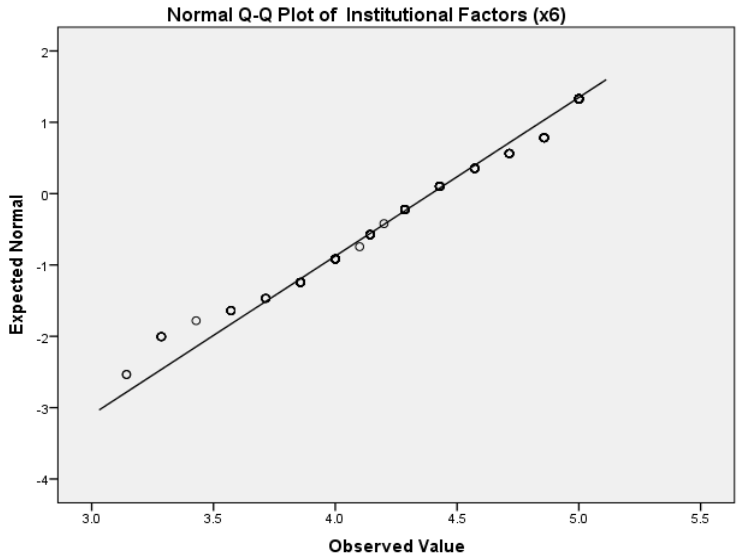
Appendix VII: Normality Plots

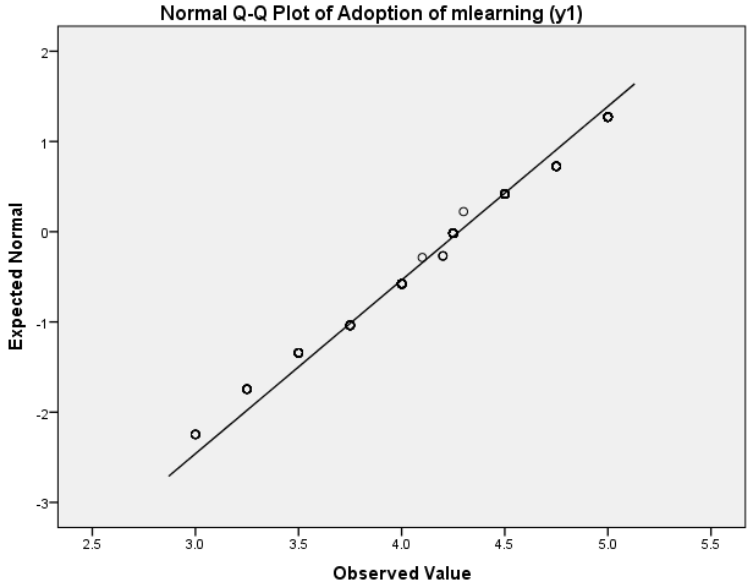





Normal Q-Q Plot of Behavioral Intention (x4)
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
3.0
3.5
4.0
4.5
5.0
5.5


Normal Q-Q Plot of Technology Use (x5)
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
2
3
4
5


Normal Q-Q Plot of Institutional Factors (x6)
Expected Normal
Observed Value
2
1
0
-1
-2
-3
-4
3.0
3.5
4.0
4.5
5.0
5.5


Normal Q-Q Plot of Adoption of mlearning (y1)
Expected Normal
Observed Value
2
1
0
-1
-2
-3
2.5
3.0
3.5
4.0
4.5
5.0
5.5

Appendix VIII: Data Collection Units

COUNTY	COMMUNITY UNIT (CU)
Kisumu	Tom Mboya
	Nyawita
	Manyatta-A
	Manyatta-PGH
	Area-A
	Area-B
	Area-C
	Manyatta-PGH
	Upper Kanyakwar-A
	Upper Kanyakwar-B
	Migosi
	Nyalenda-A
Kajiado	Olkiloriti
	Esokota
Kitui	Kavuvwani
	Kakululo
Kajiado	Majengo
Kakamega	Indangalasia-B
	Indangalasia-B
Samburu	Kisima
Nairobi	Soweto west
	Kianda
	Gatwekera

Appendix IX: LMS Data Sample Topic Summary

	AREA
	Nairobi
URBAN	Kisumu
	Kitui
RURAL	Kakamega
	Samburu
NOMADIC	Kajiado

Status	Meaning
1	Starting
99	Complete
89	ForceEnded
20	Paused
88	Expired
97	Complete but late
39	complete and failed quiz
81	force end

Progress	0-100
Chat Count	Number of texts (chat) sent over that topic
Chat Score	Out of 20
Quiz Score	Out of 40
Practicum Score	Out of 40
Total score	Chat Score + Quiz Score + Practicum Score

TOPIC ID	TOPIC NAME	TOPIC ID	TOPIC NAME
T1	Importance of Health	T26	Community Based Disease Surveillance
T10	Health Promotion	T28	Integrated Community Case Management
T11	Health Promotion Activities	T29	Understanding high blood pressure and hypertension
T12	Health Promotion Activities for Children Under 5	T3	Role of CHWs in The Community
T13	Family Planning	T30	Ebola
T14	Ante Natal Care	T31	Cholera
T15	Danger Signs in Pregnancy & After Delivery	T39	Identifying the risk factors of Hypertension
T16	Danger Signs in Children Under Five Years	T4	Sustainable Development In the Community
T17	Maternal and Child Nutrition	T40	Measuring and interpreting blood pressure readings
T18	Health Promotion and Disease Prevention	T41	Educating the community on prevention and management of hypertension
T19	Common Diseases in the Community	T42	Identification, referral, follow up and adherence of hypertensive clients to care
T2	Health and Development in the Community	T43	Reporting for hypertension
T20	Promotion of Healthy Lifestyle	T5	Kenya Essential Package for Health
T21	Substance and Drug Abuse	T6	Basics of Communication
T22	Sexual Gender Based Violence	T7	Basic Counselling skills
T23	Basic Life Saving Skills 1.	T8	Advocacy
T24	Basic Life Saving Skills II	T9	Community Dialogue
T25	Referral		

APPENDIX X: LMS DATA SAMPLE-NAIROBI

Topic	End	Duration (h)	Status	Progress	Chat Count		Chat Score	Quiz %	Quiz Score	Prac Marks	Prac %	Prac Score	Total Score	C.U
T30	9/10/2015 19:18	56	99	100	29		20	100	30	500	100	40	90	Gatwekira
T30	9/9/2015 15:28	28	99	100	55		20	80	20	500	100	40	80	Gatwekira
T30	9/10/2015 17:30	54	99	100	45		20	80	20	500	100	40	80	Gatwekira
T30	9/8/2015 20:38	9	99	100	15		20	100	30	500	100	40	90	Gatwekira
T30	9/23/2015 12:31	361	99	100	45		20	100	30	500	100	40	90	Gatwekira
T30	9/23/2015 12:17	361	99	100	18		20	100	30	500	100	40	90	Gatwekira
T30	9/9/2015 21:02	33	99	100	33		20	100	30	500	100	40	90	Gatwekira
T30	9/11/2015 10:25	71	99	100	0		0	80	20	500	100	40	60	Gatwekira
T30	9/9/2015 20:44	33	99	100	14		20	100	30	500	100	40	90	Gatwekira
T30	9/12/2015 17:49	78	99	100	44		20	80	20	500	100	40	80	Gatwekira
T30	9/8/2015 18:14	7	99	100	41		20	100	30	500	100	40	90	Gatwekira
T30	9/10/2015 14:37	27	99	100	28		20	100	30	450	90	40	90	Gatwekira
T30	9/11/2015 13:59	74	99	100	7		20	100	30	500	100	40	90	Gatwekira
T30	9/9/2015 13:06	25	99	100	21		20	100	30	500	100	40	90	Gatwekira
T30	9/10/2015 11:35	48	99	100	13		20	80	20	500	100	40	80	Gatwekira
T30	9/9/2015 14:41	27	99	100	29		20	80	20	400	80	30	70	Gatwekira
T30	9/9/2015 3:12	16	99	100	22		20	80	20	500	100	40	80	Gatwekira
T30	9/10/2015 13:01	49	99	100	19		20	100	30	500	100	40	90	Gatwekira
T30	9/10/2015 11:13	48	99	100	6		20	100	30	500	100	40	90	Gatwekira
T30	9/9/2015 16:42	29	99	100	66		20	100	30	500	100	40	90	Gatwekira
T30	9/11/2015 16:46	77	99	100	11		20	100	30	400	80	30	80	Gatwekira
T30	9/10/2015 20:02	56	99	100	36		20	100	30	500	100	40	90	Gatwekira
T30	9/9/2015 17:37	30	99	100	23		20	100	30	500	100	40	90	Gatwekira
T30	9/10/2015 22:21	59	99	100	52		20	100	30	500	100	40	90	Gatwekira

Appendix XI: LMS Data Sample-Kisumu

Start	Topic	End	Duration (h)	Status	Progress	Chat Count	Chat Score	Quiz %	Quiz Score	Prac Marks	Prac %	Prac Score	Total Score	C.U
7/7/2015 8:37	T30	7/8/2015 19:50	11	99	100	1	5	100	30	500	100	40	75	Airport
7/23/2015 9:00	T30	7/24/2015 11:01	26	99	100	6	5	100	30	500	100	40	75	Airport
7/23/2015 9:00	T30	7/24/2015 19:13	34	99	100	10	5	100	30	500	100	40	75	Airport
7/23/2015 9:00	T30	7/24/2015 13:50	28	99	100	11	5	80	20	500	100	40	65	Airport
7/23/2015 9:00	T30	7/24/2015 11:01	26	99	100	12	10	80	20	400	80	30	60	Airport
7/23/2015 9:00	T30	7/24/2015 7:20	22	99	100	189	20	100	30	250	42	0	50	Airport
7/23/2015 13:36	T30	7/24/2015 12:33	22	99	100	5	5	100	30	450	90	40	75	Airport
7/23/2015 15:20	T30	7/24/2015 7:44	16	99	100	7	5	80	20	400	80	30	55	Airport
7/24/2015 8:29	T30	7/24/2015 13:58	5	99	100	9	5	100	30	500	100	40	75	Airport
7/24/2015 11:08	T30	7/26/2015 13:10	50	99	100	21	15	100	30	500	100	40	85	Airport
7/28/2015 7:00	T2	8/1/2015 22:24	87	97	100	41	10	100	30	450	75	20	60	Airport
7/28/2015 7:00	T2	10/25/2015 15:09	2144	97	100	37	5	80	20	450	75	20	45	Airport
7/28/2015 7:00	T2	8/1/2015 12:28	77	99	100	27	5	100	30	550	79	20	55	Airport
7/28/2015 7:00	T2	7/30/2015 21:07	38	99	100	8	5	100	30	550	92	40	75	Airport
7/28/2015 7:00	T2	10/26/2015 7:08	2160	97	100	24	5	100	30	500	83	30	65	Airport
7/28/2015 7:00	T2	8/1/2015 13:12	78	99	100	21	5	100	30	500	83	30	65	Airport
7/28/2015 7:00	T2	10/29/2015 10:17	2235	99	100	18	5	100	30	550	92	40	75	Airport
7/28/2015 7:00	T2	7/31/2015 8:30	49	99	100	168	20	100	30	550	92	40	90	Airport

Appendix XII: LMS Data Sample-Kitui

Start	Topic	End	Duration (h)	Status	Progress	Chat Count	Chat Score	Quiz %	Quiz Score	Prac Marks	Prac %	Prac Score	Total Score	C.U
5/14/2015 16:16	T11	7/21/2016 12:34	10412	97	100	0	0	80	20	400	80	32	52	Enziu
5/14/2015 16:16	T11	7/20/2016 15:48	10391	99	100	0	0	80	20	500	100	40	60	Enziu
5/14/2015 16:16	T11	7/21/2016 10:28	95	97	100	0	0	100	30	300	60	10	40	Enziu
5/14/2015 16:17	T11	5/16/2015 20:32	52	99	100	0	0	100	30	350	70	20	50	Enziu
5/14/2015 21:52	T11	5/15/2015 14:14	16	39	100	4	5	40	0	200	40	0	5	Enziu
5/15/2015 9:07	T11	7/20/2016 13:47	10372	99	100	2	5	100	40	300	60	10	55	Enziu
5/19/2015 14:31	T11	7/19/2016 15:03	10248	97	100	0	0	100	40	350	70	20	60	Enziu
5/26/2015 8:58	T30	5/31/2015 17:36	128	97	100	1	20	80	20	400	80	30	70	Enziu
5/26/2015 8:58	T30	6/1/2015 8:58	0	88	90	1	20	100	30	500	100	40	90	Enziu
5/26/2015 8:58	T30	6/1/2015 8:58	0	88	90	4	20	100	30	400	80	30	80	Enziu
5/26/2015 8:58	T30	5/26/2015 13:19	4	97	100	0	0	100	30	500	100	40	70	Enziu
5/26/2015 8:58	T30	5/26/2015 12:46	3	97	100	1	20	100	30	400	80	30	80	Enziu
5/26/2015 8:58	T30	5/27/2015 9:20	24	97	100	2	20	100	30	400	80	30	80	Enziu
5/26/2015 8:58	T30	5/28/2015 19:51	58	97	100	1	20	80	20	350	70	20	60	Enziu
5/26/2015 8:58	T30	5/27/2015 0:10	15	97	100	0	0	100	30	500	100	40	70	Enziu
5/26/2015 8:58	T30	5/27/2015 21:42	36	97	100	1	20	100	30	400	80	30	80	Enziu
5/26/2015 16:45	T30	5/26/2015 18:12	1	97	100	1	20	40	0	450	90	40	60	Enziu

Appendix XIII: LMS Data Sample-Kakamega

Start	Topic	End	Duration (h)	Status	Progress	Chat Count	Chat Score	Quiz %	Quiz Score	Prac Marks	Prac %	Prac Score	Total Score	C.U
7/24/2015 14:50	T30	7/25/2015 15:13	24	99	100	13	30	100	30	450	90	40	100	Emukaya B
7/24/2015 14:50	T30	7/31/2015 14:50	0	88	11	1	5	0	0	0	0	0	5	Emukaya B
7/24/2015 14:50	T30	7/29/2015 13:32	118	97	100	9	20	80	20	400	80	30	70	Emukaya B
7/25/2015 11:16	T30	7/26/2015 6:27	19	39	100	1	5	40	0	350	70	20	25	Emukaya B
7/25/2015 13:46	T30	7/26/2015 18:31	28	99	100	3	5	100	30	350	70	20	55	Emukaya B
7/25/2015 16:49	T30	7/28/2015 20:51	76	39	100	1	5	60	5	500	100	40	50	Emukaya B
7/25/2015 18:31	T30	4/5/2016 18:37	6120	99	100	4	5	80	32	400	80	30	67	Emukaya B
7/25/2015 19:09	T30	7/28/2015 16:59	45	88	100	4	10	40	0	450	90	40	50	Emukaya B
7/29/2015 7:54	T1	7/30/2015 10:16	26	99	100	2	5	80	20	500	100	40	65	Emukaya B
7/29/2015 7:54	T1	8/2/2015 10:56	99	99	100	16	5	100	30	400	80	30	65	Emukaya B
7/29/2015 7:54	T1	7/30/2015 12:10	28	99	100	18	5	80	20	500	100	40	65	Emukaya B
7/29/2015 11:05	T30	7/29/2015 15:20	4	97	100	7	15	60	5	500	100	40	60	Emukaya B
7/29/2015 13:05	T30	6/10/2016 12:32	7607	97	100	0	0	80	32	500	100	40	72	Emukaya B
7/29/2015 15:26	T1	7/29/2015 20:10	4	39	100	3	5	40	0	175	35	0	5	Emukaya B
7/31/2015 3:14	T1	7/31/2015 12:31	9	99	100	113	20	100	30	500	100	40	90	Emukaya B
8/12/2015 19:38	T6	8/19/2015 19:38	0	99	100	31	15	100	30	500	83	30	75	Emukaya B
8/12/2015 19:38	T6	8/19/2015 19:38	0	99	100	39	30	80	20	600	100	40	90	Emukaya B

Appendix XIV: LMS Data Sample-Samburu

Start	Topic	End	Duration (h)	Status	Progress	Chat Count	Chat Score	Quiz %	Quiz Score	Prac Marks	Prac %	Prac Score	Total Score	C.U
4/16/201516:21	T30	4/22/2015 16:21	0	89	0	0	0	0	0	0	0	0	0	Angata Nanyukie
4/30/201513:03	T4	5/13/2015 7:30	0	88	0	1	0	0	0	0	0	0	0	Angata Nanyukie
5/28/201513:48	T11	6/3/2015 13:48	0	88	9	0	0	0	0	0	0	0	0	Angata Nanyukie
2/2/2016 13:09	T2	2/3/2016 18:05	4	97	100	18	5	100	40	600	100	40	85	Angata Nanyukie
10/11/20169:30	T1	10/15/2016 13:01	99	97	100	2	20	100	40	500	100	40	100	Angata Nanyukie
10/11/20169:30	T1	10/15/2016 14:07	100	97	100	7	20	100	40	500	100	40	100	Angata Nanyukie
10/11/20169:30	T1	10/13/2016 11:26	49	99	100	11	20	100	40	500	100	40	100	Angata Nanyukie
10/19/201613:31	T1	10/26/2016 13:31	0	88	71	43	20	100	40	0	0	0	60	Angata Nanyukie
10/19/201613:31	T1	10/25/2016 18:50	149	97	100	5	20	100	40	500	100	40	100	Angata Nanyukie
10/19/201613:31	T1	10/26/2016 13:31	0	88	71	2	20	100	40	0	0	0	60	Angata Nanyukie
10/19/201613:31	T1	10/25/2016 13:08	143	97	100	1	20	100	40	500	100	40	100	Angata Nanyukie
10/19/201613:31	T1	10/25/2016 13:18	143	97	100	21	20	100	40	350	70	28	88	Angata Nanyukie
10/19/201613:31	T1	10/25/2016 16:04	146	97	100	8	20	100	40	500	100	40	100	Angata Nanyukie
10/19/201613:31	T1	10/25/2016 13:35	144	97	100	2	20	100	40	500	100	40	100	Angata Nanyukie
10/19/201613:31	T1	10/26/2016 13:31	0	88	71	0	0	100	40	0	0	0	40	Angata Nanyukie
10/19/201613:31	T1	10/25/2016 12:43	143	97	100	1	20	100	40	500	100	40	100	Angata Nanyukie
10/19/201613:31	T1	10/26/2016 13:31	0	88	71	6	20	100	40	0	0	0	60	Angata Nanyukie

Appendix XV: LMS Data Sample-Kajiado

Start	Topic	Name	End	Duration (h)	Status	Progress	Chat Count	Chat Score	Quiz %	Quiz Score	Prac Marks	Prac %	Prac Score	Total Score	C.U
4/11/2015 14:18	T17		4/13/2015 10:40	44	99	100	15	20	0	30	0	0	40	90	Enkorika
4/14/2015 7:04	T17		4/15/2015 6:25	23	99	100	0	0	0	20	0	0	20	40	Enkorika
5/19/2015 16:10	T11		5/20/2015 10:43	18	99	100	9	20	80	20	400	80	30	70	Enkorika
5/19/2015 16:10	T11		5/20/2015 15:33	23	99	100	7	20	80	20	400	80	30	70	Enkorika
5/19/2015 16:10	T11		5/23/2015 8:32	88	97	100	0	0	100	30	350	70	20	50	Enkorika
5/26/2015 11:24	T30		5/27/2015 11:41	24	99	100	0	0	100	30	500	100	40	70	Enkorika
5/26/2015 11:24	T30		6/1/2015 11:24	3	99	100	7	15	60	5	500	100	40	60	Enkorika
5/26/2015 11:24	T30		5/26/2015 20:41	9	99	100	14	30	80	20	500	100	40	90	Enkorika
5/26/2015 11:24	T30		5/27/2015 14:25	27	99	100	4	10	80	20	500	100	40	70	Enkorika
5/26/2015 11:24	T30		6/1/2015 11:24	0	88	0	3	5	0	0	0	0	0	5	Enkorika
5/26/2015 11:24	T30		5/26/2015 22:01	10	99	100	11	25	80	20	500	100	40	85	Enkorika
5/26/2015 11:24	T30		6/1/2015 11:24	0	88	10	0	0	0	0	0	0	0	0	Enkorika
5/26/2015 11:24	T30		6/1/2015 11:24	0	88	10	10	20	0	0	0	0	0	20	Enkorika
5/26/2015 11:24	T30		5/27/2015 6:32	19	97	100	2	5	100	30	500	100	40	75	Enkorika
5/29/2015 16:25	T30		5/29/2015 19:39	3	97	100	3	5	80	20	350	70	20	45	Enkorika
6/5/2015 8:00	T2		6/6/2015 19:47	35	99	100	8	20	80	20	250	83	30	70	Enkorika
6/5/2015 8:00	T2		6/5/2015 19:18	11	97	100	6	20	100	30	300	100	40	90	Enkorika
6/13/2015 20:36	T4		6/14/2015 16:06	19	97	100	13	20	80	20	500	100	40	80	Enkorika
6/13/2015 20:36	T4		6/16/2015 19:37	47	99	100	3	20	80	20	500	100	40	80	Enkorika
6/13/2015 20:36	T4		6/14/2015 14:30	17	99	100	11	20	80	20	500	100	40	80	Enkorika
6/13/2015 20:36	T4		6/20/2015 20:36	65	99	100	1	20	80	20	400	80	30	70	Enkorika
6/23/2015 10:25	T10		6/25/2015 16:26	54	99	100	10	20	80	20	450	90	40	80	Enkorika