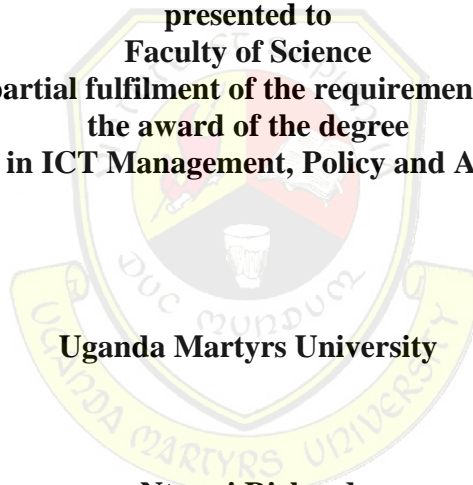


Framework for Adoption of Mobile Learning in Institutions of Higher Education

Case Study: Uganda Martyrs University

**A postgraduate dissertation
presented to
Faculty of Science
in partial fulfilment of the requirements for
the award of the degree
Master of Science in ICT Management, Policy and Architectural Design**



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Dedication

To My dear wife, Sheila Orishaba Ntwari.

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List of Abbreviations

D-learning:	Distance Learning
E-Learning:	Electronic Learning
ICT:	Information Communication Technology
IRDA:	Infrared-Enabled Devices
LMS:	Learning Management Systems
M-Learning:	Mobile Learning
NCHE:	National Council for Higher Education
NFC:	Near Field Communication Technologies
PDA:	Personal Digital Assistant
RFID:	Radio and Mobile Frequency Identification Devices
SMS:	Short Messaging System
TAM:	Technology Acceptance Model
UMU:	Uganda Martyrs University
UNESCO:	United Nations Educational, Scientific and Cultural Organization
USB:	Universal Serial Bus
Wi-Fi:	Wireless Fidelity

Abstract

In a bid to satisfy students' academic needs, Universities in Uganda are targeting to provide adequate education materials. The National Council for Higher Education, set conditions which if achieved, education materials are considered to be adequate. The conditions include computer-student ratio which should be 1:20, essential textbooks-student's ratio should be 1:5 and two subscriptions to national and International procurement journals. However, universities are facing educational challenges such as high students computer ratios, inadequate staffing, inadequate classroom space, which negatively relate to achieving adequate education materials.

With the above challenges, universities are required to adopt to new mechanisms of interacting with students. Information and communication technology (ICT) has proved to be an essential component of the educational system in overcoming these challenges. This research focuses on the development of a framework which enables the use of mobile devices in the learning process as a way of overcoming the above challenges. The research was based in Uganda Martyrs University.

The research was achieved through use of the mixed research methodology. In this methodology, qualitative data from was obtained from systems administrators using oral interviews, while quantitative data was collected from students and lecturers using a survey questionnaire. Qualitative and quantitative data collected was analysed using qualitative data analysis and quantitative data analysis methods respectively. The analysis of the data helped to derive the requirements that guided in the development of components of the proposed framework. The linkage of the framework components was based on the theories that relate to the pedagogy. Development of framework was based on the design research methodology, which has three phases. These phases are; Analysis and exploration phase, Design and construction phase and Evaluation and reflection phase. However, due to constraint of inability to identify a mobile learning expert, the framework was not evaluated. Hence as part of future work, the research recommends implementation and validation of the proposed framework.

CHAPTER ONE

GENERAL INTRODUCTION

This chapter gives general introduction to the research. It has a background and objectives of the study, the research questions, the scope, significance, and justification of the study.

1.1 Introduction

Mobile learning is part of the mobile computing domain. Mobile learning (M-Learning) is defined by O'Malley et al. (2003) as any learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies. This research, focuses on M-Learning that involves the learner using a mobile device to access learning materials. M-Learning is a sub-component of Electronic learning (E-Learning). E-Learning is defined by eLEARNINGNC (2016) as learning utilizing electronic technologies to access educational curriculum outside of a traditional classroom. In both definitions, it is observed that technology plays an important role in the learning process, and learners are not restricted to a geographical location. The difference between E-Learning and M-Learning is that in M-Learning, mobile computing devices are used in the learning process. Mobile computing is using any capable small size portable computers, hand-held, and other small devices that run on stand-alone applications or access remote applications via wireless networks such as Cellular, Bluetooth, and Wireless Local Area Networks (Sethi & Dharani, 2013). The growth of computing and its application and almost in all areas are projected to have an enormous impact on learning as suggested by Patten et al. (2006). Traditional approaches of learning are likely to be phased out and replaced by mobile learning. This is supported by Boyinbode et al. (2011) who asserts that Mobile learning (M-Learning) overcomes restrictions of the traditional classroom.

1.1.1 Mobile computing and its trends

Mobile computing involves activities of business being conducted over a wireless network or from mobile devices. Mobile Computing is any technologies that enable people to access mobile network services at anywhere and anyplace provided there is a connection link.

The connection between wireless access and mobile device in mobile computing is reflected in definition by Vasilis and Omar (2015) who described Mobile Computing as a technology that allows transmission of data, via any mobile device, without having to be connected to a fixed physical link. The same author suggests that mobile computing can be extended to mobile voice communication, which has the ability to send and receive data across cellular networks.

The non-physical link is a major advantage of Mobile computing, which gives users the ability to process and transmit data from any location with appropriate connectivity, even when on the move (Vasilis and Omar, 2015). Benefits of Mobile Computing as explained by Gartner (2010) include increased productivity; improved customer service; quicker response time and problem resolution; increased efficiency; and work-life balance. However, despite the numerous advantages, there are a number of threats faced by mobile computing. Chapungu (2013) described the threats to include limitations associated with range and bandwidth issues, security issues, transmission interferences, power assumptions, as well as a number of other related issues. The primary limitations associated with range and bandwidth can be attributed to the fact that the networks accessible by mobile computing devices are generally constrained to a range of commercial cell phone towers. Despite these shortcomings, mobile computing remains an essential technology for today (Taniar, 2008).

Vasilis and Omar (2015) explains that Mobile computing has become a very important and rapidly evolving technology. A study by Satyanarayanan (2001) suggested that mobile computing was still on the way of growth, and had gained achievements in areas such as mobile learning, mobile access of information, mobile networking, and location sensitivity which deals with geo location interpretation and information customisation. The growth of mobile computing was projected in a study by Gartner (2013) on corporate mobile learning, where the author observed some of the emerging trends from Mobile computing then as follows:

Under mobile access of information, it is projected that 40% of the workforce will be mobile by 2016; 50% of non-PC devices will be purchased by employees by 2016, and by the end of the decade 50% of devices in business will have also been purchased by employees.

Whereas in mobile networking, it is projected that 60% of industry will implement limited access network zones by 2016; 65% of all corporations will adopt MDM (Mobile Device Management) in the next five years to address security concerns; 90% of corporations will have to support at least two or more operating systems by 2017. More so, it was projected that for location sensitivity, at least 50% of the devices will have location detection facilities. Regarding these projections today, it is observed that they are materialising. Technical Support International (2016), explains that the current trends in mobile computing include the following;

- i. Mobile access of information:** Information access needs has led to mobile device developers to develop innovative devices that allow ease access of information. These devices provide the user with instant data entry, storage and processing. The common devices used include the following;
 - a) Smartphones:** Smart phones are the most trending items of mobile computing. Manufactures are being both inventive and innovative, to make improvements on the capabilities of these devices. The capabilities include the storage capacity, the quality of the display system, Data capture and processing systems such as high resolution camera, data connection capabilities such as high internet access speeds. These devices give the user convenience to carryout computing tasks on the go.
 - b) Tablet/Laptop Hybrid:** Mobile computing has given rise to the 2-in-1 Tablet/Laptop Hybrid scene. The convenience of a tablet with the ability to click on a full-sized keyboard is a great feature for business people and students, who are constantly on the go, or the average user who just wants something lightweight to use while sitting on the couch. As mobile computing shifts from a matter of convenience to a matter of course, computer manufactures brands are continuing to improve and expand their product offerings with in this line.
 - c) Wearable Technology:** Kortuem, and Segall, (2003) define Wearable technologies as mobile electronic devices that can be unobtrusively embedded in the user's outfit as part of the clothing or an accessory. Mobile computing is taking a trend whereby computing gadgets are manufactured in wearable form. Just about every company that makes mobile devices has come out with a watch model to complement their smartphones, and it is expected that the capabilities of these items will only continue to grow.

The wearable technology industry has expanded from wearable watches to now clothing brands (mostly those that focus on sportswear) that are coming out with workout gear with embedded fitness tracking sensors to monitor heart rate, pulse, steps, etc.

- ii. **Mobile networking trends:** Mobile computing is more effective if the mobile devices used are connected to a particular network. The trends on how the mobile device interconnect and communicate with each other as observed by Tutorialspoint (2016) included the following;
 - a) **3G or third generation mobile telecommunications:** 3G is a generation of standards for mobile phones and mobile telecommunication services fulfilling the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union. Application services include wide-area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment.
 - b) **Long Term Evolution (LTE):** LTE is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using new modulation techniques. It is related with the implementation of fourth Generation (4G) technology.
 - c) **Worldwide Interoperability for Microwave Access (WiMAX):** WiMAX: is a wireless communications standard designed to provide 30 to 40 megabit-per-second data rates, with the latest update providing up to 1 Gbit/s for fixed stations. It is a part of a fourth generation or 4G wireless-communication technology. WiMAX far surpasses the 30-metre wireless range of a conventional Wi-Fi Local Area Network (LAN), offering a metropolitan area network with a signal radius of about 50 km. WiMAX offers data transfer rates that can be superior to conventional cable-modem and DSL connections, however, the bandwidth must be shared among multiple users and thus yields lower speed in practice.

d) Near Field Communication (NFC): NFC is a set of standards for smartphones and similar devices to establish radio communication with each other by touching them together or bringing them into close proximity, usually no more than a few centimetres. Present and anticipated applications include contactless transactions, data exchange, and simplified setup of more complex communications such as Wi-Fi. Communication is also possible between an NFC device and an unpowered NFC chip, called a "tag".

iii. Geo-Location: Previously mobile content was general in nature such that it was up to the user to choose which content to access or not. However, with Geo-Location, content can be customised based on the location of the user. This is enhanced by Geo-Location capabilities that are established through the use of the Global Positioning System (GPS) on the mobile devices. GPS is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight of GPS satellites. The GPS program provides critical capabilities to military, civil and commercial users around the world. In addition, GPS is the backbone for modernizing the global air traffic system, weather, and location services.

In conclusion, mobile computing has and is rapidly growing from a user being confined to a single location to computing on the go. With mobile computing, people can work from the comfort of any location they wish to as long as the connection and the security concerns are properly factored. In the same light, the presence of high speed connections has also promoted the use of mobile computing. The trends explained above are of great importance to mobile learning. It is observed that all the above trends are of advantage to the mobile device user and if well incorporated into the mobile learning curriculum, they would provide better access of the learning materials to the student. The student has the ability to access information and data and process the data on the go. Furthermore, with trends such as the GPS, customised learning materials of a bigger possibility. Students would have more control of their learning process. Being an ever growing and emerging technology, mobile computing will continue to be a core service in computing, and Information and Communications Technology.

1.1.2 Mobile Learning

Mobile learning is defined as use of mobile electronic technology and devices such as PDAs (Personal Digital Assistants), mobile phones, laptops and tablet personal computers to learn (Ktoridou and Eteokleous 2005). It is observed from this definition that M-Learning is not possible unless mobile devices or devices that run on mobile technology is use.

These device include Phones, PDA's, tablets and Laptops. A critical review on the application of these devices in M-Learning has been carried out in section 1.1.3 of this report. However another school of thought suggests that it should involve a learner not being geographically hindered, that is to say mobile learning takes place when the learner is not at a fixed, predetermined location, or when the learner takes advantage of learning opportunities offered by mobile technologies (Sharples et al., 2006; Uzunboylu and Ozdamli, 2011). More support for the eradication of geographical borders is argued by Kukulska and Traxler (2007), who suggested that mobile learning as ability learner to learn without mobility restrictions in the sense that learners should be able to engage in educational activities without being tied to a tightly-limited physical location. From the above assertions, it can be deduced that mobile learning involves individuals carrying out educational activities, using mobile device enabled technology as an intermediate tool for learning, accessing data and communicating with others through wireless technology. Concepts of anytime and anywhere, with an aim of providing learners with better learning tools and experience, are made possible and a reality in M-Learning.

Often reasons cited for using mobile technologies in learning as supported by Patten et al. (2006) include flexibility, cost, adaptability, and scalability for using mobile technologies. Other advantages for introduction and usage of technology in learning include mobile devices being portable, movable and more lightweight than books and personal computers (Savill, 2010). The same author also noted that Mobile learning is an enabler that supports the learning process, which comes with lots of usefulness such as training special needs children. However, the use of technology in learning should not be driven by technical, logistical or financial reasons but rather pedagogical considerations. Zaman, Shamim, and Clement (2011) suggest that adopting and using Information Communication Technology (ICT) in schools leads to significant expansion of education and pedagogical outcome which are beneficial to both teachers and students.

When used appropriately, ICT can help to strengthen education in an increasingly networked society, raising the quality of education by making learning and teaching an active process connected to real life. Mehdipour and Zerehkafi (2013) maintain M-Learning to be emerging as one of the solutions to the challenges faced by education. The authors explain that:

“With a variety of tools and resources always available, M-Learning provides increased options for the personalization of learning. Mobile learning in classrooms often has students working interdependently, in groups, or individually to solve problems, to work on projects, to meet individual needs, and to allow for student voice and choice. With access to so much content anytime and anywhere, there are plenty of opportunities for formal and informal learning, both inside and outside the classroom”

From the above, it is observed that technology has the ability to change how students access and interact with learning materials. The biggest advantage is that technology provided the anytime anyplace access of learning materials, provided the student has connectivity on his mobile device.

Various research such as Kukulska-Hulme and Traxler, 2005; JISC, 2005; Attewell & Savill-Smith, 2004 have reviewed literature and have hinted on how to categorise M-Learning. Kukulska-Hulme and Traxler, 2005 clearly categories M-Learning into five categories. These categories include the following;

- i. Technology-driven mobile learning:** In technology driven mobile learning, specific technological innovation is deployed in an academic setting to demonstrate technical feasibility and pedagogic possibility.
- ii. Miniature but portable E-Learning:** Mobile, wireless, and handheld technologies are used to re-enact approaches and solutions already used in 'conventional' E-Learning, perhaps porting some E-Learning technology such as a Virtual Learning Environment (VLE) to these technologies or perhaps merely using mobile technologies as flexible replacements for static desktop technologies
- iii. Connected classroom learning:** In the connected classroom, the mobile, wireless, and handheld technologies are used in classroom settings to support collaborative learning, perhaps connected to other classroom technologies such as interactive whiteboards.

- iv. **Informal, personalised, situated mobile learning:** The Mobile, wireless, and handheld technologies are enhanced with additional functionality, for example location-awareness or video-capture, and deployed to deliver educational experiences that would otherwise be difficult or impossible.
- v. **Mobile training/ performance support:** The technologies are used to improve the productivity and efficiency of mobile workers by delivering information and support just-in-time and in context for their immediate.
- vi. **Remote/ rural/ development mobile learning:** The technologies are used to address environmental and infrastructural challenges to delivering and supporting education where 'conventional' E-Learning technologies would fail, often troubling accepted developmental or evolutionary paradigms.

Reviewing the above categories, it is observed that mobile learning is less of electronic learning. In both, there is use of technology to enhance learning. However, from the above categories, the research further observes that mobile learning involves use of mobile devices to execute learning processes such as access of learning material, or mobile learning involves the learner learning from anywhere as long as there is connectivity of the technology.

Wang and Higgins (2006) explained that while E-Learning has met with some acceptance among educators and is increasingly being implemented, it is necessary to solve the problems that the authors discuss before m-learning can become effective, accepted and widely used. Educators who are interested in using mobile phones for learning with their students should be aware of the current limitations. These limitations included the following;

i. Mobile Learning Psychological Limitations:

M-learning is the acquisition of any knowledge or skill through using mobile technology, anywhere, anytime (Geddes, 2004). With mobile devices, mainly mobile phones, tablets, PDAs, and iPods, proponents suggest that people can learn on airplanes, trains, buses, and soon since M-Learning happens when people are away from their offices or classrooms. Wang and Higgins (2006) argues that since any learning needs effort and brainwork, depending on the state of one's being Mobile might not be possible since people may be tired. The same authors further explain that if they want to learn, mobile devices are not likely to be their main choice.

The more likely choices would be DVD/CD Players, videotapes, computers installed with learning software or computers with high speed access to the Internet for e-learning.

ii. Mobile Learning Pedagogical Limitations:

M-Learning lies at the intersection of mobile computing and e-learning and offers anytime, anywhere resources; strong search capabilities; rich interaction; powerful support for effective learning; and performance-based assessment (Singh, 2003). However, precisely because M-Learning can theoretically take place anywhere and anytime, it is hard to follow up on the learning achievements of those attempting it. Naturally, one does not always get immediate feedback from the mobile phone, but one simply catches the data on the device and uploads it when connectivity is next available. Students who are used to traditional teaching/learning methods feel that mobile phone learning lacks interpersonal and direct interaction (Bouhnik & Marcus, 2006). In most cases, both common sense and good pedagogical practice have taught us that learning and teaching need quick interactions in order to be most effective. Also, in m-learning courses, whether based on mobile phones or other mobile devices, it is hard to administer a test. Without on-site supervision, course organizers have no reason to trust that the answers sent from a mobile phone are being sent personally by the actual registered mobile phone holder and m-learner.

iii. Mobile Learning Technical Limitations:

From the various definitions, it is observed that mobile learning involves use of mobile devices. The use of mobile devices is faced with various technical limitations which include the following;

- a. **Small screens and low resolutions:** In order to view images and text, a large mobile device screen is preferable. However, it obviously cannot be too large or mobile phones would not be portable or convenient. This size might be all right for viewing texts for a short time, but usually not for longer than one or two minutes, as for longer than that people's eyes become tired (Bryan, 2004).
- b. **Input limitations:** Mobile device input is not at all user-friendly. Slow and inconvenient input methods are real problems with mobile devices.

Wang and Higgins (2006) explains that to input a word in any language, users may have to hit a key several times even to find the right letter, and it takes time to switch between the number input mode and letter mode. This is both time waste and costly if an individual is using a commercial connection.

- c. **The limitations of accessing the Internet:** As the mobile phone wireless network is different from cabled Internet networks, it is difficult to access ordinary Internet web pages from a mobile phone. Most ordinary Internet web pages are distorted on mobile phone screens and a lot of multi-media information is lost. Therefore, in order to enable mobile phone access to the Internet, it is necessary to design special web pages, currently mainly using WML language, and simplify the web function.
- d. **Lack of standardization and compatibility:** In practice, m-learning materials designers find it is currently impossible to design a generic version for all platforms (Attewell, 2005). Teachers have to design different learning materials specifically for particular mobile platforms. However, this is being overcome with use of new technologies such as HTML5.

For mobile learning to be implemented successfully, the above limitations have to be put into consideration. More so, where possible the researcher should ensure mechanism to counteract the limitations is in place.

Due to benefits and opportunities presented by mobile learning, its trends are changing the way content is delivered to the learner, moving from non-dynamic methods to accommodate the new innovations in the field; Mobile learning is currently utilising smartphone and tablet applications such as iTunesU, instead of the traditional short messaging system (SMS) or web based systems such as Udemy. Most of these applications such as Skype and MeetingGo which offer online presentations, and Coursera used for content management work only if there is a connection link, that is to say there is a need for the wireless internet connection. In the case of unreliable connection, applications such as iTunesU have incorporated an offline mode, in which the user first downloads material to use in instances when connectivity is lost. As explained by Pappas (2016), for efficiency reasons, these applications are following the trends below;

- i. **Responsive Design:** Initial design of E-Learning materials had a fixed design such that user had to scroll up and down or left to right as they interacted with the materials. More so, the layout of the pages would be cut off by screens of smaller devices. With responsive design, courses automatically adjust to the screen size and resolution of the device.

A responsive Learning Management System modifies the placement of the images, text blocks, and layout based on the device. This ensures that every learner receives the same experience, even those who are using mobile phones, tablets, and wearable tech gadgets to participate. For example, the LMS may slightly adjust the size and placement of your graphics if the learner has a smaller device, or change the position of the sub headers to streamline the flow of your E-Learning course.

- ii. **Use of HTML5:** Mobile learning is on the rise, which means that E-Learning professionals must utilize tools that cater to mobile learners. HTML5 is versatile, faster, and robust. HTML5 has a major advantage of the ability for design interactive, which helps in engaging E-Learning experiences for the masses, without having to worry about excluding your mobile learners due to technology that they might be using to access content. This is primarily due to the fact that HTML5 is accessible on all platforms, devices, and browsers.

- iii. **Geo-Location:** Many Learning Management Systems (LMS) are now offering geo-location features, which give instructors the chance to deliver relevant online training to your global audience. The LMS automatically detects the learner's location and then delivers the appropriate mobile learning course or online training materials. Geo-Location is useful when designing location-based online content, such as, scavenger hunt online training exercises, or regional surveys. Geo-location must usually be paired with localization if you are catering to international markets. This typically involves in depth audience research to learn about the customs, societal norms, and backgrounds of your online learners.

- iv. **Big Data Applications:** Mobile Learning is a sub-component of E-Learning, which focuses on the use of mobile devices that have a wireless connection to access learning materials. Mobile learning has taken advantage of Big data.

Big Data as defined by Tankard (2012) as data management of the ever-increasing amount of information that organisations are storing, processing and analysing, owing to the growing number of information sources in use. Big data has been an integral part of E-Learning for a number of years. Big Data gives users the opportunity to examine learner preferences and improve the overall mobile training strategy.

Big data applications help administration to keep track of mobile traffic, device usage, and determine the strengths and weaknesses of your mobile training program. After doing so you have the ability to customize the mobile learning experience and improve the elements that may be falling short of expectations. If you do want to take advantage of app analytics, opt for a Learning Management System that has built-in reporting features that focus on your mobile learning content.

- v. **Wearable Technology:** Wearable technology is trendy in Mobile learning. These wearable gadgets are also making their way into the realm of eLearning and transforming the way we access and acquire new information. Wearable tech has the potential to turn simulations and online scenarios into dynamic and interactive experiences in online training environments. This is mainly due to the fact that the technology is now more user-friendly and affordable. In corporate setting, instead of sitting through a sales training presentation, employees can now interact with virtual customers, master their negotiation skills, and learn every step in the transaction process by using an augmented reality device.

Analysing the above trends, they are a great innovation to mobile learning. By integrating these trends into mobile learning strategy, one has the power to create technology centric mobile learning experiences that take advantage of modern advancements, which equates to even more benefits for on-the-move mobile learners.

1.1.3 Common Mobile devices used in mobile learning

Mobile learning can be understood in a variety of ways, depending on the element that an institution or individuals focus on (Taylor, 2006): Learning through mobile terminals, learning with students that are on the move, learning through mobile content. This research focuses on M-Learning that features the use of mobile devices to access learning materials.

A mobile device is any portable computing device such as a mobile phone, personal digital assistant (ISACA, 2010). Prieto, Migueláñez, and García-Peñalvo (2013) explain the different types of mobile devices as they apply to mobile learning. These devices include the following;

- i. Smartphones:** Smartphones are small size devices that combine the uses of the conventional mobile phones with those of a pocket pc (Korucu & Alkan, 2011). Smartphones offer internet connectivity and a wide range of functionalities that go from the elaboration of documents and multimedia to the realization of web 2.0 activities. The main advantages of smartphones are reduced size, autonomy, the provision of network connection anytime anywhere, and processor capacity. Smartphones can be used in a broad set of mobile learning experiences, from game based learning activities (Camargo, Bary, Boly, Rees, & Smith, 2011) to the distribution of E-Learning content (Gopalan, Karavanis, Payne, & Sloman, 2011). In Higher Education there is a growing number of universities that integrate smartphones in everyday activities, whether they are used as a communication tool, a content delivering tool or a basis for collaborative learning activities (Lum, 2012).
- ii. Tablets:** Since the release of the first iPad in 2010, tablets have quickly spread in the mobile devices market. This resource composed of a tactile screen, generally between 7 and 10 inches, offers the same functionalities of a computer and it's handheld without the need of external peripherals (Prieto, Migueláñez, and García-Peñalvo, 2013). This device is especially useful in the development of mobile learning activities, helping to overcome the difficulties related to the small screen size and power of the rest of technological devices (Álvarez, Bravo, García, & Álvarez, 2013).
- iii. iPod:** iPod is a portable media player that allows a user to download music, podcasts, audio books and other video (Jacob and Issac, 2014). Students can thus download lecture materials, audio and video lectures. With bigger screen iPods the users can read even electronic books. The students can also share information files, work together on a project, provide visual directions or can interface with the iPod through a microphone. Jacob and Issac (2014) explain that the Ipod helps in teaching support, as the professors in a university could give the audio or video lecture to the registered students as a free download.

However, the cost can be a factor where all the students cannot afford to use one. It also does not provide interactivity and the screen size is generally small to read large chunks of data.

- iv. **Personal Digital Assistant (PDA):** PDAs form a good combination of digital storage along with computing power, internet access, wireless network access through Wireless Fidelity (Wi-Fi) or Bluetooth, and pen or stylus input interface, along with other word processing tools (Jacob and Issac, 2014). The authors further explain that the PDA lets users access email and web content and can play audio and video files. It supports interactive and group learning. The advantages of a PDA include; easy data entry, since text and data entry is possible through the screen keyboard or stylus. The relatively large screen of the PDA is more advantageous for the integration of communication tools in it. However, the PDA is slightly bulky for a normal sized pocket.
- v. **Laptop or Tablet Personal Computer (PC):** Laptop or tablet PC is the most functional of all the mobile devices and it has all the features of a workstation PC. It comes with the network support for Bluetooth, WI-Fi and Ethernet. Tablet PCs also integrate handwriting recognition, voice to text conversion for input. These computing devices do support email, web surfing, word processing, Instant Messaging, Voice over Internet Protocol connections and many other application programs. Lot of interactivity and collaboration in research can be thus supported. Pros: The laptop provides the most powerful computing environment with mobile devices. Cons: The relatively large size and lack of mobility-on-the-run limits its network usage, where mobile network services are available.

Some of these devices are multifunctional and may be used for voice calls, text messages, email, Internet access, and may allow access to computers and/or networks. Mobile devices have an operating system, which is responsible for providing an interface to the hardware. Mobile devices have user software called applications, which are normally referred to as apps. Most recent versions of mobile devices are equipped with powerful apps and functionalities such as Global Positioning System which helps to customise content such as having localised subtitles in video tutorials, Bluetooth for data transfer, Wireless Fidelity (Wi-Fi) and Mobile internet. These applications and technologies give mobile devices more computing abilities making it more of a minimised version of a computer. The other capability is having bigger space for storage of data.

The use of wireless, mobile, portable, and handheld devices are gradually increasing and diversifying across every sector of education, and across both the developed and developing worlds. It is gradually moving from small-scale, short-term trials to larger more sustained and blended deployment. In the education sector, mobile devices come with great innovations and opportunities. This is supported by Cavus and Ibrahim (2008), who observed that regardless of the location of the students, mobile computing devices can provide students with educational opportunities such as access to course content, interact with instructors and student colleagues.

The benefits of mobile wireless technologies can be utilised to overcome the limitation of educational flexibility with wired technology. With strength of mobility, mobile wireless technologies help improve efficiency and effectiveness in teaching and learning (Maginnis, White, and Mckenna, 2000). The benefits of mobile devices in learning are supported by Motiwalla (2007) who argues that key features of using a mobile device for electronic Learning (E-Learning) are its personalization capability and extended reach; this has potentially attracted more and more learners, especially adult learners, for whom the work-life balance is critical.

1.1.4 Frameworks for Mobile learning

A framework is a real or conceptual structure intended to serve as a support or guide for the building of something that expands the structure into something useful (Rouse, 2015). There are different types of frameworks used in the research process. The first one is a theoretical framework, which is defined by Swanson (2013) as theories formulated to explain, predict and understand phenomena and in many cases, to challenge and extend the existing knowledge within the limits of critical bounding assumptions. The author further explains that the theoretical framework is a structure that can hold or support a theory of a research study, which explains why the research problem under the study exists. Research activities are guided by a theoretical framework through reliance on a formal theory. The theory in question should have been developed by using an established, coherent explanation of certain sorts of phenomena and relationships (Lester, 2005). The theoretical framework is the type of framework this study is to come out with because the study is grounded on a theory.

Scriven (1986, cited in Lester, 2005) describes a practical framework. The author describes a practical framework as "a framework is not informed by formal theory but by the accumulated practice knowledge of practitioners and administrators, the findings of previous research, and often the viewpoints offered by public opinion". In this type of framework, Research questions are derived from a knowledge base and research results are used to support, extend, or revise the practice. A practical framework guides research by using "what works" in the experience of doing something by those directly involved in it. This is the framework I intend to use.

Researchers have developed practical mobile learning frameworks, to assist institutions of higher learning in adoption and usage of mobile devices in learning. Park (2011) developed a Pedagogical Framework for Mobile Learning. According to Moore (2011), pedagogy is the art of teaching. This framework does categorize mobile technologies educational applications into four types namely:

i. high transactional distance socialized M-Learning:

A mobile learning activity is classified as this type when 1) the learners have more psychological and communication space with their instructor or institutional support; 2) the learners are involved in group learning or projects where they communicate, negotiate, and collaborate with each other; 3) learning materials or the rules of activity are delivered from the predetermined program through mobile devices; and 4) transactions mainly occur among learners, and the instructor or teacher has minimal involvement in facilitating the group activity. This type might replace the traditional technology mediated classroom group activity where students in a group or pair conduct given tasks or assignments.

ii. high transactional distance individualized M-Learning:

Mobile learning activities are classified as type 2 when 1) the individual learners have more psychological and communication space with the instructor or instructional support; 2) the individual learners receive tightly structured and well organized content and resources (e.g., recorded lectures, readings) through mobile devices; 3) the individual learners receive the content and control their learning process in order to master it; and 4) the interactions mainly occur between the individual learner and the content. This type demonstrates an extension of E-Learning which allows greater flexibility and portability.

iii. low transactional distance socialized M-Learning:

In this type, individual learners interact both with the instructor and other learners as they use mobile devices. They have 1) less psychological and communication space with the instructor; and 2) loosely structured instruction; but (3) work together in a group as they solve the given problem and try to achieve a common goal; and (4) engage in social interaction, negotiation, and frequent communication naturally. This type demonstrates the most advanced forms in terms of the versatility of mobile devices and learners' social interactions.

iv. low transactional distance individualized M-Learning:

This last type of mobile activity refers to 1) less psychological and communication space between instructor and learner and 2) loosely structured and undefined learning content. On this basis, 3) individual learners can interact directly with the instructor, and 4) the instructor leads and controls the learning in an effort to meet individual learners' needs while maintaining their independence. This type shows characteristics unique to mobile learning that support blended or hybrid learning.

This framework developed by Park (2011) has a gap of not considering the Lecturer as key players in the learning process. Lecturers are key because they are in charge of content generation and discussion modulation. The same framework does not consider training for both students and lecturers on how mobile learning will be conducted. Hence usefulness of mobile learning might be over shadowed by lack of training. Another gap in this framework is that it lack assessment modules which are used to assess the technology, users and processes. Assessment techniques help in determining the gaps in the framework its self and the needs of the user.

Ozdamli (2012) describes a framework of mobile learning according to new trends in developing technology. The framework has four key pedagogical aspects of mobile learning which include; integration of tools, pedagogical approaches, assessment techniques and teacher training. The framework is illustrated Figure 1.1 shown below;

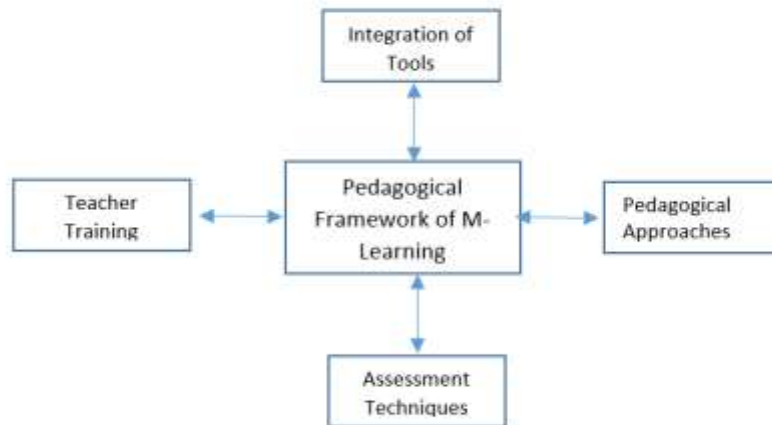


Figure 1.1: Pedagogical Framework of Mobile Learning. (Ozdamli, 2012)

Under the integration of tools, the author looks at a mobile devices integration: as a supportive tool such as mobile tools support communication between learners, teachers, provides file sharing, discussion, information search, and other features. Also mobile tools can use as an instructional tool. Pedagogical approaches, as constructivism, blended learning, collaborative learning and active learning are presented in the pedagogical approaches. In Assessment techniques, mobile learning instructors can use all assessment techniques for evaluate learner products/projects. These Assessment techniques include computer based, self-assessment and peer assessment and tutor assessment. In the Teacher training, this supports teachers' work and endorse them during content production as well as delivery strategies decision. Techniques and methods to build a learning community encourage the participants to explore the systems as well as the materials This framework defers from Parks (2001) due to the fact that it put both teachers and traditional pedagogical methods into consideration.

However, the above framework lacks a componet of student training. This componet is important because it helps students understand the usage and usefulness of the system. Another setback is that this framework is does not critically analyse the technology connectivity of the mobile devices. It only puts into consideration the mobile devices.

Another four-level framework was developed by Leung and Chan (2003). The author presents the framework as shown in Figure1.2 below;

Mobile learning applications
Mobile user infrastructure (browser, handheld devices)
Mobile protocol (adoption of content with WAP)
Mobile network infrastructure (cellular systems, satellites, etc)

Figure 1.2: Mobile learning framework. (Leung and Chan, 2003)

This framework focused on the adoption of mobile devices in learning and their operationalization to deliver content. The four levels included;

i. Mobile learning applications:

The author explains that there are unlimited number of potential mobile learning applications, of particular interest are mobile learning activity management and proactive learning management. Mobile learning activity management can track the location of a student and evaluate the needs of the student in a particular situation so that it is possible to arrange course material delivery accordingly, thus improving and enhancing the student's learning purposes.

ii. Mobile user infrastructure:

Mobile devices and wireless networks can provide texts, video on demand, and information services. Hence Learners would require such technology as appropriate mobile devices, and high-bandwidth wireless networks. This is attributed to the fact that connectivity is important because disconnection caused by handovers seriously affect the quality of information services. Learners require several functional components to realize these applications. These components include sufficient storage, processing power, download speed.

iii. Mobile protocol

Mobile protocol connects different applications, tools, networks, and technologies to provide a common user interface. Achieving application independence from device and wireless technologies is important for mobility to be a success. Protocol is a layer for connecting mobile learning applications with different mobile networks and operating systems without noticing mobility awareness.

iv. Mobile network infrastructure.

Mobile devices and protocols, mobile learning applications do depend on networking support. Transmission rate and coverage are the two most important factors. Because many mobile learning applications require small messages, they may use the short messaging service of the mobile data networks or other networks.

The framework above by Leung and Chan (2003) has the following gaps; the framework focuses mainly of mobile devices and how they can be used to access data and transmit data. This framework does not put into consideration the pedagogy needs of the students. Yet pedagogy is key in the learning process because it describes how best students would internalise the learning data. The same framework lacks training and assessment modules. More so, users are not considered as part of the framework, hence user needs are neglected.

In South Africa, The An Opencast Mobile learning Framework for Enhancing Learning in Higher Education by Boyinbode, Bagula, and Ngambi (2011) does also focus on mobile devices. The framework is illustrated in Figure 1.3 shown below;

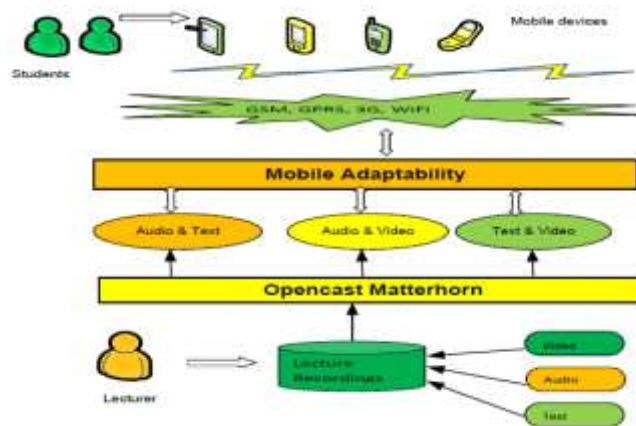


Figure 1.3: Architecture of Opencast Mobile Learning System (Boyinbode, et al., 2011).

Since the research is for higher education in the African context where connectivity is a challenge, the research focuses on downloadable offline content for mobile devices. This framework includes some pedagogy methods of information dissemination, but it working offline means that students are not able to get information in real time; hence the difficulty in having clarifications and important questions getting answered in time.

The Opencast Mobile learning Framework for Enhancing Learning in Higher Education by Boyinbode, Bagula, and Ngambi (2011) focuses mainly on the use of podcasts. Hence, there is a gap that this framework does not put into consideration other lecture material delivery methods. This framework limits pedagogy to classroom lecture content. The framework leaves out the M- Learning strategy such as training and assessment.

In Uganda, research by Muyinda, et al. (2011) developed a mobile learning framework based on an E-Learning framework (Khan, 2001 cited Muyinda, et al. 2011, pg 3. The E-Learning framework has twelve focus areas namely; Learning Objects, MLearning Device, MLearning Interface, MLearning Connectivity, MLearning Process, MLearning Costs, MLearning Resources, MLearning Context, MLearning Pedagogy, MLearning Ethics, MLearning Policy and MLearning Evaluation. However, this framework took into consideration a mobile device as a mobile phone with more emphasis on the learning objects. Other mobile devices such as tablets, portable computer, were not put into consideration, yet these devices have got bigger storage capacity, bigger screens and faster internet capabilities than mobile phones. More so the framework did not review the other focus areas apart from the mobile learning objects

Framework by Muyinda, et al. (2011) focuses on the mobile phone as the device used in mobile learning. This framework does not put into account other mobile device like tablets. Furthermore, emphasis is on objects used to access information. This framework leaves out import aspects such as training needs of students and lecturers, and assessment module.

Gaps in the reviewed frameworks:

In reviewing the above frameworks, it is observed that they have gaps which would hinder the effectiveness of each framework in implementation of mobile learning successfully. The gaps identified are lack of pedagogy consideration in the frameworks, stakeholders such as lecturers were not included in framework, lack of Assessment and training modules. The above gaps reveal the ineffectiveness of the frameworks reviewed. With these shortcomings, there is need to develop a framework that would address them.

1.2 Background

In a bid to satisfy students' academic needs, Universities in Uganda are targeting to provide adequate education materials. According to National Council for Higher Education (NCHE) (2008), education materials are considered to be adequate the following conditions are satisfied; the computer-student ratio should be 1:20, Essential Textbooks: Students Ratio is 1:5 and two subscriptions to national and International journals, the class ratio should be 1: 1 for each course year while lecturer-student ratio is 1:20. NCHE (2010) observed that in Uganda, the current average computer-student ratio around the country is about 1:40, textbook to student ratio is 1:10, classroom course ratio is 1:2, and the lecturer student ratio is 1:25. From the above, its observed that universities are facing educational challenges related to achieving adequate education materials. These challenges include limited classrooms, library services, and high lecturer student's ratios. Because of these challenges, universities are required to adopt to new mechanisms of interacting with students. This research focuses on the development of a framework which enables the use of mobile devices in Learning as a way of overcoming the above challenges. Ssekakubo, Suleman, and Marsden, (2014) explained that Information and communication technology (ICT) has proved to be an essential component of the educational system in overcoming these challenges. ICT has positively impacted the educational system and has played an important role in meeting both educational and economic challenges.

The use of ICT to support teaching and learning is commonly referred to as E- Learning. eLEARNINGNC (2016) explained that in most cases, E-Learning refers to a course, program or degree delivered completely online. E-Learning is a learning system supported by hardware and software. E-Learning can be conducted in online mode, whereby the lecturer interacts in real time with students but both being in a different location using computer technologies. Also, E-Learning can take an offline mode, whereby a lecturer uploads learning materials and students can interact with the material at leisure. In institutions of higher learning, Learning Management Systems (LMS) are among the ICT tools that can be used to implement E-Learning.

Hall (2001) explains that a Learning Management System (LMS) is software that automates the learning process, through registration and log-in of registered users, managing course catalogues, record data from learners, and provide reports to management.

This is supported by Szabo and Flesher (2002), who explained that E-Learning management system delivers and manages instructional content, identifies and assesses individual and organizational learning or training goals, tracks the progress towards meeting those goals, and collects and presents data for supervising the learning process of the organization as a whole. The learning management system delivers content but also handles registering for courses, course administration, and skills gap analysis, tracking, and reporting. More so, these systems via communications tools also provide interaction between learners either instantly or non-instant communication. Communication tools were described by Unwin et al. (2010) as inbuilt email, chat, whiteboard, and discussion forums. Institutions of higher learning tend to use the LMS to supplement traditional face-to-face delivery by enabling learners to access learning resources through electronic means. LMS are also used to enhance existing distance courses and therefore reaching more learners across various geographical boundaries. The success of LMS in high institutions of learning is attributed to Internet penetration as well as a well-developed ICT infrastructure.

E-Learning systems face major obstacles in third world countries including Uganda. These obstacles limit the adoption and usage of the E-Learning systems. This is supported by Wamae (2011), who explains that there are factors that affect are in the process of implementation of E-Learning systems, in Higher Education Institutions. The author explains that the factors are due to the technology, users, context of usage and the associated costs. These factors include; among other things, connectivity (low bandwidth) and accessibility, inadequate telecommunications infrastructure and lack of reliable power supply. This is supported by Khaled and Khonika (2009), who observed that a weaker economy and absence of adequate infrastructure such as electricity facilities were the main obstacles of effective E-Learning practices in the least developed countries. Hence, the various technological environment and social-economic aspects need to be addressed before implementation of E-Learning systems.

Uganda Martyrs University offers certificate, diploma, graduate and postgraduate programmes in various fields. In order to bring services closer to the people, the university opened various campuses located in different districts around the country, which offer programmes similar to those offered at the main branch in Nkozi, Mpigi district. The inception of various campuses led to increasing in student numbers to about 3500 students.

However, educational materials remain constrained in comparison with the student numbers. For example, the ratio of computers to students is 1:20, which is NCHE recommended ratio. However, the computer labs also double as lecture rooms for the students. This makes the access to computers be constrained. The other notable ratio is Essential Textbooks: Students Ratio is 1:12 while the recommended ratio is 1:5. This negatively affects the quality of service. For better service delivery, the university implemented a learning management code named Moodle in 2013.

Moodle is an open source web-based learning management system. Individual users of the software have the freedom to run, modify, adapt, customise and share without charge. Bălăcescu and Ghimiși (2014) explained that both teachers and students around the world have found it easy and comfortable to use Moodle since the system has interfaces that are easy to learn and understand. The layout and organisation of courses in Moodle are recommended by Bailye (2013), who explained that the layout made finding things easier, hence students could comfortably use Moodle tools. The same researcher further explained that Moodle is a tool that incorporates pedagogy tools of traditional learning into electronic methods, providing an anytime-anywhere accessibility for both the student and the teacher. The benefits of Moodle to students is having subscription tools such a RSS feeds for forum discussions, calendar feeds, ability to integrate email services such Microsoft outlook, ability for Moodle to give email notifications about forum discussions or marked assignments, ability to link Moodle to online storage services such as Google drive or Dropbox and ability to customise Moodle to suit an institution needs University of England (UNE) (2013). These benefits are a great boost to traditional learning methods. Students are empowered to learn from each other and more so a lecturer has more interface with students through discussion boards.

Moodle was adopted and implemented in Uganda Martyrs University as a result of a proposal by senior staff to adopt E-Learning in order to change the way UMU was delivering lecture materials, especially to long distance Learners. Before implementation, Lecturers would provide hardcopy notes to students, a few would send notes to student email. For any research materials, students would utilise internet cafes to get materials. The problem faced by this method included lack of a centralised source of learning, It was not easy to implement tracking tools that do help in enhancing performance, there was limited access to learning resources such as notes, it was difficult to implement compliance measures.

The purpose of introducing of Moodle Learning management system in Uganda Martyrs University was to provide an extra interface for students to access learning materials. The system intended to provide lecturers with centralised point for distribution of learning materials, assessment and class analysis performance tools. However, there is less usage of Moodle by students and lecturers than it was anticipated.

The adoption of Moodle Learning Management system was based on the Technology acceptance model (TAM). The TAM describes how users come to accept and use a technology. The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably: Perceived usefulness which was defined by Davis (1989) as "the degree to which a person believes that using a particular system would enhance his or her job performance". Perceived ease-of-use defined the same author as "the degree to which a person believes that using a particular system would be free from effort".

E-Learning has not been successful at UMU despite using of TAM. The challenges faced by Moodle adoption in UMU include; TAM does not put into consideration pedagogy needs of the university yet the universities sole purpose is to impart education and skills to students. Students' access to Moodle is limited because TAM does not investigate the technological needs of users. There is a need to investigate why TAM has failed to work in the adoption of Moodle. The reason for the investigation include; A few lecturers have signed up in the system, delivery of learning materials using Moodle is still very low. The reasons for this were to be investigated in this study. More so, Lecturers are in charge of enrolling students to a particular course unit on the platform, hence when the lecturers do not use the system, students cannot use it too. This research intended to identify factors that accounted for the slow adoption, and then propose a framework for adoption of mobile devices in learning, that would help overcome these factors.

1.3 Statement of the Problem

Moodle was implemented in UMU based on the Technology Acceptance Model. This model focuses on how information technology is adopted and implemented by an organisation to enhance business processes.

Focusing on education business processes, TAM framework is not an appropriate framework for adoption and implementation of educational related technologies. The reason is that it does not have the ability to address pedagogical needs of an academic institution such as a university. These pedagogical needs of an institution of higher learning include the following:

- i. Content analysis of learning materials: Individuals responsible have to ensure that the right content as stipulated in the curriculum is followed as required.
- ii. Audience analysis: Techniques in audience analysis help the content developer such as Lecturer to be able to understand the kind of audience he or she is interacting with.
- iii. Goal analysis: Goal analysis helps all stakeholders in the learning process understand the target or aim of particular course units.
- iv. Media analysis: In the media analysis, the stakeholder review methods and techniques how the content can be delivered to the learner.

The above pedagogy needs are never put into consideration in the TAM model, since the model focuses on technology as a tools of automating business processes. In addition, the TAM framework does not consider the stakeholders infrastructure and access channels. Uganda Martyrs University have got both wire and wireless network infrastructure in its campuses. However, if a student is off campus, then access to this infrastructure is hindered. More so, other factors such as electricity being of, high cost of internet and high maintenance cost and the cost of buying an access device such as a Laptop is high. Hence much as E-Learning is implemented in UMU, the access of the E-Learning is hindered by these factor. Thus, this translates into the relevant stakeholders not being able to use the E-Learning system. Hence, to address these shortcomings, a framework for adoption of Mobile learning was developed. The framework is ensured pedagogy is included in the usage of technology during the automation of learning processes. Furthermore, the framework include components that help the institution's manager review the appropriate technology and methods that can be used to deliver content to the learner over the mobile device.

1.4 Objective of the Study

Objectives of the study were categorised into major and specific objectives. The major objective of the study describe the intentions of the research while specific describe the steps carried out to achieve the major objective.

1.4.1 Major Objective:

The major objective of the research is to improve E-Learning by developing a framework that is effective in the implementation of E-Learning with the integration of mobile devices.

1.4.2 Specific Objectives

The specific objectives of the research are;

- i. To review some of existing mobile learning frameworks so as to identify their strengths and shortcomings
- ii. To identify components, sub-components, characteristics and relationships that are required to assemble a framework
- iii. To develop a framework that can be used to effectively and efficiently integrate E-Learning to with mobile devices.
- iv. To verify the framework using expert knowledge.

1.5 Research questions

- i. What shortcomings do exist in current E-Learning frameworks?
- ii. What are the issues and factors affect access to and use mobile devices in Learning?
- iii. What strategy can be used to deliver and access learning materials using a mobile device?

1.6 Scope of the Research

The scope of the study states boundaries within which the study was conducted in terms of geography, content and time scope as described below;

1.6.1 Geographical scope

The study will be based on E-Learning processes at Uganda Martyrs University.

1.6.2 Content scope

The study will be based on the development of a mobile learning framework for UMU, which will guide stakeholders on adoption and usage of mobile devices in learning.

1.7 Significance of the Study

The framework is expected to be of significance to different stakeholders in the following ways:

- i. Management in institutions of Higher education shall be able to implement mobile learning easily if and when they use this framework.
- ii. The proposed framework will provide a foundation from implementing mobile learning to both academic and non-academic institutions, which are interested in the provision of mobile learning services to its clients.
- iii. Both Lecturers and students will use minimal time, and effort during the mobile learning activities since the framework is developed in consideration.
- iv. The framework shall improve on quality of information and feedback there by producing timely and accurate user reports, which can be used to improve the learners' experience.
- v. The research will be a source of literature for other researchers
- vi. Similarly, the research will be used by other researcher to improve or customised the developed framework, in order to suit their needs
- vii. Furthermore, this research will provide information to scholars whose research interests are leaning towards the mobile learning subdomain.
- viii. Students will use the framework to easily understand the principles of mobile learning, and how best they can utilise their mobile devices in learning.

1.8 Definition of Keywords;

Distance Learning: Any learning is done at a physical distance from a university.

Electronic Learning: Learning that can be done on-campus or off-campus, but is always done when time and space must be dedicated to learning.

Mobile device: Any mobile technology with multiple functions and capabilities, especially the ability to access the Internet.

Mobile Learning: The process of using a mobile device to access and study learning materials and to communicate with fellow students, instructors or institutions.

CHAPTER TWO

LITERATURE REVIEW

The chapter was based on reviewing the literature that was relevant to this research. Literature reviewed was obtained from similar research work published by different scholars. The reviewed work was related to the main and specific objectives of this research. Requirements of developing a framework guided the researcher on how to select the different literature to review.

Literature was reviewed as follows. Different frameworks of distance learning and its technologies were reviewed first. These included the Flex Learning Framework, Distance Learning frameworks and Electronic Learning frameworks. Research methodologies that could be used as well as sampling procedures involved were reviewed. More so, data collection, data analysis and Framework methodology were reviewed. The research process was also reviewed. The framework review methods were also discussed in this Chapter

2.1 Introduction

Learning can occur in all situations and environments, however, until recently the role of technology in this learning has been limited in many settings. For example, unpredicted conditions such as weather changes may affect a learner's ability to accomplish a learning task. In the traditional classroom where the education process takes place, teachers and learners meet face to face at the same time and in the same place. Learners typically receive the learning content from the teacher in real time. As a result, the learning activities are limited to those prepared in advance by the teacher, and it is difficult to adapt the learning materials to each individual learner's learning needs. Key advantages of traditional learning are direct contact between the teacher and students and immediate feedback from the student. However, it also has some disadvantages such as a student missing content if they are unable to attend a lesson.

Distance learning (D-learning) and electronic Learning, on the other hand, continue to grow rapidly to support and assist learning participants (teachers and learners) through the use of learning tools (emails, learning management systems).

Success factors for distance learning are described by Cheawjindakarn et. al (2012) as institutional management to support distance learning, conducive learning environment for the learner, the instructional design incorporated with pedagogy tools, services support such as training and course evaluation. Hence while developing distance learning institutions should put the above factors into consideration. E-Learning is a subset of distance learning that involves the use of technology to support the learning process. Most D-learning and E-Learning technologies do not require the teacher and learner to be present at the same location at the same time and involve communication infrastructures. M-Learning is the intersection of mobile computing and E-Learning; M-Learning refers to the ability to learn everywhere at any time without physical connection to cable Networks. Mobile computing refers to continuous accessibility to the learner, while wireless implies communicating without wires.

2.2 Distance Learning Frameworks

Distance learning is defined by Joi, Camille and Krista (2011) as the effort of providing access to learning for those who are geographically distant. The instructional delivery of learning materials includes an instructor located in a different place from the learner. The advancement of technologies in communication and transport has created significant interest in adopting new forms of education such as D-learning (Keegan 2002, cited Al-Hmouz, 2012). The concept of D-learning is based on the possibility offering learning services at a distance where teachers and students are separated by location and time. Similarly, Hentea, Shea, and Pennington (2003) explained that in order to overcome the barrier of location and time, communication technologies are used to close the gap and support the learning process.

D-learning is the foundation of electronic learning. This is supported by a flexible learning framework by Brown (2003), which illustrates the relationship of distance learning to E-Learning and M-Learning as shown in Figure 2.1 below;

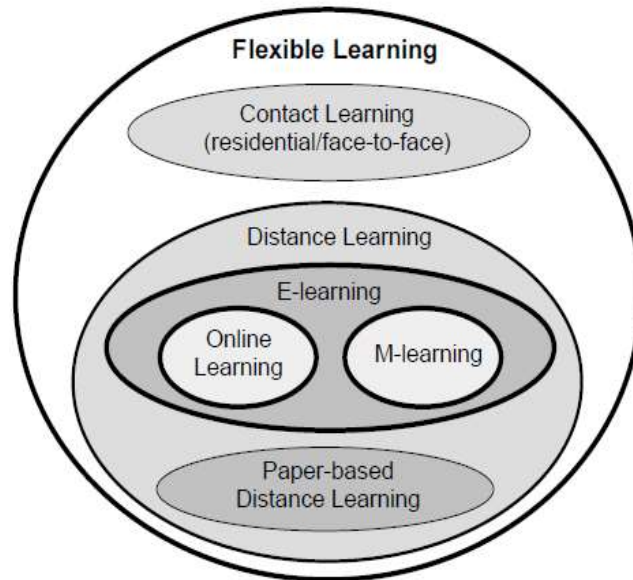


Figure 2.1: The role of M-Learning in the future of E-Learning in Africa by Brown (2003).

The above framework describes the components of flexible learning. Flexible learning is defined by Higher Education Academy (2016) as accessing education in a way that is responsive in pace, place and/or mode of delivery. It is often supported by the use of credit accumulation and transfer. Flexible learning can include: using technology to provide the remote or online study. The components of the flexible learning framework above include the residential face to face learning where the trainer provides home schooling services to the learner. It also includes Distance learning component where the learner can get an education without being physically located at the school premises. Distance learning can be paper based, whereby the learning materials are sent in hard copy to the student or the learning materials can be sent electronically, thus giving birth to electronic learning.

Flexible learning is of two types. It can be in the form of residential face to face where the presence of the instructor is paramount or it can be in the form of distance learning. In distance learning, the instructor's presence is not much considered. Here the focus is on the delivery of learning materials to the learner. Distance learning is of two forms. It can be paper based, whereby the learning materials are delivered to the student in hardcopy paper form. The student then reads and compiles the assignments and hands in for marking. The other form of distance learning is E-Learning whereby technology is used to deliver the learning materials.

Students can receive the learning materials via electronic channels such as email, learning management systems and so on. This is termed as on-line learning. When students the learning materials via mobile devices, then it is termed as mobile learning.

The flexible learning framework above guided Brown (2003) in explaining the relationships between Flexible learning, D-learning, E-Learning, and M-Learning. Once these linkages were well defined, the researcher had the ability to academically the role of M-Learning in the future of E-Learning in Africa. The strength of the framework is its ability to draw the boundaries between the different flexible learning technologies. However, the above framework has a weakness of not explicitly showing the underlying sub-components of the different technologies such as online learning or Mobile learning. Once these sub-components are not identified, the implementation or usage of the framework is hard.

The above framework will be useful in guiding me on how to differentiate the different flexible learning technologies and their inter-linkages. The framework will provide me with a foundation for identifying the components and sub-components of the mobile learning framework.

2.3 Electronic Learning framework

E-Learning is defined by Sangrà et. al., as:

“an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication, and interaction and that facilitates the adoption of new ways of understanding and developing learning”. (2012, pg 5)

From the above definition, it is noted that E-Learning involves delivery of class content via any electronic media, including but not limited to the Internet, intranets, extranets, satellite broadcast, audio/video tape, interactive television, and Compact Disk.

Muyinda, et al. (2011); Khan (2001) explain that E-Learning framework provides guidance in: planning and designing E-Learning and blended-learning materials (e.g., Massive Open Online Courses, Mobile Learning), organizing resources for E-Learning environment and blended-learning materials, designing distributed learning systems, corporate universities, virtual universities and cyber schools, designing Learning Management Systems, Learning Content Management Systems and comprehensive authoring systems, evaluating E-Learning.

The framework also caters for blended-learning courses, and programs, and evaluating E-Learning authoring tools/systems. Khan (2001) explains an E-Learning framework addressing global E-Learning issues. The framework has eight (8) major dimensions that are instrumental to meaningful implementation of E-Learning. The eight (8) major dimensions in the Global E-Learning Framework presented in Figure below are: Institutional, Pedagogical, Interface Design, Evaluation, Management, Resource Support, Ethical and Technological dimensions. Each of the major dimensions consists of several sub-dimensions as is detailed in Figure 2.2 below;

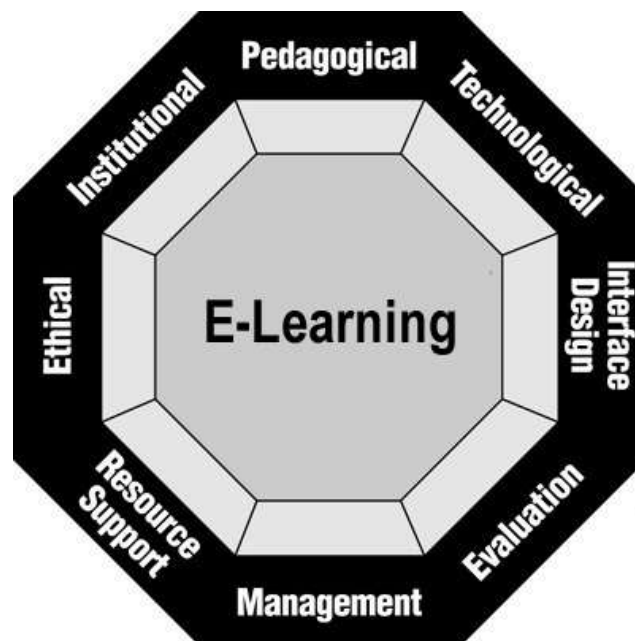


Figure 2.2: Elearning Framework, as presented by Badrul Khan (2001)

Khan (2001) explains the above framework as follows:

- i. The pedagogical dimension of E-Learning refers to teaching and learning. This dimension addresses issues concerning content analysis, audience analysis, goal analysis, media analysis, design approach, organization and methods and strategies for E-Learning environments.
- ii. The technological dimension of the E-Learning Framework examines issues of technology infrastructure in E-Learning environments. This includes infrastructure planning, hardware, and software.
- iii. The interface design refers to the overall look and feel of E-Learning programs. Interface design dimension encompasses page and site design, content design, navigation, and usability testing.

- iv. The evaluation for E-Learning includes both assessment of learners and evaluation of the instruction and learning environment.
- v. The management of E-Learning refers to the maintenance of learning environment and distribution of information.
- vi. The resource support dimension of the E-Learning Framework examines the online support and resources required to foster meaningful learning environments.
- vii. The ethical considerations of E-Learning relate to social and political influence, cultural diversity, bias, geographical diversity, learner diversity, information accessibility, etiquette, and the legal issues.
- viii. The institutional dimension is concerned with issues of administrative affairs, academic affairs and student services related to E-Learning.

The above framework explains both policy and educational needs for E-Learning to be a success. More so pedagogy tools are given due focus as that of the technological needs. This creates a well-balanced blend of technology and education. More so the framework emphasises managerial support through consideration of management and institutional policies. Ethical issues combined with regular evaluation help all stakeholders in ensuring that E-Learning is implemented as required. However, this framework lacks the mobility component of accessing learning materials. This framework will provide a structure for developing the mobile learning framework.

2.4 Research methodology

Research methods are key for research to be accomplished. There are basically three research approach methods, which are the quantitative, qualitative and mixed-methods research. Babbie (2010) explains that Quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques. Quantitative research usually involves collecting and converting data into numerical form so that statistical calculations can be made and conclusions drawn (Wolfenbarger and Samouel, 2015). Quantitative methods can be used to verify which of such hypotheses are true. MacDonald and Headlam (2014) explains that Surveys are a popular method of collecting primary data. The broad area of survey research encompasses any measurement procedures that involve asking questions of respondents. Quantitative surveys are used when a researcher needs to generate primary data from a large number of sources to answer the research question.

This research method is appropriate because it involves statistical analysis which permits researchers to discover complex relationships and to determine to what extent one variable influences another. MacDonald and Headlam (2014) explain that the following have to be put into consideration while undertaking a survey;

- i. Population:** A grouping of individuals of entities with defined attributes.
- ii. Sampling:** The sample is the section of the wider population that will be engaged in the survey and sampling is the process of identifying who the research will aim to contact from that population.
- iii. The format of the survey:** there are of two types namely: Cross-sectional surveys which are used to gather information on a population at a single point in time. An example of a cross-sectional survey would be a questionnaire that collects data on peoples' experiences of a particular initiative or event. The other format is longitudinal surveys which gather data over a period of time. This would allow analysis of changes in the population over time and attempt to describe and/or explain them.
- iv. Questions:** There is a whole range of questions to be asked in survey design. The commonly used questioning methods include; Closed questions and Ranking scales questions.
- v. Administration:** Here methods on how the survey will be conducted are identified. The common methods include postal surveys, telephone surveys, email/internet surveys, street surveys/administered surveys.

However, quantitative research fails to account for the full set of potentially important factors that may be vital in understanding the research since views and perceptions are constrained (Tewksbury, 2009).

On the other hand, MacDonald and Headlam, (2014) explain that Qualitative research concerned with a quality of information, qualitative methods attempt to gain an understanding of the underlying reasons and motivations for actions and establish how people interpret their experiences and the world around them. Qualitative research involves understanding participants' perspectives on the topic of interest and presenting definitions that are constructed by participants regarding those topics (Wolfenbarger and Samouel, 2015).

Hanson et al, (2005) explains that qualitative research methods are based on data in the form of words, images, and observations which are recorded as written notes, photographs, audiotapes or drawings and so on, that lend themselves to thorough, and detailed descriptions of complex behaviours, processes, relationships, settings, and systems. The same authors explain furthermore that qualitative research's flexibility in design and analysis is beneficial in a way that it allows for integration of important, but unexpected events and findings. Wolfenbarger and Samouel (2015), explain that in summary qualitative research gets its strength on building an understanding of how participants perceptions of ideas; appreciate context rather than control it; exploit human potential to analyze and interpret; and provide accurate, comprehensive, and descriptive foundations. Qualitative methods provide insights into the setting of a problem, generating ideas and/or hypotheses. The researcher further explains that there different techniques used to collect data. These techniques include;

- i. **Questionnaire:** in this method open end questions are used by the researcher.
- ii. **Interviews:** The different types and styles of interview elicit very different types of information. Conducting interview is an interpersonal process and as an investigator, you must be very aware of your own behaviours and assumptions in the context.
- iii. **Discussion groups:** These are also known as 'focus' groups are an example of a technique imported into social research from market research.
- iv. **Workshops:** This is a group-based method of research in which there is an emphasis on activity-based, interactive working. The focus is on everyone participating and undertaking the work. Therefore, when using this type of research technique, the researcher acts as a facilitator, rather than leading the discussion or activity.
- v. **Observation:** These sometimes referred to as "participant observation". They consist of a mix of techniques; informal interviews, direct observation, participation in the life of the group, collective discussions, analyses of personal documents produced within the group, self-analysis, and life histories, notes, diaries and transcripts are often kept and the observation method can generate a lot of written material which the investigator must synthesize.
- vi. **Visual techniques:** These offer an interesting, stimulating and interactive approach to gathering information. They are appropriate in a variety of situations, as they fulfil numerous functions. Visual methods such as drawing, painting, video, photography and hypermedia offer increasingly accessible and popular resources for research.

However, qualitative research takes time to collect data and hence cannot be used in cases that require collecting data from a sample size (Sandelowski, 2000). Furthermore, the results can easily be influenced by the personal biases of the researcher. Therefore, this approach could not be used alone during the research since there was need to involve a large student and lecturer's population, yet time is limited. Quantitative research methodology could not be used alone, since the research also required in-depth understanding of the Moodle learning management system processes.

Hence using either qualitative or quantitative research each used alone cannot focus on finding and analysing all the required information. Sandelowski (2000) proposes the use of mixed-method research as a solution for the challenge above. In mixed methods, qualitative and quantitative methods are used together as either distinct design components, or are explicitly integrated. Tashakkori and Teddlie (2003) explains that mixed methods involves all procedures of collecting and analysing both quantitative and qualitative data in the context of a single study. Therefore, since qualitative data provide a deep understanding of survey responses, and statistical analysis can provide detailed assessment of patterns of responses, then Mixed methods designs can provide practical advantages when exploring complex research questions (Tewksbury, 2009). So, to carry out an effective and intensive research, mixed research methods were used during the research. Qualitative research was used to provide an in- depth description of the Moodle Learning Management System as well as the use of mobile device in the learning processes.

In summary, quantitative and qualitative research methods investigate and explore the different claims to knowledge and both methods are designed to address a specific type of research question. While the quantitative method provides an objective measure of reality, the qualitative method allows the researcher to explore and better understand the complexity of a phenomenon. The above literature presents a clear statement of what constitutes quantitative and qualitative research designs and summarized techniques used to conduct studies for both research approaches. It further presents statements of what constitutes the mixed methods approach which was used when conducting this research. Although each approach seeks to validate sensory knowledge as truth, neither is complete in its form. Mixed method research was to be applied in this research because; it is useful in studying a limited number of cases in depth, useful in describing complex phenomena.

Mixed methods can be used to conduct cross-case comparisons and analysis and can also provide understanding and description of people’s personal experiences of occurrences. Hence, the researcher used both qualitative and quantitative methods to collect and analyse data. The above requirement helped the research to carefully design the research tools since these acted as a check list.

2.4.1 Research Process:

Kothari (2004) explains that the Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps. The same author represented the research process as shown in Figure 2.3 below;

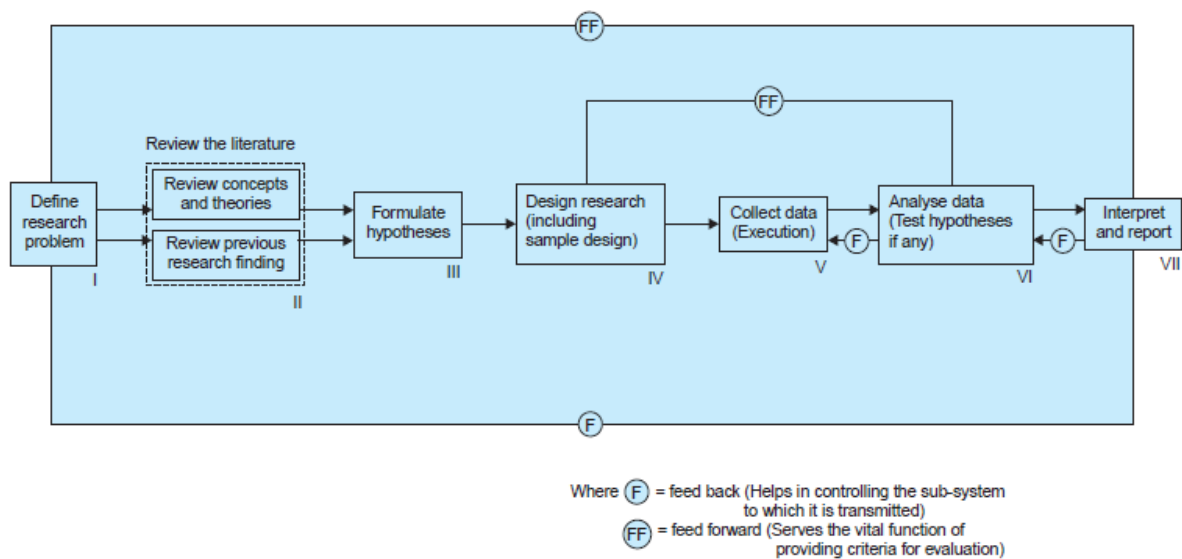


Figure 2.3: Diagram representing the research process as presented by Kothari (2004)

From the above Figure 2.3, it is observed that the research process consists of a number of closely related activities, as shown through steps I to VII. More so, the above activities overlap continuously rather than following a strictly prescribed sequence, and hence, at times the researcher has to rephrase a particular step. This is well illustrated by the Feed forward (FF) and Feedback (F) loops shown in the diagram. Hence the first step determined the nature of the last step to be undertaken. If subsequent procedures have not been taken into account in the early stages, serious difficulties may arise which may even prevent the completion of the study (Kothari, 2004). The researcher has to always remember that the various steps involved in a research process are not mutually exclusive; nor are they separate and distinct.

They do not necessarily follow each other in any specific order and the researcher has to be constantly anticipating at each step in the research process the requirements of the subsequent steps. However, the following order concerning various steps provides a useful procedural guideline regarding the research process. The research methodology is explained by Kothari (2004) as follows;

i. Formulating the research problem:

Kothari (2004) explains that there are two types of research problems. These problems include those which relate to states of nature and those which relate to relationships between variables. Hence the researcher must single out the problem to be studied, that is to say, the researcher must decide the general area of interest or aspect of a subject-matter that would be inquired into (Kothari, 2004). Initially the problem may be stated in a broad general way and then the ambiguities, if any, relating to the problem be resolved. Then, the feasibility of a particular solution has to be considered before a working formulation of the problem can be set up. The formulation of a general topic into a specific research problem, thus, constitutes the first step in a scientific enquiry. Essentially two steps are involved in formulating the research problem, and these are: understanding the problem thoroughly, and rephrasing the same into meaningful terms from an analytical point of view. This research focuses on the states of nature of Learning Management System in Uganda Martyrs University code named Moodle.

ii. Literature Review:

Once the problem is formulated, a brief summary of it should be written down. At this juncture the researcher should undertake extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go to. Academic journals, conference proceedings, government reports, books etc., must be tapped depending on the nature of the problem. In this process, it should be remembered that one source will lead to another. The earlier studies, if any, which are similar to the study in hand should be carefully studied. A good library will be a great help to the researcher at this stage.

iii. Preparing the research design:

Once the research problem having been formulated clearly, the researcher is then required to prepare a research design which states the conceptual structure within which research would be conducted. The preparation of such a design facilitates research to be as efficient as possible yielding maximal information.

In other words, the function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money. But how all these can be achieved depends mainly on the research purpose. A flexible research design which provides opportunity for considering many different aspects of a problem is considered appropriate if the purpose of the research study is that of exploration. But when the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be one that minimises bias and maximises the reliability of the data collected and analysed. The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following: the means of obtaining the information; the availability and skills of the researcher and his staff (if any); explanation of the way in which selected means of obtaining information will be organised and the reasoning leading to the selection; the time available for research; and the cost factor relating to research, i.e., the finance available for the purpose.

There are several research designs, such as, experimental and non-experimental hypothesis testing. Experimental designs can be either informal designs (such as before-and-after without control, after-only with control, before-and-after with control) or formal designs (such as completely randomized design, randomized block design, Latin square design, simple and complex factorial designs), out of which the researcher must select one for his own project. The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:

- a. the means of obtaining the information;
- b. the availability and skills of the researcher and his staff (if any);
- c. the explanation of the way in which selected means of obtaining information will be organised and the reasoning leading to the selection;
- d. the time available for research; and
- e. the cost factor relating to research, i.e., the finance available for the purpose.

iv. Determining sample design:

Liamputtong and Ezzy (2008) defines sampling as “a research technique of selecting a smaller (but representative) collection of units from a population used to determine facts about that population”. The same author further explains that the main reason for sampling is to condense usage of resources (such as time and funds) and work load giving results with a high degree of accuracy that can be calculated mathematically.

Sampling is highlighted by Ebner and Trull, (2009), as an important step in the process of research because it assists in determining the quality of inferences made by the researcher that stem from the underlying findings. In both quantitative and qualitative studies, researchers should choose the number of participants to select (for instance sample size) and how to select these sample members (for instance sampling scheme). In mixed methods investigations researchers should take sampling decisions for both the qualitative and quantitative components of the study (Ebner and Trull, 2009). One of the important components that distinguish qualitative and quantitative research is the sampling aspect. While quantitative research ideally uses probability sampling to permit statistical inferences to be made, qualitative research uses purposeful sampling schemes aimed at improving the understanding of the information-rich cases (Morrison, 2013).

All the items under consideration in any field of inquiry constitute a ‘population’. A complete enumeration of all the items in the ‘population’ is known as a census inquiry. It can be presumed that in such an inquiry when all the items are covered no element of chance is left and highest accuracy is obtained. The researcher must decide the way of selecting a sample or what is popularly known as the sample design. In other words, a sample design is a definite plan determined before any data are actually collected for obtaining a sample from a given population. Samples can be either probability samples or non-probability samples. With probability samples each element has a known probability of being included in the sample but the non-probability samples do not allow the researcher to determine this probability. Probability samples are those based on simple random sampling, systematic sampling, stratified sampling, cluster/area sampling whereas non-probability samples are those based on convenience sampling, judgement sampling and quota sampling techniques. Kothari (2004) explains the different types of sampling as follows;

- a. Deliberate sampling: Deliberate sampling is also known as purposive or non-probability sampling.

This sampling method involves purposive or deliberate selection of particular units of the universe for constituting a sample which represents the universe. When population elements are selected for inclusion in the sample based on the ease of access, it can be called convenience sampling.

- b. Simple random sampling: This type of sampling is also known as chance sampling or probability sampling where each and every item in the population has an equal chance of inclusion in the sample and each one of the possible samples, in case of finite universe, has the same probability of being selected.
- c. Systematic sampling: In such a design the selection process starts by picking some random point in the list and then every n th element is selected until the desired number is secured. An element of randomness is usually introduced into this kind of sampling by using random numbers to pick up the unit with which to start. This procedure is useful when sampling frame is available in the form of a list.
- d. Stratified sampling: If the population from which a sample is to be drawn does not constitute a homogeneous group, then stratified sampling technique is applied so as to obtain a representative sample. In this technique, the population is stratified into a number of non-overlapping subpopulations or strata and sample items are selected from each stratum. If the items selected from each stratum is based on simple random sampling the entire procedure, first stratification and then simple random sampling, is known as stratified random sampling. This is the sampling technique that the researcher used to select the sample for this research.
- e. Quota sampling: In stratified sampling the cost of taking random samples from individual strata is often so expensive that interviewers are simply given quota to be filled from different strata, the actual selection of items for sample being left to the interviewer's judgement. This is called quota sampling. The size of the quota for each stratum is generally proportionate to the size of that stratum in the population. Quota sampling is thus an important form of non-probability sampling. Quota samples generally happen to be judgement samples rather than random samples.

- f. Cluster sampling and area sampling: Cluster sampling involves grouping the population and then selecting the groups or the clusters rather than individual elements for inclusion in the sample. While Area sampling is quite close to cluster sampling and is often talked about when the total geographical area of interest happens to be big one.

Under area sampling we first divide the total area into a number of smaller non-overlapping areas, generally called geographical clusters, then a number of these smaller areas are randomly selected, and all units in these small areas are included in the sample.

- g. Multi-stage sampling: This is a further development of the idea of cluster sampling. This technique is meant for big inquiries extending to a considerably large geographical area like an entire country. Under multi-stage sampling the first stage may be to select large primary sampling units such as states, then districts, then towns and finally certain families within towns. If the technique of random-sampling is applied at all stages, the sampling procedure is described as multi-stage random sampling.
- h. Sequential sampling: This is somewhat a complex sample design where the ultimate size of the sample is not fixed in advance but is determined according to mathematical decisions on the basis of information yielded as survey progresses. This design is usually adopted under acceptance sampling plan in the context of statistical quality control.

The research choose Simple random sampling for this research. This was mainly because each element in the population had the desired attributes and hence has each member had equal chances of being selected. The simple random sampling helps eliminate bias.

v. Collecting the data:

In dealing with any real life problem it is often found that data at hand are inadequate, and hence, it becomes necessary to collect data that are appropriate (Kothari, 2004). Data collection is another set of concrete operations at the technique level of research contains the combined use of data collection methods that are usually tagged with either qualitative or quantitative research, such as open-ended and unstructured interviewing and structured questionnaires, respectively.

There are several ways of collecting the appropriate data which differ considerably in context of money costs, time and other resources at the disposal of the researcher. Kothari, (2004) explains that Primary data can be collected either through experiment or through survey.

If the researcher conducts an experiment, he observes some quantitative measurements, or the data, with the help of which he examines the truth contained in his hypothesis. The same author explains that in the case of a survey, data can be collected by any one or more of the following ways:

- a. By observation:** This method implies the collection of information by way of investigator's own observation, without interviewing the respondents. The information obtained relates to what is currently happening and is not complicated by either the past behaviour or future intentions or attitudes of respondents. This method is no doubt an expensive method and the information provided by this method is also very limited. As such this method is not suitable in inquiries where large samples are concerned.
- b. Through personal interview:** The investigator follows a rigid procedure and seeks answers to a set of pre-conceived questions through personal interviews. This method of collecting data is usually carried out in a structured way where output depends upon the ability of the interviewer to a large extent. This method is good for qualitative research methods.
- c. Through telephone interviews:** This method of collecting information involves contacting the respondents on telephone itself. This is not a very widely used method but it plays an important role in industrial surveys in developed regions, particularly, when the survey has to be accomplished in a very limited time.
- d. By mailing of questionnaires:** The researcher and the respondents do come in contact with each other if this method of survey is adopted. Questionnaires are mailed to the respondents with a request to return after completing the same.

It is the most extensively used method in various economic and business surveys. Before applying this method, usually a Pilot Study for testing the questionnaire is conducted which reveals the weaknesses, if any, of the questionnaire. Questionnaire to be used must be prepared very carefully so that it may prove to be effective in collecting the relevant information.

- e. **Through schedules:** Under this method the enumerators are appointed and given training. They are provided with schedules containing relevant questions. These enumerators go to respondents with these schedules. Data are collected by filling up the schedules by enumerators on the basis of replies given by respondents. Much depends upon the capability of enumerators so far as this method is concerned. Some occasional field checks on the work of the enumerators may ensure sincere work.
- f. **Focus Group Discussions:** Thomas, Silverman and Nelson, (2015) maintains that in order to discover the difference and similarities between the perspectives of participants, a distinctive type of interview referred to as a focus group discussion can be used. The authors define Focus groups are interviews with small groups of people, with the aim of nurturing exchange of ideas between participants. These justly standardized groups to allow for some evaluation but enough mixture to encourage discussion. However, such discussions are prone to the partiality by the facilitator. They do not provide information at individual level and the data collected by this technique is challenging to analyze.

The researcher selected two of these methods of collecting the data taking into consideration the nature of investigation, objective and scope of the inquiry, financial resources, available time and the desired degree of accuracy. The author recommends that a researcher should pay attention to all these factors but much depends upon the ability and experience of the researcher. In this case the researcher used the oral interviews and questionnaire technique to carry out the survey.

vi. Analysis of data

Data needs to be analysed after it is collected, Albright and Winston (2010) explains that data analysis is the process used by the researcher to shrink large volumes of data so as to create meaning of this data. Qualitative approaches are used to evaluate qualitative data and quantitative methods are used to analyze quantitative data (Morrison et al, 2013).

a. Quantitative Data Analysis

Agresti and Kateri (2011) assert that quantitative data analysis encompasses arrangement and recording of data and the usage of several straight forward and inferential statistics systems or to describe the data and draw inferences.

The descriptive concepts include frequency distributions or cumulative frequency distributions, frequency polygons, histograms, numerous categories of charts like bar charts and pie charts, scatter diagrams, box plots among others. Software package such as SPSS, STATA, MINITAB, LIMDEP, and Microsoft excel are recommended for use during data analysis for better results (Agresti and Kateri, 2011).

b. Qualitative Data Analysis

The techniques used to analyze qualitative data include constant comparison, content analysis, and narrative analysis techniques among others. In content analysis, Bryman and Cramer, (2005) presents an method to data analysis by creating codes, applying the codes to texts, testing inter coder consistency when more than one code is used, creating a matrix of units of analysis by variable and then conduct statistical analysis of the matrix narrative analysis discovers recurrent resemblances in people’s stories (Bryman and Cramer, 2005). In content analysis, Bryman and Cramer, (2005) presents a method to data analysis by creating codes, applying the codes to texts, testing inter coder dependability when more than one code is used, creating a matrix of units of analysis by variable and then conduct statistical analysis of the matrix. Similarly constant comparative method is used to analyze data by assigning codes that reflect various categories and properties to units of data through sorting them into groups of similar meanings (Merriam, 1998). These classifications ought to mirror the aim of this research, be comprehensive and jointly limited.

vii. Preparation of the report:

Finally, the researcher has to prepare the report of what has been done by him. Writing of report must be done with great care keeping in view the following:

- a. The layout of the report should be as follows: the preliminary pages; the main text, and the end matter. In its preliminary pages the report should carry title and date followed by acknowledgements and foreword. Then there should be a table of contents followed by a list of tables and list of graphs and charts, if any, given in the report.

The main text of the report should have the following parts: Introduction: It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part, Summary of findings: After introduction there would appear a statement of findings and recommendations in non-technical language. If the findings are extensive, they should be summarised, Main report: The main body of the report should be presented in logical sequence and broken-down into readily identifiable sections, Conclusion: Towards the end of the main text, researcher should again put down the results of his research clearly and precisely. In fact, it is the final summing up. At the end of the report, appendices should be enlisted in respect of all technical data. Bibliography, i.e., list of books, journals, reports, etc., consulted, should also be given in the end. Index should also be given specially in a published research report.

- b.** Report should be written in a concise and objective style in simple language avoiding vague expressions such as ‘it seems,’ ‘there may be’, and the like.
- c.** Charts and illustrations in the main report should be used only if they present the information more clearly and forcibly.
- d.** Calculated ‘confidence limits’ must be mentioned and the various constraints experienced in conducting research operations may as well be stated.

For this research, the researcher will employ mixed methods to carry out the research. First of all, qualitative methods will be used to select the sample. A population with a particular trait was selected. The questionnaire consisting of both close open-ended questions and close ended questions, which were to be administered to a selected sample of the population. Data for the close ended questions was to be analysed using quantitative methods. However, the open ended questions were analysed using qualitative methods. These questions were to be coded for better analysis.

2.5 Framework design methodology: Design-Based Research methodology

Design Based Research is defined by Muyinda, et al. (2011) as a

“a systematic but flexible methodology aimed at improving educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories”.

The above definition, suggests one principle that sets design-based research apart from other forms of educational research, which is the commitment of researchers to develop solutions to educational problems in collaboration with practitioners. Researchers and teachers collaboratively design research-informed learning experiences for students and then study the impact of these designs on learning.

McKenney and Reeves (2012) describe three phases to the design-based research process. These processes include the following: The first phase 1. Analysis and exploration, whereby the research team focuses on problem identification and diagnosis; After the first phase, the second Design and construction, in which research team considers available knowledge about the problem and potential solutions in order to design the solution to be tested, as well as a coherent process for implementation and evaluation.; 3. Evaluation and reflection where In this stage, the research team gathers data about the impact of the innovation as it is implemented through iterative cycles of the design in order to determine local impact. This is the methodology that was adopted to develop the framework.

The above three phases can be achieved through process steps. Association of Information Systems (2007 cited in Muyinda, et al., 2011, pp. 11) described five process steps of Design Research. These process steps are the Awareness of the Problem, Suggestion, Development, Evaluation and Conclusion and are illustrated in the Figure 2.4 below;

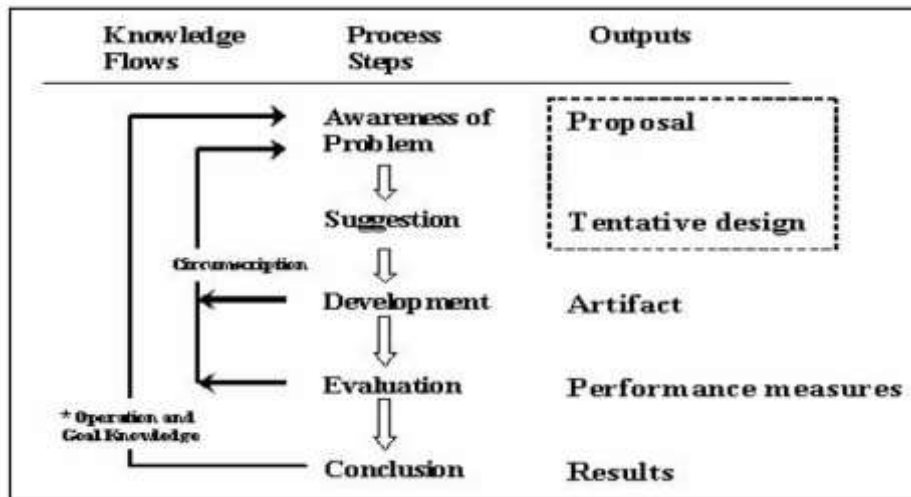


Figure 2.4: Design Research Methodology as presented by Muyinda, et al., (2011).

Under the first step of Awareness of the problem, a survey of the students and teachers is undertaken.

A semi-structured, self-administered questionnaire is used to capture data. The survey may consist of open and close ended questions. Awareness of the Problem process step was useful for gathering requirements for suggesting and developing the framework during the Suggestion and Development process steps respectively. In the Evaluation, process steps the developed framework is compared with existing M-Learning and E-Learning frameworks with a view of establishing the novelty in the research. In the Conclusion process step, conclusions of the uniqueness of the framework are drawn. Also, determination of whether there is a need for refinement of the framework is in this phase. The development of the Mobile learning framework was based on this methodology. The researcher followed each step as illustrated above to come up with the framework.

2.5 Review methodology: Systematic review

Khan et. al. (2003) explains that a review earns the adjective systematic if it is based on a clearly formulated question, identifies relevant studies, appraises their quality and summarizes the evidence by use of explicit methodology. The author further explains that it is the explicit and systematic approach that distinguishes systematic reviews from traditional reviews and commentaries. The steps in a systematic review are explained as follows:

i. Step 1: Framing questions for a review

The problems to be addressed by the review should be specified in the form of clear, unambiguous and structured questions before beginning the review work.

Once the review questions have been set, modifications to the protocol should be allowed only if alternative ways of defining the populations, interventions, outcomes or study designs become apparent

ii. Step 2: Identifying relevant work

The search for studies should be extensive. Multiple resources (both computerized and printed) should be searched without language restrictions. The study selection criteria should flow directly from the review questions and be specified a priori. Reasons for inclusion and exclusion should be recorded

iii. Step 3: Assessing the quality of studies

Study quality assessment is relevant to every step of a review. Question formulation (Step 1) and study selection criteria (Step 2) should describe the minimum acceptable level of design. Selected studies should be subjected to a more refined quality assessment by use of general critical appraisal guides and design-based quality checklists (Step 3). These detailed quality assessments will be used for exploring heterogeneity and informing decisions regarding the suitability of meta-analysis (Step 4). In addition, they help in assessing the strength of inferences and making recommendations for future research (Step 5)

iv. Step 4: Summarizing the evidence

Data synthesis consists of a tabulation of study characteristics, quality, and effects as well as the use of statistical methods for exploring differences between studies and combining their effects (meta-analysis). Exploration of heterogeneity and its sources should be planned in advance (Step 3). If an overall meta-analysis cannot be done, subgroup meta-analysis may be feasible

v. Step 5: Interpreting the findings

The issues highlighted in each of the four steps above should be met. The risk of publication bias and related biases should be explored. Exploration for heterogeneity should help determine whether the overall summary can be trusted, and, if not, the effects observed in high-quality studies should be used for generating inferences. Any recommendations should be graded by reference to the strengths and weaknesses of the evidence.

2.6 Learning Theories

Nichols (2003) describes a theory as a set of hypotheses that apply to all instances of a particular phenomenon, assisting in decision-making, philosophy of practice and effective implementation through practice. Theories of learning are “empirically-based accounts of the variables which influence the learning process and provide explanations of the ways in which that influence occurs” (Mayes & de Freitas, 2005). From the above definitions, it is observed that theory provides a general explanation for observations made over time, explains and predicts behaviour, can never be established beyond all doubt, and may be modified. There are various learning theories, but three categories remain dominant: Behaviorism, Cognitivism, and Constructivism. This study was based on these three learning theories. The theories relate to each other as follows;

2.6.2 Behaviourism Theory

E-Learning programs had been designed based on a behaviourist technique to learning. The behaviourist institution of inspiration, influenced through Thorndike (1913), Pavlov (1927), and Skinner (1974), claims that learning is a transformation in observable behaviour triggered by external stimuli within the environment (Skinner, 1974). The behaviourist school of thought sees the mind as a black box, in the sense that a response to a stimulus can be observed quantitatively, thereby ignoring the effect of thought processes occurring in the mind. This school, therefore, looks at overt behaviours that can be observed and measured as indicators of learning (Good & Brophy, 1990).

Behaviourism assumes that a learner is essentially passive, responding to environmental stimuli. Hence in behaviourism, it is believed that a learner starts out with a clean slate, and behaviour is shaped by positive and negative reinforcement. This reinforcement, whether positive or negative, increases the possibility of an event happening again. Positive reinforcement is the application of a stimulus while Negative reinforcement is the withdrawal of a stimulus. Similarly, a punishment which is the opposite of reinforcement decreases the possibility of an event happening again. Behaviourism can take up many forms (Schunk, 2012). These forms are; connectionism, Classical Conditioning, Contiguous Conditioning, Operant conditioning, and Instructional Applications.

i. Connectionism behaviourism:

The connection behaviourism was a theory by Edward L. Thorndike (1874–1949). The researcher explained that connectionism is of two types namely “Try and error” and the “Laws of exercise and effect”. In try and error, the researcher suggested that the most fundamental type of learning involves the forming of connections between sensory experiences that is perceptions of stimuli or events and neural impulses (responses) that manifest themselves behaviorally (Thorndike, 1913a, 1913b, 1914). The researcher believed that learning often occurs by trial and error (selecting and connecting) and hence Trial-and-error learning occurs gradually (incrementally) as successful responses are established and unsuccessful ones are abandoned. Connections are formed mechanically through repetition; conscious awareness is not necessary.

This theory is applicable in learning technological systems in a sense that the more one uses a system, the more they find it easy and useful to use.

Thorndike (1913a, 1913b, 1914) explained that basic learning involved the laws of exercise and effect. The Law of Exercise has two parts: The Law of Use which explains that a response to a stimulus strengthens their connection; the Law of Disuse which explains that when a response is not made to a stimulus, the connection’s strength is weakened (forgotten). From the above it is observed that the longer the time interval before a response is made, the greater is the decline in the connection’s strength. While the Law of Effect explains that when a modifiable connection between a situation and a response is made and is accompanied or followed by a satisfying state of affairs, that connection’s strength is increased: When made and accompanied or followed by an annoying state of affairs, its strength is decreased. The above look more similar, but are differentiated by the fact that The Law of Effect emphasizes the consequences of behaviour: Responses resulting in satisfying (rewarding) consequences are learned; responses producing annoying (punishing) consequences are not learned.

ii. Classical Conditioning:

Schunk (2012) explained that Classical conditioning is a multistep procedure that initially involves presenting an unconditioned stimulus, which elicits an unconditioned response. The classical condition theory was advanced by Pavlov presented a hungry dog with meat powder as unconditioned stimulus, which would cause the dog to salivate hence the unconditioned response. To condition the animal required repeatedly presenting an

initially neutral stimulus for a brief period before presenting the unconditioned stimulus. Pavlov then replaced the meat powder with a ticking metronome as the neutral stimulus. In the early trials, the ticking of the metronome produced no salivation. Eventually, the dog salivated in response to the ticking metronome prior to the presentation of the meat powder. The metronome had become a conditioned stimulus that elicited a conditioned response similar to the original unconditioned response.

Repeated non-reinforced presentations of the conditioned stimuli without the unconditioned stimulus caused the conditioned response to diminish in intensity and disappear. Pavlov (1927, 1928) believed that any perceived stimulus can be conditioned to any response that can be made. Subsequent research has shown that the generality of conditioning is limited. Within any species, responses can be conditioned to some stimuli but not to others. Conditioning depends on the compatibility of the stimulus and response with species-specific reactions (Hollis, 1997). All organisms inherently possess the basic behavioural patterns that enable them to survive in their niches, but learning provides the fine-tuning necessary for successful adaptation (Garcia and Garcia, 1985).

iii. Contiguous Conditioning:

This conditioning was a behavioural perspective on learning by Edwin R. Guthrie (1886–1959), who postulated learning principles based on associations (Guthrie, 1940). The researcher expressed that the key behaviours under contiguous conditioning were acts and movements. Guthrie's basic principles reflect the idea of contiguity of stimuli and responses: A combination of stimuli which has accomplished a movement will on its recurrence tend to be followed by that movement. (Guthrie, 1952, p. 23), alternatively, Stimulus patterns which are active at the time of a response tend, on being repeated, to elicit that response. (Guthrie, 1938, p. 37).

Movements are discrete behaviours that result from muscle contractions. Guthrie distinguished movements from acts or large-scale classes of movements that produce an outcome. For example playing the piano and using a computer are acts that include many movements. A particular act may be accompanied by a variety of movements; the act may not specify the movements precisely. In basketball, for example, shooting a basket (an act) can be accomplished with a variety of movements.

Contiguity learning implies that a behaviour in a situation will be repeated when that situation recurs (Guthrie, 1959); however, contiguity learning is selective. At any given moment, a person is confronted with many stimuli, and associations cannot be made to all of them. Rather, only a small number of stimuli are selected, and associations are formed between them and responses. The contiguity principle also applies to memory. Verbal cues are associated with stimulus conditions or events at the time of learning (Guthrie, 1952). Forgetting involves new learning and is due to interference in which an alternative response is made to an old stimulus.

Associative Strength is contended in Guthrie's theory that learning occurs through the pairing of stimulus and response. Guthrie (1942) explained that stimulus pattern gains its full associative strength on the occasion of its first pairing with a response. The Author rejected the notion of associations through frequency, as embodied in Thorndike's original Law of Exercise. The author explained that that much as it is believed that people learn complex behaviours by performing them once, initially one or more movements become associated. Repetition of a situation adds movements, combines movements into acts, and establishes the act under different environmental conditions.

Guthrie (1942) explained that Contiguous Conditioning should not involve rewards and punishments. The researcher believed that responses do not need to be rewarded to be learned. The researcher explained that key mechanism is contiguity or close pairing in time between stimulus and response. The response does not have to be satisfying; a pairing without consequences could lead to learning. Guthrie (1952) disputed Thorndike's Law of Effect because satisfiers and annoyers are effects of actions; therefore, they cannot influence the learning of previous connections but only subsequent ones. Rewards might help to prevent unlearning (forgetting) because they prevent new responses from being associated with stimulus cues.

Behaviourism theory requires the teacher to give the learner immediate feedback, break down the task into small steps, repeat the directions as many times as possible, work from the most simple to the most complex tasks, give positive reinforcement, skinner believed that positive reinforcement is more effective in changing behaviour than punishment. All of these are to be adjusted to be age appropriate. On the other hand, students are expected to respond to reinforcement put in place by the instructor, pace themselves in an assignment to work from

the most basic to the more complicated concepts, ask questions for more clarity in directions and also ask for feedback. Hence behaviourism can be applied in mobile learning by ensuring that tasks are sub divided in smaller but meaningful tasks and a reward system is in place to encourage learners.

2.6.3 Cognitivist Theory

Cognitive theorists see learning as an interior procedure, and contend that the amount realized relies on the processing capacity of the learner, the quantity of effort expended in the course of the learning method, the depth of the processing (Craik & Lockhart, 1972; Craik & Tulving, 1975), and the learner's present expertise constitution. Cognitivists see learning as an internal process that involves memory, thinking, reflection, abstraction, motivation, and metacognition. Cognitive psychology looks at learning from an information processing point of view, where the learner uses different types of memory during learning. Sensations are received through the senses into the sensory store before processing occurs.

The information temporarily stored in the sensory store for less than one second, and if it is not transferred to working memory immediately, it is lost (Kalat, 2007, cited in Ally, 2004). Hence the cognovits suggest that online instruction must use strategies to allow learners to attend to the learning materials so they can be transferred from the senses to the sensory store and then to working memory. Kalat (2007) cited in (Ally 2004) explained that the amount of information transferred to working memory depends on the amount of attention that was paid to the incoming information and whether cognitive structures are in place to make sense of the information. The author further explained that the duration in working memory is approximately 20 seconds, and if the information in working memory is not processed efficiently, it is not transferred to long-term memory for storage.

As indicated above, memory is given a prominent role in the learning process. Learning results when information is stored in memory in an organized, meaningful manner. Teachers/designers are responsible for assisting learners in organizing that information in some optimal way. Ertmer and Newby (1993) explained that designers should use techniques such as advance organizers, analogies, hierarchical relationships, and matrices to help learners relate new information to prior knowledge.

2.6.4 Constructivism

The nature of knowing a philosophical viewpoint of Constructivism (Piaget, 1950). The author further explains that there are many types of constructivism, but the most prominent focuses on how humans make meaning in relation to the interaction between their experiences and their ideas. Constructivism is not a pedagogy, but rather it is often associated with pedagogic approaches that promote active learning, or learning by doing. Constructivism is a theory describing how learning happens, regardless of whether learners are using their experiences to understand a lecture or following the instructions for building a model airplane. In both cases, the theory of constructivism suggests that learners construct knowledge out of their experiences. Constructivism has influenced a number of disciplines, including psychology, sociology, education and the history of science. Eddy (2004), explains that during its infancy, constructivism examined the interaction between human experiences and their reflexes or behaviour-patterns. Piaget (1950) called these systems of knowledge schemes. The formalization of constructivism from a within-the-human perspective is generally attributed to Piaget (1950) because the author articulated mechanisms by which information from the environment and ideas from the individual interact and result in internalized structures developed by learners. Piaget (1950) identified processes of accommodation and assimilation that are key in this interaction as individuals construct new knowledge from their experiences.

During the process of assimilation, when individuals assimilate new information, they incorporate it into an already existing framework without changing that framework. This may occur when individuals' experiences are aligned with their internal representations of the world, but may also occur as a failure to change a faulty understanding; for example, they may not notice events, may misunderstand input from others, or may decide that an event is a fluke and is therefore unimportant as information about the world. In contrast, when individuals' experiences contradict their internal representations, they may change their perceptions of the experiences to fit their internal representations. According to the constructivism theory, accommodation is the process of reframing one's mental representation of the external world to fit new experiences.

Accommodation is the mechanism by which failure leads to learning: when we act on the expectation that the world operates in one way and it violates our expectations, we often fail, but by accommodating this new experience and reframing our model of the way the world works, we learn from the experience of failure, or others' failure.

For constructivist theory to be effective in learning the learning process, the following factors should be put into consideration;

- i. **The nature of the learner:** Wertsch (1997) explains that social constructivism does recognise the uniqueness and complexity of the learner. The author further explains that this theory encourages, utilizes and rewards the learner as an integral part of the learning process. Therefore, the nature of the learner must come first for learning process to be effective. By this, it implies that the social status of the learner must be the first point of analysis.
- ii. **The importance of the background and culture of the learner:** For the trainer to be able to understand the nature of the student, background and culture of the learner should be put into consideration. Social constructivism encourages the learner to arrive at his or her version of the truth, influenced by his or her background, culture or embedded world view. Historical developments and symbol systems, such as language, logic, and mathematical systems, are inherited by the learner as a member of a particular culture and these are learned throughout the learner's life (Wertsch, 1997). This also stresses the importance of the nature of the learner's social interaction with knowledgeable members of the society. It is observed that without the social interaction with other more knowledgeable people, it is impossible to acquire social meaning of important symbol systems and learn how to utilize them. Young children develop their thinking abilities by interacting with other children, adults and the physical world. From the social constructivist viewpoint, it is thus important to take into account the background and culture of the learner throughout the learning process, as this background also helps to shape the knowledge and truth that the learner creates, discovers and attains in the learning process (Wertsch 1997).
- iii. **Responsibility for learning:** Glasersfeld, (1989) argued that the responsibility of learning should reside increasingly with the learner.

Social constructivism thus emphasizes the importance of the learner being actively involved in the learning process, unlike previous educational viewpoints where the responsibility rested with the instructor to teach and where the learner played a passive, receptive role. Glasersfeld (1989) emphasized that learners do construct their own understanding and that they do not simply mirror and reflect what they read.

Learners look for meaning and will try to find regularity and order in the events of the world even in the absence of full or complete information.

- iv. **Use of discussion groups:** Discussions involve students seated in a circle, motivating and controlling their own discussion. The teacher / instructor acts as little as possible. Perhaps the teacher's only function is to observe, although he/she might begin or shift or even direct a discussion. The students get it rolling, direct it, and focus it. They act as a team, cooperatively, to make it work. They all participate, but not in a competitive way. Rather, they all share in the responsibility and the goals, much as any members share in any team sport. Although the goals of any discussion will change depending upon what's under discussion, some goals will always be the same: to illuminate the subject, to unravel its mysteries, to interpret and share and learn from other points of view, to piece together the puzzle using everyone's contribution. Discussion skills are important. Everyone must be aware of how to get this discussion rolling and keep it rolling and interesting. Just as in any sport, a number of skills are necessary to work on and use at appropriate times. Everyone is expected to contribute by using these skills.

- v. **The motivation for learning:** Another crucial assumption regarding the nature of the learner concerns the level and source of motivation for learning. According to Glasersfeld (1989), he explained that sustaining motivation to learn is strongly dependent on the learner's confidence in his or her potential for learning. These feelings of competence and belief in potential to solve new problems, are derived from first-hand experience of mastery of problems in the past and are much more powerful than any external acknowledgment and motivation (Prawat and Floden 1994).

- vi. **Instructors as facilitators:** In a constructivist approach, instructors have to adapt to the role of facilitators and not teachers (Bauersfeld, 1995). This means that whereas a teacher gives a didactic lecture that covers the subject matter, a facilitator helps the learner to get to his or her own understanding of the content. In the former scenario the learner plays a passive role and in the latter scenario the learner plays an active role in the learning process. The emphasis thus turns away from the instructor and the content, and towards the learner (Gamoran, Secada, & Marrett, 1998).

This dramatic change of role implies that a facilitator needs to display a totally different set of skills than that of a teacher (Brownstein 2001). A teacher tells, a facilitator asks; a teacher lectures from the front, a facilitator supports from the back; a teacher gives answers according to a set curriculum, a facilitator provides guidelines and creates the environment for the learner to arrive at his or her own conclusions; a teacher mostly gives a monologue, a facilitator is in continuous dialogue with the learners (Rhodes and Bellamy, 1999).

- vii. **The nature of the learning process:** Social constructivist scholars do view learning as an active process where learners should learn to discover principles, concepts and facts for themselves, hence the importance of encouraging guesswork and intuitive thinking in learners (Brown et al.1989; Ackerman 1996). In fact, for the social constructivist, reality is not something that we can discover because it does not pre-exist prior to our social invention of it. Kukla (2000) argues that reality is constructed by our own activities and that people, together as members of a society, invent the properties of the world. Other constructivist scholars agree with this and emphasize that individuals make meanings through the interactions with each other and with the environment they live in. Knowledge is thus a product of humans and is socially and culturally constructed (Ernest 1991; Prawat and Floden 1994). McMahon (1997) agrees that learning is a social process. He further states that learning is not a process that only takes place inside our minds, nor is it a passive development of our behaviors that is shaped by external forces and that meaningful learning occurs when individuals are engaged in social activities. Vygotsky (1978) also highlighted the convergence of the social and practical elements in learning by saying that the most significant moment in the course of intellectual development occurs when speech and practical activity, two previously completely independent lines of development, converge.

Through practical activity a child constructs meaning on an intra-personal level, while speech connects this meaning with the interpersonal world shared by the child and her/his culture.

- viii. **Dynamic interaction between task, instructor and learner:** A further characteristic of the role of the facilitator in the social constructivist viewpoint, is that the instructor and the learners are equally involved in learning from each other as well (Holt and Willard-Holt 2000). This means that the learning experience is both subjective and objective and requires that the instructor's culture, values and background become an essential part of the interplay between learners and tasks in the shaping of meaning. Learners compare their version of the truth with that of the instructor and fellow learners to get to a new, socially tested version of truth (Kukla 2000). The task or problem is thus the interface between the instructor and the learner (McMahon 1997). This creates a dynamic interaction between task, instructor and learner. This entails that learners and instructors should develop an awareness of each other's viewpoints and then look to their own beliefs, standards and values, thus being both subjective and objective at the same time (Savery 1994).
- ix. **Collaboration among learners:** Learners with different skills and backgrounds should collaborate in tasks and discussions to arrive at a shared understanding of the truth in a specific field (Duffy and Jonassen 1992). Most social constructivist models, such as that proposed by Duffy and Jonassen (1992), also stress the need for collaboration among learners, in direct contradiction to traditional competitive approaches. One Vygotskian notion that has significant implications for peer collaboration, is that of the zone of proximal development. Defined as the distance between the actual developmental level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers, it differs from the fixed biological nature of Piaget's stages of development. Through a process of 'scaffolding' a learner can be extended beyond the limitations of physical maturation to the extent that the development process lags behind the learning process (Vygotsky 1978).

The research has put these requirements into consideration while coming up with the framework. This mainly to the fact that the learning theories predict the behaviour of students and are core to how students will adopt and use the mobile learning service. The above learning theories are to be used as a guide to come up with the sub-components of the framework.

2.7 Diffusion of Innovation Theory

The Diffusion of Innovation Theory (DOI) is one of the most popular theories for studying adoption of information technologies (IT) and understanding how IT innovations spread within and between communities (Rogers, 1995). According to the theory, an innovation is any idea, process or object perceived as new by the intended user (Rogers, 1995). Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1995). Similarly, Daft (1978) defines an organizational innovation as the adoption of an idea or behaviour that is new to the organization adopting it. Therefore, an innovation need not necessarily refer to a technology; it may refer to a renewal in terms of thought and action as well. Roger (1995) described steps that an individual go through from his first knowledge of such innovation, his attitude to acceptance or rejection, to the decision to implement the new idea. The user's final decision to accept and implement an innovation is influenced by different factors.

Rogers (1995) identified the five user-perceived attributes that consistently proved to be determinants of success of an IT innovation: relative advantage, compatibility, complexity, trialability and observability.

- i. Relative advantage is the degree to which the user perceives benefits or improvements on the existing technology by adopting an innovation.
- ii. Compatibility deals with how the intended users perceive the innovation will fit into their set of values, needs and experiences.
- iii. Complexity is the ease or the way the innovation might be learned by the intended user.
- iv. Trialability is the ability of an innovation to be put on trial without total commitment and with minimal investment. Finally,
- v. Observability refers to the positive outcomes intended users can see from the implementation of such innovation.

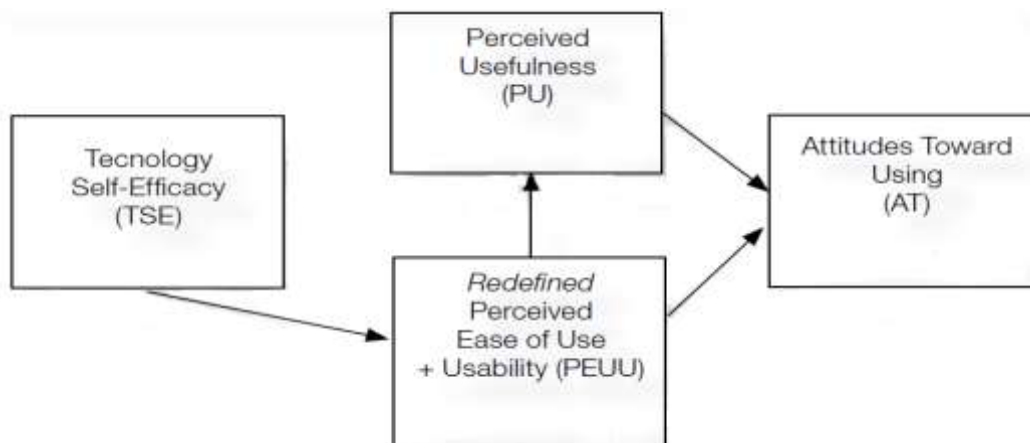
An important part of the analysis and design of any information system is justifying and demonstrating the effectiveness the information system.

This research builds on the DOI theory to evaluate the success and significances of mobile learning in a university setting.

In conclusion, the review of the Diffusion of Innovation theory provides the researcher with steps and guidelines for engaging individuals and organizations to support both willingness and ability to use the framework, thus helping to improve the likelihood that the framework would be adopted.

2.8 Usability Model

Holden and Rada (2011), explain that the Technology Acceptance Model (TAM) represents how users come to accept and use a given technology and can be applied to teachers' use of educational technologies. The TAM is a theoretical model that predicts how a user comes to accept and use a given information technology. It specifies casual relationships among external variables, belief and attitudinal constructs, and actual usage behaviour (Davis, 1989). The model suggests that when users are presented with a particular information technology, a number of factors, notably perceived usefulness and perceived ease of use, influence their decision of how and when they will use the technology. Holden and Rada (2011) refined the TAM in order to specifically address the teachers' usability of technology. The authors suggested the model below;



Usability and Technology Self-Efficacy model as presented by Holden and Rada (2011)

The above model considered the influence of perceived usability on teachers' technology acceptance. Secondly, it addressed the influence of teachers' technology self-efficacy on their technology acceptance. Hence, the model extends the currently accepted TAM by incorporating usability and contributes to our understanding of how and why teachers are using the available technologies. The above model helped the researcher in ensuring that the developed framework was usable.

CHAPTER THREE

METHODOLOGY

In this chapter, the researcher gives the methodology that was used in doing this research. It explains the research and framework development methodologies, target population, and sampling procedures including the sampling techniques and sample size. Data collection methodologies used namely oral interview and questionnaires are explained. In addition data analysis, framework requirements analysis and design, implementation and testing methodologies are also highlighted.

3.1 Research design:

The Mixed-method research methodology which entails both qualitative and quantitative research was used. The qualitative part of the mixed methods research was suitable because it assisted in obtaining in-depth understanding of underlying processes. The quantitative part of the mixed methods help collect statistical data about the variations in perceptions of users involved in these processes, from which requirements to develop a framework for integration of mobile devices in E-Learning were gathered can be gotten (Sandelowski, 2000). These could not have been obtained if either qualitative or quantitative approaches were only applied independently. Mixed methods also provided more comprehensive evidence (such as the purpose for carrying out this research) for reviewing the research problem than either quantitative or qualitative research only if used. Qualitative research approach was used to figure out a complete understanding of the existing E-learning systems and infrastructure, and their complications as well as the views and requirements of the stakeholders for the new framework. Much as this research was mixed design, it was more biased towards quantitative methods because the research intended to understand the underlying statistical reasons.

3.2 Study population

Uganda Martyrs University has an estimated student population of 3500 students, lecturer's population about 250 lecturers and 3 Systems Administrators. The study purposively targeted Masters Students mainly because the researcher could reach this targeted population quickly. The survey was purposive in nature because the researcher survey part of the population that he believed had basic computer usage skills.

3.3 Sampling Procedures

Sampling procedures refer to the techniques used to determine the sample size and the methods that will be used to select the sample. The techniques used to select the sample for this study are explained below;

i. Sample size

Sample size refers to the number of observation to include in a sample (Kothari, 2004). In this research was determined using a method presented by Isreal (1992). This method was chosen because the same author recommends it to be used if a one needs to pick a sample from a big population size, where the variance and standard deviation is not known. The sample size was calculated based on the confidence interval, confidence level and maximum validity (P). Isreal (1992) defines the confidence interval (also called margin of error) as the plus-or-minus figure usually reported in a given survey results. The same author defines confidence level tells you how sure you can be. Confidence level is expressed as a percentage and represents how often the true percentage of the population who would pick an answer lies within the confidence interval. Due to the big population size, the calculation for the sample size took into account the following, 10% confidence interval (Margin of Error), 95% confidence level, $P = 0.5$ (where p is the maximum variability) (Isreal, 1992), and population size = 3753, and formula for calculation is $\text{Sample Size} = ((Z\text{-score})^2 * \text{Standard deviation} * (1 - \text{Standard deviation})) / (\text{Margin of error})^2$. Therefore relying on published tables, the sample size of the study was determined as 97 respondents (Isreal, 1992, p. 3 Table 1.).

ii. Sampling technique

The researcher used probability sampling techniques in particular Stratified Sampling. The choice of using stratified sampling is because the non-homogenous population constitutes of three categories that is Systems administrators, Lectures and students. Kothari (2004) explained that if a population from which a sample is to be drawn does not constitute a homogeneous group, stratified sampling technique is applied in order to obtain a representative sample. Under stratified sampling the population was divided into three strata each stratum constituting of individuals with the same characteristics. Elements were then selected from each stratum to constitute a sample. MacDonald and Headlam (2014), suggested the stratified sampling technique using a stratified random sampling formula which was used to find the sample size of respondents to participate in the research. The formula recommend by the same authors is illustrated below;

Sample size of the strata = size of entire sample / population size * layer size. This can also be expressed as

$$\tau_h = \left[\left(\frac{N_h}{N} \right) \times \tau \right]$$

Where τ_h is the sample size for stratum h, N_h is the population size of the stratum h, N is the total population size and τ is the total sample size.

Using the above formula, the sample was distributed in the different strata as shown in Table 3.1 below;

Table 3.1: Obtaining the sample size for each strata

Category	Population	Illustration	Sample size
Lecturers	250	$\frac{97}{3753} \times 250$	6
Students	3500	$\frac{97}{3753} \times 3500$	90
Systems Administrators	3	$\frac{97}{3753} \times 3$	0.077

It is observed from the above table that the sample size of the systems administrators is very small. The researcher choose to interview two (2) systems administrators because they are stakeholders in the operation of the Moodle Learning Management System. More so, the researcher interviewed two (2) pedagogy experts for the study.

3.4 Data collection Methods and instruments

Data collection method refers to the ways how data was collected while instruments refers to the tools used to collect the data (Kothari, 2004). Some of these tools include questionnaires, document review guide and oral interview guide. A questionnaire survey tool with both closed-ended and open questions was used to collect both quantitative and qualitative data respectively on the factors contributing to the preferences of Lecturers and Students as regard to the current E-Learning system and requirements of the proposed framework. These questions were selected based on questions used in similar research by Hamann (2015) which focused on the construction and validation of an m-learning framework for online and blended learning environments. The choice of close ended question was to obtain the statistics, from which in an attempt to explain what was observed is got from. For open ended question was to obtain a detailed description of what is observed from the respondents' response (MacDonald and Headlam, 2014). The questionnaire was also used to collect responses as regards Moodle Learning Management System. The usage of these tools is explained as follows;

3.4.1 Document Review

The document review method was used because the data found in existing documents was considered consistent and certifiable. During this research the relevant UMU documents were reviewed namely; Institution's academic policy, Moodle management records, E-Learning policies, and manuals of the existing Moodle Learning Management System. Information about Moodle Learning Management System's management policies and procedures was collected from these documents. This was aimed at identify the strengths and weaknesses in the system. Material contained in official and unofficial documents made it possible to organize and make comparisons between ideal conceptualizations of the current system being use for E-Learning and actual explanations made by Lecturers, Students and Systems administrators. A document review guide was provided for in **Appendix VI**.

3.4.2 Questionnaire

Questionnaires were administered to both students and lectures. These questionnaires helped in accessing and collecting information from them instantaneously in a short period of time. Also, the questionnaires maintained consistency as all participants received similar questions as those of the other colleagues. The specific questionnaire were administered to the respondents according to the usage status of the respondent. Hence respondents were divided into four categories. These categories included Lecturers that have used Moodle, Lecturers that have not used Moodle, students that have used Moodle and students that have never used Moodle.

The questionnaire in **Appendix I** was administered to 87 students to investigate the training of usage, ease of use and usefulness of Moodle Learning Management System. The same questionnaire investigated difficulties faced during the usage of the Moodle learning Management system. It was also meant to find out Students' requirements about the introduction of mobile devices to access the Moodle Learning Management System. The questionnaire contained close ended questions which were used to collect data that could be subjected to statistical data analysis. The questionnaire was composed of two sections. The first section was about the students' perceptions on the existing Moodle Learning Management System. Perceptions are important because the researcher is able to measure magnitude of how widespread is a given practice (Tilahun, 2009). The second section contained questions that were used to establish the gaps in the existing the usage of the system.

The second part also captured the requirements for introduction and usage of Mobile devices in accessing the learning Materials. Similar to the students' questionnaire, the questionnaire in **Appendix II** was used to capture the Lecturers' perceptions of the usage of the Moodle Learning Management System. The Lecturers' questionnaire had the same structure as that of the students that is first section was about the Lecturers perceptions on the existing Moodle Learning Management System. The second section contained questions that were used to establish the gaps in the existing the usage of the system and requirements for usage of mobile devices in learning processes.

Students or Lecturers that had not used the Moodle Learning Management system, a different questionnaire was presented to them. The questionnaire was tailor made to collect information such as whether the participant had been trained on how to use the Moodle Learning Management System, the reasons for not using the system, and requirements for the usage of Mobile devices to access the learning management system. The questionnaire for students in **Appendix III** was administered to students who had not used Moodle Learning Management System, while the one administered to Lecturers that had not used Moodle is as shown in **Appendix IV**.

3.4.3 Oral Interview

Face to face oral interviews were held with the systems administrators and pedagogy experts. The systems administrators were selected because they are critical in the operations of Moodle learning management system in the institution. Pedagogy experts were chosen because the researcher intended to come up with a framework that incorporates pedagogy. The interview method was used because it gives opportunity to the researcher to seek detailed answers, and both the interviewer and the respondent can seek clarification where need be. Oral interviews provided comparable qualitative data (macdonald and headlam, 2014). This not only helped the researcher to obtain first hand and in-depth information, but also collected information about the challenges, problems and gaps in the current E-Learning system. Individuals who were interviewed are systems administrators in charge of the operations of the Moodle management system and the network infrastructure on the UMU main campus and Rubaga campus. They provided in depth information about the current system including its strengths and weaknesses.

The interview process created a level of interpersonal relationship that advanced an understanding with the systems administrator on student results. A semi-structured oral interview guide as shown in **Appendix V** was applied.

3.5 Data Analysis

Data analysis is the process a researcher used to diminish large amounts of data to make sense of them (Zhenming, Liang and Guohua, 2003). Data analysis was carried out to gain insight of the process and practices of operating and usage of the Moodle Learning Management System. In this research, data analysis involved analysis and interpretation of both qualitative and quantitative data.

i. Qualitative data analysis

O'Connor and Gibson (2014) explain that formal systems for the analysis of qualitative data have been developed in order to help researchers get at the meaning of their data more easily. These systems involve: coding techniques for finding and marking the underlying ideas in the data; grouping similar kinds of information together in categories; relating different ideas and themes to one another. In this research, Atlas.ti software was used to analyse the qualitative data. The first step was organizing the Data: here the researcher refers to the interview guide. The researcher Identifies and differentiates between the questions/topics that are to be answered. The next step is Finding and Organizing Ideas and Concepts: The researcher identifies salient themes, recurring ideas or language, and patterns of belief that link people and settings together. Then the researcher buildings over-arching themes in the Data in the next step; each of the response categories has one or more associated themes that give a deeper meaning to the data. Different categories can be collapsed under one main over-arching theme. The researcher then ensures Reliability and Validity in the Data Analysis and in the Findings. Validity: The accuracy with which a method measures what it is intended to measure and yields data that really represents "reality". Reliability: The consistency of the research findings. Finding Possible and Plausible. Finally, Explanations of the Findings are made: The researcher makes a summary of the findings and the themes. This summary should address the following: Are these findings what you were expecting, based on the literature, Were there any major surprises in the findings? How are they different/similar to what is stated in the literature from other similar studies?

ii. Quantitative data analysis

The quantitative data analysis was carried out. This involves the techniques by which researchers convert data to numerical forms and subject them to statistical analyses. The data was first prepared by being inspected for completeness and consistency. Incomplete questionnaires (those missing over 10% of the total response (Babbie, 2010).) were then eliminated. Data was then entered into Microsoft excel software. The data was then coded, followed by data quantification. Babbie, (2010) defines quantification of data as the numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect.

3.6 Framework development methodology

The framework was developed using the design-based research process. This process is presented by McKenney and Reeves (2012) as a three phase process.

Phase One: Analysis and exploration

The first phase is the Analysis and exploration, whereby the researcher focuses on problem identification and diagnosis; the first step in design research was to identify and explore a significant educational problem. A practical question was considered that is: What is the educational problem that the research will address? In the first phase, stakeholders (such as teachers, students and systems administrators) and researcher together explored the nature of the problem they were facing. It was important for practitioners to be involved in this phase so that the full extent of the problem is known, rather than being interpreted solely by researchers. Questions such as the following helped to focus this aspect of the enquiry: Which individuals are knowledgeable about the problem?, What data will be collected from these practitioners?, What questions will be asked?, How will these data be analysed?. A literature review is also conducted in this phase to refer to the work that has already been done in the area or in related areas, and how similar problems might have been addressed in another field. After this initial investigation of the problem, related literature and practitioners' ideas, it should be possible to create research questions to guide the research.

By the end of this phase, there is a clear description of the problem and its educational context, a literature review, a summary analysis of practitioners' views, and preliminary research questions.

Phase two: Design and construction

The second phase was the Design and construction, in which research team considered available knowledge about the problem and potential solutions. In the second phase of design research, a solution to the problem (or intervention) is proposed that can be implemented in the educational setting. In order to create the solution, the literature was consulted to find relevant theory that can guide thinking, as well as locate existing design principles that may have addressed a similar problem. The second literature review process was a critical stage in design research. This was because it facilitated the creation of draft design guidelines to inform the design and development of the intervention that sought to address the identified problem. Other researchers may have addressed a similar problem and determined design principles of relevance. A more focussed literature search helped to locate these specific principles. The next step is to create a list of draft principles to guide the design of the intervention or solution to the problem that was explored in Phase 1. This step required analysis, as there was a need to combine theory of learning with existing principles, as well as the ideas collected from the practitioners. Once the draft principles have been created, it is important to consider the best way to deliver or operationalize the intervention within the learning environment.

Often the intervention is technology-based, so innovative technologies is part of the solution. A guiding question at this stage is such as what technologies appear most useful for operationalizing or implementing the intervention? Think about technologies is useful for the students to use as cognitive tools as well as for delivery of content, Once the draft principles have been created, the proposed solution is designed and developed (according to the draft principles) ready for implementation. The design of the learning environment when the design principles that guide the creation of the learning environment are set, consideration how each will be instantiated in the learning setting takes place. By the end of this phase, design principles had been produced, appropriate delivery technologies selected, and a solution to the problem was developed ready for implementation in the learning environment.

Phase three: Evaluation and reflection

This was the final phase whereby in this stage, the research team was to gather data about the impact of the innovation as it is implemented through iterative cycles of the design in order to determine local impact. The solution designed in Phase 2 is implemented and evaluated in iterative cycles in Phase 3.

The iterative nature of design research means that a single implementation was not sufficient to gather enough evidence about the success of the intervention and its effect on the problem situation. A typical design research study has two or more cycles, where after the first implementation and evaluation, changes are made to the learning design to further improve its ability to address the problem. The first implementation evaluation is planned in much the same way as any research study, where choice of participants, and data collection and analysis strategies are selected in relation to the research questions. After the first implementation of the solution and the analysis of the data, evidence on the success or otherwise of the approach was to be collected. A review of this evidence enables changes to be made to the intervention to improve it. Often the refined second implementation is quite similar to the first but with a different group of students (such as the next time the unit or course runs). The data collected may be the same, or could be modified because of the analysis and findings.

3.7 Evaluation of the framework

The usability model by Holden and Rada (2011) was applied to evaluate the framework so as to ensure that it satisfied the user requirements. Likewise, the researcher used the Diffusion Of Innovation theory (DOI) by Rogers (1995) since it was helpful in defining the steps involved in evaluating and adopting the framework developed as a result of this research undertaking. Also, the DOI allowed timely and practical feedback to be given for further implementation of the system. Furthermore, the theory identified five user-perceived attributes for adopting the system that consistently proved to be determinants for the success of the evaluation of the system. These included; relative advantage, compatibility, complexity, trialability and observability.

3.8 Ethical Considerations

The protection and respect of rights of all study participants were a priority in this study. Participants were clearly be informed about the purpose of the study and benefits and they were assured of anonymity. To ensure privacy and confidentiality and protect respondents, their names were not obtained and the questionnaires were not labelled in any way in the process of data collection. Most important, respondents' participation in the study was voluntary and they were allowed to stop the survey or refuse to answer questions that they did not want to answer.

This was to ensure that the respondents' right of self-determination were not violated. Informed consent was obtained either verbally or in writing from the respondents before participating in the study.

CHAPTER FOUR

PRESENTATION OF RESULTS, ANALYSIS, DISCUSSION OF FINDINGS, AND DESIGN OF FRAMEWORK

This chapter presents the findings of the survey on factors that influenced usage of Moodle Learning Management System among students and lecturers at Uganda Martyrs University. The findings led to the development of a framework that guides institutions of higher learning on how mobile devices could be used to enhance electronic learning. The framework is developed based on Design Research methodology by McKenney and Reeves (2012), in which the first phase is Analysis and exploration; in this phase, the researcher focuses on problem identification and diagnosis. The second phase is Design and construction, in which researcher considers available analysis about the problem and develops the framework; Main activities in this phase include suggestions for components of the framework, development, and integration of components of the framework. The final stage of the design research methodology is Evaluation and reflection. In this phase, the research team gathers data about the impact of the innovation as it is implemented through iterative cycles of the design in order to determine local impact.

4.1 Analysis of Data Collection Results

Data collected using semi-structured questionnaires was analysed using Microsoft excel program. The questionnaires were customised to individuals who had used Moodle learning management system and their colleagues that had not used the system. The questionnaire consisted of close-ended questions. The questionnaires collected data on Moodle Learning Management System usage, training of users, mobile learning needs. Requirements for constructing the sub-components and components of the framework for mobile learning were deduced from the findings. These findings are discussed as follows;

4.1.1 Moodle Learning Management System ease of usage

Davis (1989) explains that technology can easily be adopted if it can easily be used and if found useful to the user. The first questions of the survey inquired about the ease of use and usefulness of Moodle learning management system. The survey findings indicate that the Moodle Learning Management System has been used by both students and lecturers.

The respondents who have used the Moodle Learning Management System include 3 students and 2 lecturers. It is from these respondents that we investigated how easy and useful it was to use the system. The results from lecturers' survey are shown in the Table 4.1 below;

Table 4.1 Lecturer's perceptions on usage of Moodle LMS

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not used
I easily navigate the Moodle Learning Management system		2				
I easily upload learning materials and assessment materials in the Moodle Learning Management system	2					
Moodle Learning Management system has improved student learning		1	1			
Moodle Learning Management system has made course management easier		2				
I recommend Moodle Learning Management system to colleagues		2				

From Table 4.1 above, it is observed that lecturers who have used Moodle Learning Management system found it easy to use the system. All the Lecturers who had used Moodle argued that they easily navigated the Moodle Learning Management system. The same number of lecturers could easily upload learning content and hence Moodle learning management system made course management easy. One of the lecturers who have used Moodle agree that Moodle has improved student learning. It is observed that all lecturers who have used Moodle Learning Management system would recommend Moodle to colleagues. From the above analysis, it is conclusive that Moodle Learning Management System is an easy system to lecturers that have used it. The above analysis indicates that most probably the reason for some lecturers not using the system is not because it is hard to use.

The Lecturers' were further asked which functionalities of the Moodle Learning Management System they found easy to use. Table 4.2 summaries their responses.

Table 4.2 Lecturer's ease of use of Moodle LMS tools

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Never used
Communication tools	On-line surveys	1	1				
	Discussion forums	1	1				
	Moodle Chat room		2				
	sending email to peers and lecturer	1	1				
	posting news / announcements	1	1				
	Managing student groups	1	1				
	Built in wiki pages		2				
Assessment and grading	Administering Online quizzes /exams	1		1			
	Managing student assignments		1		1		
	Managing grades		2				
	Using Choice of multiple responses		2				
	Workshop peer assessment			1	1		

In Table 4.2 above, it is observed that all lecturers who have used Moodle agreed that it easy to use the Moodle Learning Management system internal communication tools to communicate to students and peers. It is also observed that assessment and grading functionalities in Moodle were ease to use. These functionalities included: managing grades, managing students' assignments and use choice of multiple responses. The analysis above indicates that the pedagogy functionalities in Moodle are easy and useful to use. Therefore, the reason for some lecturers not using the system is not because the functionalities are hard to use.

There was a need to probe the ease of use of Moodle Learning Management System by students that have used the system. The response of these students is as shown in the Table 4.3 below;

Table 4.3: Ease of use of Moodle LMS by Students

	Very easy	Easy	Neutral	Difficult	Very difficult	Not used
Learning to use Moodle Learning Management system	1	1		1		
Navigating Moodle Learning Management system		3				
Access to learning materials using Moodle Learning Management system	2			1		
Submitting assignments and test		1		1		1
Use of Moodle Learning Management system communication tools			1	1	1	
Getting technical support	2	1				

Observations from Table 4.3 above indicate that majority of students who have used Moodle found it easy to learn how to use Moodle Learning Management system, access of learning materials using Moodle Learning Management system and getting technical support. All students that have used Moodle found it easy to Navigating Moodle Learning Management system. It was observed that a student among the three that have used Moodle found submitting tests and usage of the communication tools easy. From the above Table, it observed that Moodle is an easy system to use. From the above analysis, it is observed that Moodle is an easy to use system. Hence, reason for some students not using the system is not because the Model is hard to use.

4.1.2 Moodle Learning Management system usefulness

There was need to investigate whether Moodle Learning Management System was a useful system to both Lecturers and students. The Table 4.4 below represents the lecturers' perception on how useful the system was;

Table 4.4: Lecturer’s perceptions on usefulness of Moodle LMS tools

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Never used
Communication tools	On-line surveys		1				
	Discussion forums		1				
	Moodle Chat room	1					
	sending an email to peers and lecturer						
	posting news / announcements		1				
	Managing student groups		1				
	Built in wiki pages						
Assessment and grading	Administering Online quizzes /exams	1			1		
	Managing student assignments		1				1
	Managing grades		1				1
	Using Choice of multiple responses		1				1
	Workshop peer assessment			1			

Analysis of Table 4.4 above indicates that a Lecturer who has used Moodle admitted that Moodle Learning Management System’s communication tools and assessment tools did meet their teaching expectations. Hence the usefulness of the Moodle communication and assessment functionalities was not the cause for Moodle not being used by other lecturers.

4.1.3 Factors that attribute to non-usage of Moodle Learning Management system

Analysis of results in section 4.1.2 indicated that majority of students and lecturers who have used Moodle learning management system are said to have found it useful and easy to use. There is hence need to investigate factors that do attribute to the non-usage by other students and lecturers. The Lecturers and students who have never used Moodle Learning Management System were asked reason why they never used the system.

Both Lecturers' and students' responses are reflected in Table 4.5 below;

Table 4.5: Students and lecturers reasons for not having used the Moodle LMS

	Students (%)	Lecturers (%)
Lack of internet access	10.4%	26.7%
Lack of device to use to access Moodle Learning Management System	13.0%	6.7%
Lack of training on how to use to Moodle Learning Management System	10.4%	26.7%
Moodle Learning Management System is not applicable to my class	0.0%	6.7%
Unavailability of learning materials on Moodle Learning Management System	6.5%	0.0%
Unavailability of Moodle Learning Management System	10.4%	13.3%
Lack of time to develop content to upload	0.0%	6.7%
Moodle Learning Management System is difficult to use	10.4%	0.0%
I have not heard of Moodle Learning Management System	35.1%	13.3%
No comment	3.9%	0.0%
Total	100.0%	100.0%

Table 4.5 above shows that majority of students (35.1%) have not used Moodle Learning Manage System because they have not heard about it. The same reason accounts for 13.3% of the lectures not having used the system. There is a need for an awareness campaign component included in the framework. Other notable reason for not using Moodle include Lack of internet access (10.4% of lecturers and 26.7 of students) to connect to the system. To solve this challenge Technology functionality is proposed in the framework. This functionality will help review and define the devices and technology to be used to access the system. To solve the problem of lack of training on how to use Moodle, a training functionality is proposed in the framework.

4.1.4 Assessment of students and Lecturers training

Another inquiry was carried out to investigate the relationship between Moodle Learning Management System usage and training on how to use the system.

The Table 4.6 below relates the training status of both students and lecturers.

Table 4.6: Moodle LMS training status of both students and lecturers

	Trained	Not Trained
Students that have used Moodle	100%	0
Students that have not used Moodle	11.5%	88.5%
Lectures that have used Moodle	100%	0
Lectures that have not used Moodle	33.3%	66.7%

As indicated in Table above, majority of both students (88.5%) and lecturers (66.7%) that have not used Moodle learning management system have not been trained on how to use the system. 100% of both students and lecturers who have used the Moodle Learning Management System were trained on how to use the system. Chuttur (2009) explained that training helps to expose the usefulness of a particular technology or system. Hence once the user has been equipped with training, he or she is able to realise the usefulness of a particular system. The above analysis indicates that training is one of the reasons why Moodle was not used by both students and Lecturers. Training is essential for individuals to use Moodle. The functionality of training is proposed to be part of the framework

Another inquiry was carried out to find out why of some students and Lecturers had not been trained. Table 4.7 summarizes their responses

Table 4.7: Students' and Lecturers' reasons for not being trained

	Students	Lecturers
Lack of interest in using the system	7.1%	8.3%
The training team used an approach I did not like	3.8%	0%
Training was not relevant to my needs	11.5%	0%
Have had Limited time to interact with the system	1.9%	0%
Not aware about Moodle training	38.5%	8.3%
I did not know about the system	25.0%	25.0%
No comment	19.2%	58.4%
Total	100%	100%

Analysis of Table above shows that majority of the students (38.5%) and a small number of Lecturers (8.3%) were not aware of training of the Moodle Learning Management system. It is observed that 25% of both Lecturers and students did not know that the system existed, while 7.1% of students and 8.3% of lectures lacked interest in using the system.

Hence the lack of awareness about the system was the major challenge for not being trained. An awareness functionality that includes techniques of informing people about the system is hence proposed in the framework.

4.1.5 Reasons why trained individuals never used Moodle LMS

Considering Chuttur (2009) observation that training exposes the usefulness of a system, there is need to find out why individuals that were trained never used the Moodle learning management system yet it is assumed that these individuals had discovered the usefulness of the system. Table 4.8 explains the reasons why trained individuals never used the system.

Table 4.8: Reasons why trained individuals never used Moodle LMS

	Students	Lecturers
Limited internet access	27.3%	50%
Lack of device to use to access the Learning Management system	27.3%	25%
Unavailability of learning materials on the Learning Management system	10%	0.0%
Unavailability of the Learning Management System	10%	0.0%
The Learning management system is difficult to use	27.3%	0.0%
Time is required to develop content to use on Moodle	0.0%	25%
Total	100%	100%

Table 4.8 above shows that both students (27.3%) and lecturers (50%) did not use the Moodle learning management system because of limited internet access. Similarly, the study found out that 27.3% of students and 25% of lectures admitted to lacking a device to use to access the Moodle learning management system. 27.3% of the students found the Moodle learning management system difficult to use. The study found out that 25% of the lecturers did not use the Moodle learning management system because the time needed to develop content to use / upload on the system. Hence, in summary, limited internet access, lack of a device access the learning management system were challenges faced by both lecturers and students. The proposed that technology functionality shall be in position to solve these challenges. The researcher proposed the use of different pedagogy techniques to overcome the challenge of lack of time to develop learning content by lecturer.

4.1.6 Perceptions on the use of mobile devices to accesses learning materials

Since the core of this research is to develop a framework for use of mobile devices to access learning materials, there was a need to investigate the perceptions of using mobile devices such as mobile phones and tablets to easy accessibility of the Moodle Learning Management system. Table 4.9 depicts the perceptions of both students and lecturers on the use of mobile devices to access learning materials.

Table 4.9: Preferences on using mobile devices to access learning materials

	Students	Lecturers
Yes	89.7%	63.6%
No	6.9%	27.3%
No comment	3.2%	9.1%
Total	100%	100%

From the above Table 4.9, it is observed that majority of both students (89.7%) and Lecturers (63.6%) preferred to use a mobile device to access the Moodle Learning Management system. Hence, the researcher proposes mobile device functionality into the framework to guide on how to incorporate the mobile devices into the learning processes.

4.1.7 Results from the oral interviews administered System Administrator

The personnel in the Systems Administration department were interviewed based on the interview guide in **Appendix 3A**. Two staff from this department were interviewed. These staffs included the Systems Engineer and the Moodle systems administrator. It was discovered that all of them agreed that Moodle was being underutilised. The respondent explained that training was conducted, though only individual interested in the system were trained. It was observed that there was infrastructure for accessing the system on campus such as wireless network hot spots but access devices such as laptops were not provided. Labs equipped with desktop computers were available to be used to access the system. However, access to the labs was hindered by the fact that they doubled as lecturer rooms. When asked on how this system can be fully utilised, the administrators proposed that the need to have a policy to guide on Moodle usage. The same administrators proposed that a management component should be put into consideration in the proposed framework.

They attribute this to the fact that there was no mechanism in place to guide on how systems are managed and used. The systems administrators suggested the need to adopt the Information Technology governance methodology in management of IT resources and stakeholders.

The 3P Model Approach to IT Governance Design was adopted to solve this problem. This model considers three issues (who, how and what) of an effective IT governance implementation and these are People, processes and portfolio. Relying on the three perspectives (people, portfolios and processes), the model provides a generic and guiding frame for setting the core components (mechanisms, structures and focus areas) of a governance framework. In addition to management of the system, the administrators proposed a periodic review of the systems and their processes, as a way of enhancing the efficiency and effectiveness on the quality of service to the main institutional stakeholders for proper decision making and management. Hence there is a requirement for monitoring and control of all process and stakeholders. This requirement was proposed to be included in proposed framework.

Interview results for the Two pedagogy experts, indicated that there was need to use learning theories in the incorporation of pedagogy in the learning process. The reason advanced for use of the learning theories was to avoid extraneous cognitive load and introducing appropriate and fundamental loads at user-appropriate levels. The researcher hence put this into consideration during framework development.

4.2 Framework design and construction

Shortcomings in the usage of Moodle Learning Management system and Requirements of the framework were identified in the results analysis in section 4.1 above. The short coming included Lack of training on how to use the system, potential user such as students know being aware of the existence of the system, lack of devices to be used in the access of the system, difficulty to develop learning content to upload in the system. Requirements derived from these short comings were used in construction of Components and Sub-components of the framework. Each sub-component defines techniques or methods that are used to realise the sub-components particular function. The relationship between these components and sub-components are then identified.

The components are then assembled to form a framework. These components include: Awareness, Technology, Management, Evaluation and Pedagogy components.

4.2.1 Requirements of the framework

Having identified the shortcomings that affect effective use of the Moodle Learning Management System in teaching and learning, this sub section presents a framework that provides guidelines on what and how to arrive at this goal. According to this study, there are four key requirements of framework that is; Training and awareness; accessibility, ease of use and usefulness that needed focus since they were found to play a key role in influencing the usage of the Moodle Learning Management System. Each of these are examined as follows;

i. Awareness and Training

The findings revealed that there was limited or no prior awareness of university students and lecturers in using Moodle Learning Management System. Awareness is highly regarded as necessary to using technology (Chuttur, 2009). Therefore management and the University decision-makers should consider this as a first process in the utilization of ICT in Education. Considering the rapid change in technology, continuous and routine training through workshops, seminars and conferences on the diffusion of Moodle Learning Management System to both users (System administrators and end users like the lectures and Students) is required. This training should be organised targeting new entrants in the university (both Students and lectures) on how to use and navigate the Moodle learning Management system since some of them join the University with very little or no knowledge about this web technology. During the training, Emphasis should be put on the significance of the effective use of Moodle Learning Management System as a modern tool in performing their duties. Short certificate courses in Web technology usage should be organised as this will encourage, build confidence and empower users to learn other applications and train their fellow colleagues in future. Hence from this requirement, a component of Training Techniques.

ii. Accessibility

The findings asserted that some trained members could not use the Moodle learning management system because they lacked devices to access the system. Lack of accessibility renders the system ineffective because both ease of use and usefulness are hindered.

Most of the respondents acknowledged that they were interested in using mobile technologies to access the Moodle Learning Management system. Hence University management should put into consideration on how best and effective mobile technologies are incorporated in the learning setting. Hence the technologies component comprising of sub-components of mobile devices and mobile technologies for the framework is derived from this requirement.

iii. Ease of Use

The study findings revealed that generally, the Moodle Learning Management System in Uganda Martyrs University was easy to use by both Students and lectures that were trained. However, there is need to improve on their interactivity and ability to be used. This property should be checked during implementation stage and the management should encourage stakeholder involvement throughout the processes of design and implementation. Users' Requirements during the implementation stage should be put into consideration as much as possible as research suggests (Bouwman et al., 2005), the decision to finally use any technologies such a mobile technologies entirely relies on the user. So, the departments concerned must ensure that Software Development Life Cycle activities are followed systematically in order to ensure usability or ease of use of Moodle Learning Management System on mobile devices. Hence technologies used should be able to fit the user requirements in terms of data manipulations and presentation. Hence components of Monitoring and Evaluation and Information Technology governance are derived from this requirement.

iv. Usefulness

Study findings reveal that the Moodle Learning Management System are regarded not useful by the non-trained students and lecturers in pursuance of their roles of learning and teaching respectively. This is a major factor that determines a system's usage in the university setting. In order to integrate usefulness of mobile technologies and electronic learning that will improve the teaching and learning; give greater control over the teaching and learning; enable users accomplish their task quickly; increase productivity of users and improve effectiveness and efficiency of Lecturers and Students at the University.

The University Management should ensure that: the Moodle Learning Management System are frequently updated with new and relevant information including but not limited to; study materials, academic results, Sub-components of Pedagogical Approaches and Assessment Techniques are derived from this aspect. These two sub-components make up the Pedagogical approaches component of the framework.

4.2.2 Relationship of the components

Mayer, Moreno, and Sweller (2016), established E-Learning design principles, which are based on the learning theories, discussed in chapter 2.6. These principles focused on minimizing extraneous cognitive load and introducing appropriate and fundamental loads at user-appropriate levels. These include the following established principles;

- i. Multimedia principle (also called the multimedia effect):** This principle considers using any two out of the combination of audio, visuals, and text promote deeper learning than using just one or all three.
- ii. Modality principle:** This principle explains that learning is more effective when visuals are accompanied by audio narration versus onscreen text. There are exceptions for when the learner is familiar with the content, is not a native speaker of the narration language, or when printed words are the only things presented on screen. Another exception to this is when the learner needs to use the material as reference and will be going back to the presentation repeatedly.
- iii. Coherence principle:** The less that a learner knows about the presentation content, the more they will be distracted by unrelated content. The irrelevant video, music, graphics, etc. should be cut out to reduce the cognitive load that might happen through learning unnecessary content. Learners with some prior knowledge, however, might have increased motivation and interest with unrelated content.
- iv. Contiguity principle:** Learning is more effective when relevant information is presented closely together. Relevant text should be placed close to graphics, and feedback and responses should come closely to any answers that the learner gives.

- v. **Segmenting principle:** More effective learning happens when learning is segmented into smaller chunks. Breaking down long lessons and passages into shorter ones helps promote deeper learning.
- vi. **Signalling principle:** Using arrows or circles, highlighting, and pausing in speech are all effective methods of signalling important aspects of the lesson. It is also effective to end a lesson segment after releasing important information.
- vii. **Learner control principle:** For most learners, being able to control the rate at which they learn helps them learn more effectively. Having just play and pause buttons can help more than having an array of controls (back, forward, play, pause). Advanced learners may benefit from having the lesson play automatically with the ability to pause when they choose.
- viii. **Personalization principle:** A tone that is more informal and conversational, conveying more of a social presence, helps promote deeper learning. Beginning learners may benefit from a more polite tone of voice, while learners with prior knowledge may benefit from a more direct tone of voice. Computer characters can help reinforce content by narrating the lesson, pointing out important features, or illustrating examples for the learner.
- ix. **Pre-training principle:** Introducing key content concepts and vocabulary before the lesson can aid deeper learning. This principle applies more to low prior knowledge learners versus high prior knowledge learners.
- x. **Redundancy principle:** Having graphics explained by both audio narration and on-screen text creates redundancy. The most effective method is to use either audio narration or on-screen text to accompany visuals.

It is from the above principles by Mayer, Moreno, and Sweller (2016), that components of the framework were linked to each other. The linkages are explained as follows;

- a. The Training component of the framework and technology components was a result of the pre-training principle.

- b. Personalisation, modality and learner control principles were considered in developing the Information Technology governance component.
- c. Mobile technology component was a result of the Learner control principle, Modality principle and coherence principle helped in coming up with this component.
- d. The pedagogy component was based on the multimedia, cognitive, segmenting, redundancy and continuity principles.
- e. The monitoring and evaluation component was a result of all the above principle. This was because this component oversees the operation of other component.

4.2.3 Design and construction phase

Basing on the above requirement, the researcher proposed the following framework in Figure 4.1 for the use of mobile devices in learning processes;

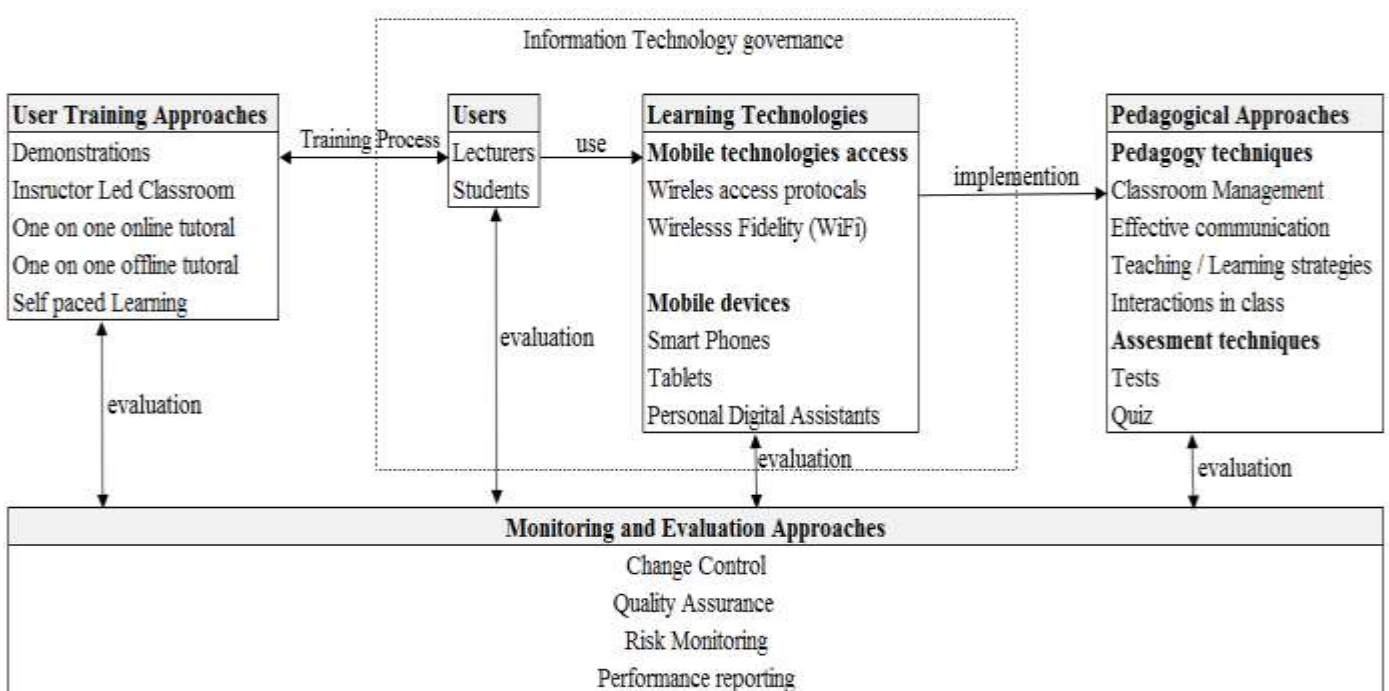


Figure 4.1: Proposed Framework for use of Mobile devices in learning

In the framework above, the training process is the link that gives the relationship between users and the user training approaches. The users are the stakeholders that use the mobile devices to support the learning processes. These users implement the pedagogical approaches through the use of mobile devices that have got mobile technologies access points such as Wi-Fi. The user is able to access the provided learning materials.

This defines the link between the users, the learning technologies component and the pedagogy approaches component. Another link between users and mobile technologies is that they are linked together by the Information technology governance. This defines the rules, policies and guideline how users can use the technology while accessing the learning materials. For efficiency of framework, monitoring and evaluation approaches are used to refine process involved in M-learning. This evaluation occurs in all the areas of the framework, which is user training approaches, users, learning technologies and pedagogical approaches. The framework components of the framework above are explained in details as follows;

- i. **Information Technology governance Component:** This component entails the management and maintenance of learning environment and distribution of information. This component involves the proper definition of people, portfolios, and process involved while performing learning duties. This component addresses the continuation, redesigning, and upkeep of the learning environment. This continuation might be utilized to figure out if the instructive innovation climate is performing sufficiently, and whether the guideline is meeting its aim. This measurement additionally addresses issues of value control, planning, staffing, security, and contracts.
- ii. **User Training Approaches:** The Training component raised from the training and awareness requirements. This component aims at creating awareness about the Mobile learning and training users on how to use the system. Under this component, training techniques such as system Lecture/demonstration, Classroom training with instructor, One-on-one tutorial, Self-paced learning are used. Classroom or instructor-led training remains one of the most popular employee training techniques, even with the numerous technological advances in the training industry. There are different types of this training. These include whiteboard techniques where you request feedback for what you have written on the board, PowerPoint presentations, video training, and storytelling. Instructor-led training is fun and interactive as employees get the opportunity to compare results and share ideas. These training techniques are aimed at ensuring the users easily use the system in a useful way.
- iii. **Mobile Learning technologies:** The mobile learning technologies component involves data handling and mobile device characterisation.

This component has two subcomponents namely Mobile technologies and Mobile devices. The mobile technologies sub-component includes a definition of data access, storage, presentation, and manipulation methods. These methods include how use of data access methods such as Wireless access protocol like 3G and 4G, and define how mobile applications can connect to the learning system. The Mobile device sub-component includes assessment and development of mobile infrastructure, Hardware, and software. In this component mobile devices such as smartphones and tablets are evaluated for ability to support mobile learning. Both sub-components work together thereby helps in the selection of the most suitable technologies for learning. The Mobile technologies component delivers issues relating to the choice of the most reasonable learning administration framework and specialized apparatuses (that is, sound and video conferencing stages) for accomplishing the organization's learning objectives and targets. Specialized prerequisites, for example, the server limits, transfer speed, security, reinforcements, and other foundation issues are additionally tended to.

- iv. **Pedagogical Approaches:** This component explores the techniques of teaching and how the mobile devices can employ the techniques to impact knowledge to a student. The component has two sections. The first section is Pedagogy techniques, where methods of impacting knowledge such as Classroom Management, effective communication, Teaching strategies, Interactions in class are considered. In the Assessment techniques sub-component, methods of assessment such as quizzes, assignments, puzzles are put into consideration. These methods help in determining whether the student has gained knowledge for what has been taught.
- v. **Monitoring and Evaluation component:** The Evaluation component defines methods and ways how system usage will be monitored and reviewed for better performance. This component addresses the appraisal of learners; assessment of the guidelines and learning environments; evaluation of content improvement and of individuals required in the configuration procedure (planners, designers, production team, and quality assurance team); audit of instructional design and processes and assessment of E-Learning at the system and institutional levels.

Techniques used in this component include: Change Control management, Quality Assurance Control, Risk Monitoring and Performance Reporting. It is from this component that decision makers can make decision that ensure the effectiveness of Mobile learning in the university.

4.2.4 Framework Implementation

Aspects of this Framework involve the various dimensions or factors that are significant when using a mobile device to access Moodle Learning Management System in teaching and learning in a University Environment. The implementation of this Framework shall have a bearing on the University Expenditure. Because of this, the research was not able to implement the framework. The researcher recommends that the implementation should be done within the University annual work plans and Budget.

4.3 Evaluation and reflection

In evaluation and reflection, the developed framework is evaluated to find out whether it meets the requirements of the user. In this case, the researcher had planned to use an expert to review the framework. However, due to resource constraints such as identifying an individual who is an expert in the mobile learning domain, the researcher was not able to carry out the evaluation. Hence evaluation of this framework is recommended for further studies.

4.4 Conclusion

This chapter presented the findings plus an analysis of those findings and a discussion of the results and concludes that users (lectures and Students) of Moodle Learning Management System do require training and awareness as a leading factor to use Moodle Learning Management System and hence making Moodle Learning Management System easy to use (requiring little mental effort to use and easy to learn how to operate). Most importantly, the results in the chapter show that the crucial factor in determining the eventual use of Moodle Learning Management System is hinged on the quality and quantity of the information on the system such as study materials; academic results; projects and scholarship materials; news; applications such as email, chats, discussion boards This according to the TAM model is what influenced the users' very low attitude and eventual less frequent or no intention to use the Moodle Learning Management System. Therefore, in Uganda Martyr's university, Moodle Learning Management System very less used in teaching and learning.

The chapter also presented a solution in form of a Framework to assist in the effective use of Moodle Learning Management System on mobile devices in teaching and learning at the University. This framework highlights three elements: - Training, ease of use and usefulness that need to be focused on to elevate the effective usage of Moodle Learning Management System and in the Implementation of the framework, clear procedures are outlined.

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

In this chapter, results and research findings were presented in a summary form. The conclusions about the results are presented together with challenges faced during the research process. This Chapter also includes recommendations and suggestions for further research.

5.1 Overview of the Research

The researcher first gives the introduction to the topic. Here the researcher first defines the domain in which the research features. There after the researcher explains thematic areas of the study. These thematic areas include the following;

- i. Mobile computing is explained since the research falls under the mobile computing domain. The researcher goes ahead to explain the different applications of mobile computing, and then relates the application of mobile computing to education. Then a brief description of the trends in mobile computing is explained.
- ii. Mobile learning was a thematic area that was reviewed. This section presented the different applications of mobile computing. Categories of mobile computing and drawbacks mobile learning were discussed in this section.
- iii. The analysis of common mobile computing devices used was also carried out. The different devices were identified, together with advantages and disadvantages of these devices. Furthermore the trends of the devices were explored.
- iv. Mobile learning frameworks were reviewed. In particular, their strength and weaknesses were identified. It is from these weaknesses that the researcher proposed the development of a better framework for mobile learning that addresses the weaknesses.

The researcher then gave a detailed background to the problem that existed in Uganda Martyrs University in relation to usage of the Moodle Learning Management system. Then the statement of the problem was derived from this background. The researcher then formulated the main objective of the study.

Specific objectives which detail how the main objective was to be achieved were the stated. The researcher then states the research questions that are going to be answered by the research, followed by the scope of the research and the significance of the research.

Literature review was also carried out. In the literature review, the different literature that is in line with the study was reviewed. This literature reviewed was selected basing on passed similar researches. Specifically the researcher reviewed the literature as follows:

- i. The general framework of flexible learning was reviewed first by the research. This framework is presented by Brown (2003). The framework was important to the study because both E-Learning and M-Learning fall under this field. The researcher went head to review the different components of this framework and the relationships between these components.
- ii. Secondly, the research reviewed the different E-learning frameworks. The purposed of reviewing these frameworks was to understand the how E-Learning is implemented and its relationship to M-Learning.
- iii. Review of the research methodology followed. In this review, the different research methods were in detail identified and their role in this research defined. The different data collection techniques were also identified. More so, the researcher reviewed the data analysis techniques that are available and how they can be applied to this research.
- iv. The framework development methodology was another element review. In this the design research methodology was investigated, since most education technology intervention researchers recommended the methodology. Both methods were deployed in developing the framework.
- v. Finally, the different theories related to learning process were reviewed. These theories greatly helped the research to develop a pedagogic framework which would help to avoid information overload to students.

The methodology used in realising this research was also presented. The researcher discusses the research design in the methodology. The Mixed research methodology was used for this research. This methodology was chosen because of the need to collect statistical and detailed data about the current system. The study population is defined in this section. Furthermore, the sampling techniques are defined with the sample size and sampling technique being elaborated. The sample is then calculated based on the stratified sampling method. Data collection methods and instruments are then identified and discussed on how they will be used in the data collection process. Methods on how data was to be analysed are then discussed. For this research, the researcher employed both qualitative and quantitative methods; qualitative analysis methods were used for the open ended questions in which a detailed explanations to questions asked were given. For quantitative analysis, statistical results for the closed ended question were obtained. The ethical considerations made in the study and limitations of the study are then presented. The framework development methodology is the final section of the methodology. Here an explanation of how the research design methodology was used to develop the framework is explained.

Results from data collection were then presented, analysed and discussed. These results were of the oral interviews and survey carried out. Requirement of the framework were then gathered from the analysis of the results. The framework was developed based on design research methodology. The first phase of this methodology is Analysis and exploration of the problem. In this phase, the problem was analysed from the data collected using the data collection tools. The framework components were proposed in this phase. The second phase was the framework design and construction. In this phase the requirements of the framework were analysed and components constructed. The connections between the components were established. Thereafter, the components of the framework were put together for form the framework. The evaluation phase was to follow. However, due to lack of an expert to evaluate the framework, the researcher recommends this phase in to be carried out in future work.

5.2 Summary of findings

This study indicated that Moodle Learning Management system is not being effectively used by the Students and Lecturers in conducting their learning and teaching functions respectively in the University.

The survey results indicated that most users in Uganda Martyrs University (both Students and Lecturers) had less or no training in using the Moodle Learning Management System. Furthermore, a small fraction of lectures and students that were trained indicated that lack of internet access and device to access the learning management system as the major setback of using the system. Some of the trained users pointed out strongly that they perceived the Moodle Learning Management System not useful in their activities of teaching and learning at University. This perception led to the negative orientation regarding the use of Moodle Learning Management System that culminated in no intention to even visit the system. The majority of potential users did not have an idea of the existence or presence of Moodle Learning Management System in their University.

Having critically analysed these results, it was found out that lack of content or information that is relevant and up-to-date like contact details, academic results; appropriate functional applications like email. This explained why users did not consider Moodle Learning Management System as a tool that improves their teaching and learning, or help them accomplish their tasks quickly, or increases their productivity and improves their effectiveness at the University. This was the greatest factor that contributed to the poor or ineffective usage of the Moodle learning management system. Therefore there was a necessity to develop a Framework to guide and assist on the effective use of mobile devices to access Moodle Learning Management System in teaching and learning at the University. The researcher used the data analysis results to obtain the requirements of the framework. It is from these requirements that components of the framework were developed and joined together to form the framework.

5.3 Conclusion

On reviewing the extent of usage of Moodle learning management system in teaching and learning, results showed that lectures and students do not use Moodle Learning Management System while performing their duties at the University. In fact, most students and lectures that were surveyed indicated that they have never visited or navigated the Moodle learning management system throughout their stay at the University. This was strongly linked to not being trained led to the perception that this system is not considered useful or important in their teaching and learning processes.

This was blamed on the fact that using the Technology Acceptance Model did not improve their learning and teaching; productivity and task completion; effectiveness and efficiency. These were associated with limited or no relevant and up to date content on the Moodle Learning Management System including but not limited to study materials, academic results, applications like email and chats and discussion boards.

The researcher proposed a framework that can be used to incorporate mobile devices into the learning process, as a way of overcoming the challenges defined above. This framework comprised of different component that work together to deliver pedagogy techniques using a mobile device. Each component was a result of a specific requirement that rose from analysis of data that was collected. Hence the framework addresses the challenges which were identified from the collected.

5.4 Challenges:

During the process of carrying out this research, the researcher encountered a number of shortcomings. These challenges are as follows;

- i. There was a challenge of obtaining the exact student and lecturer population numbers. The figures used in this research as estimates from the relevant offices. However, since the sampling was purposive in nature, the researcher has confidence on the sample.
- ii. I was challenged in writing and organizing this thesis. This was because I did not undertake any research methods course and project at undergraduate level. More so Research Methods were taught to us in the last semester of the Masters.

5.5 Recommendations.

In line with the findings and the conclusion emerging from the study, the following recommendations are made:

- i. In order to address the challenge of insufficient experience of using Moodle Learning Management System among lectures and Students and limited zeal to undertake mobile learning through the use of training, continuous awareness workshops and training be inculcated within the University to attract buy-in from the prospective beneficiaries.

- ii. In order to increase the usability of Moodle Learning Management System of Universities, during the adoption and implementation phases, proper Internal Strategy Formulation is done and qualified Mobile technology developers to be contracted to do the job. This involves competent management to oversee the processes of implementation within a University.
- iii. In order to step up the usefulness of the Moodle Learning Management System, University management should ensure that competent and self-driven employees in the ICT department especially Webmasters be recruited and remunerated well since the work of updating the Moodle Learning Management System is tedious because of its repetitiveness nature and also strive for the establishment of functional ICT Departments within a University.
- iv. More so, the university management should incorporate mobile learning into its curriculum so that lectures would have the opportunity and time to create and customise content for the learning management system. The developed content should be optimised for better access by the various stakeholders.

5.6 Suggestions for Further Research.

This research used a purposive sampling method, whereby a few classes that had computer skills were sampled. There is a need for the research to be carried out across the entire university including all the campuses. As part of future work, evaluation of the framework is suggested since time constraints and finding an expert could not allow the evaluation to be carried out. Further research focusing on the use of social media in teaching and learning in order to foster the development of ICT in Education can be done.

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Appendix I

Survey questionnaire to be filled in by Students of Uganda Martyrs University who have used Moodle Learning Management System.

Objective: To collect data which will be used to determine factors that hinder the accessibility and usability of the Moodle Learning Management

My name is Richard Ntwari, a student of Masters of Information Communication Technology Policy and Management at Uganda Martyrs University. As part of my Masters research Thesis, I am conducting a survey to identify the factors that influence the adoption and usage of Moodle Learning Management System among university students, and how mobile devices can be used to enhance electronic learning. The results will be used to develop a framework for use of mobile devices in the learning processes. The framework will be used by stakeholders in institutions of higher learning in the implementation of mobile learning. Information gathered during this survey will strictly be used for academic purposes and shall be treated as confidential.

Thank you!

Instruction: Check the option(s) that apply.

1. i) Were you trained on how to use Moodle Learning management system?

Yes No

ii) If no, what is the reason for not being trained?

- A. Lack of interest in using the system
- B. The training team used an approach I did not like
- C. Training was not relevant to my needs
- D. Others (please specify below)

2. i) In reference to using Moodle learning management system; Please rate the following:

	Very Easy	Easy	Neutral	Difficult	Very Difficult	Never used
A. Learning to use Moodle learning management system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Navigating Moodle learning management system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Access of learning Materials using Moodle learning management system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D. Submitting assignments and tests	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E. Use of Moodle learning management system communication tools	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F. Getting technical support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ii) Give reasons, if any of the choices above is Difficult, very difficult or never used

2. A	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	
2. B	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	
2. C	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	
2. D	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	
2. E	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	
2. F	Unviability of support	<input type="checkbox"/>	Lack of knowledge base	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	

3. i) The following Moodle learning management system communication tools were easy to use.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Never used
A. Online surveys	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Discussion forums	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Text chat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D. Sending email to peers and Lectures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E. News/announcements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ii) Give reasons, if any of the choices above is Disagree, Strongly disagree or never used

- | | | | | | | | | |
|------|-------------------|--------------------------|-----------------------|--------------------------|-------------------|--------------------------|-------------------|----------------------|
| 3. A | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Are hard to learn | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 3. B | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Are hard to learn | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 3. C | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Are hard to learn | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 3. D | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Are hard to learn | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 3. E | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Are hard to learn | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 3. F | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Are hard to learn | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |

4. Would you prefer accessing learning materials using electronic methods?

Yes No

5. Would you use a mobile device such as a Mobile phone or tablet to access the Moodle Learning Management System if the system can be operated on the device?

Yes No

6. i) If there were technological constraints hindering the availability of all services, which one would you take as a priority to access using a mobile device such as a mobile phone or tablet?

- A. University Library services
- B. University email
- C. Lecture Notes and Course tutorials
- D. External Tools
- E. Not interested in any
- F. Others (specify)

ii) If you have selected “Not interested in any”, what is the reason?

7. If you were to learn a new application, which training approach would you prefer to be given?

- A. I prefer to be trained in a peer group setting
- B. I prefer to learn on my own using try and error
- C. I prefer to learn using a tutorial.
- D. I prefer to have someone teach me how to use a new application

Appendix II

Survey questionnaire to be filled in by Lecturers of Uganda Martyrs University who have used Moodle Learning Management System.

Objective: To collect data which will be used to determine factors that hinder the accessibility and usability of the Moodle Learning Management

My name is Richard Ntwari, a student of Masters of Information Communication Technology Policy and Management at Uganda Martyrs University. As part of my Masters research Thesis, I am conducting a survey to identify the factors that influence the adoption and usage of Moodle Learning Management System among university lecturers, and how mobile devices can be used to enhance electronic learning. The results will be used to develop a framework for use of mobile devices in the learning processes. The framework will be used by stakeholders in institutions of higher learning in the implementation of mobile learning. Information gathered during this survey will strictly be used for academic purposes and shall be treated as confidential.

Thank you!

Instruction: Check the option(s) that apply.

8. Were you trained on how to use the Moodle Learning Management System?

Yes No

9. i) Rating lecturer's perceptions of Moodle Learning Management System

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Never used
A. I easily navigate the Moodle Learning Management system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. I easily upload learning materials and assessment materials in the Moodle Learning Management system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Moodle Learning Management system has improved student learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D. Moodle Learning Management system has made course management easier	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E. I recommend Moodle Learning Management system to colleagues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ii) Give reasons, if any of the choices above is Disagree, strongly disagree or never used

2. A	Poor design	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Hard to Learn	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
2. B	Poor design	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Hard to Learn	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
2. D	Poor design	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Hard to Learn	<input type="checkbox"/>	Others: (specify)	<input type="text"/>

10. i) Assessment of usage of Moodle Learning Management System functionalities

	Very Easy	Easy	Neutral	Hard	Very Hard	Never used
A. Accessing the course site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Creating a course profile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Posting course materials (file upload, media etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D. Repurposing course materials for multiple courses or semesters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E. Creating course calendar / schedule	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F. Activating course quiz / examinations by date or Location	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ii) Give reasons, if any of the choices above is Disagree, strongly disagree or never used

3. A	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
3. B	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
3. C	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
3. D	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
3. E	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
3. F	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>

11. The following Moodle Learning Management System communication tools are easy to use.

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree	Never used
A. Online surveys	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Discussion forums	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Moodle chat room	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D. Email notifications to students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E. Posting News / announcements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F. Managing student groups – discussion/team projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G. Built in Wiki pages and Glossary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ii) Give reasons, if any of the choices above is Disagree, strongly disagree or never used

4. A	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
4. B	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
4. C	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
4. D	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
4. E	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
4. F	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>
4. G	Navigation issues	<input type="checkbox"/>	Lack of accessibility	<input type="checkbox"/>	Poor / Lack of training	<input type="checkbox"/>	Others: (specify)	<input type="text"/>

12. i) The following Moodle Learning Management Systems communication tools meet my teaching expectations.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Never used
A. Online surveys	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- | | | | | | | |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| B. Discussion forums | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| C. Text chat | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| D. Sending email to students | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| E. News/announcements | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| F. Managing student groups – discussion/team projects | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

ii) Give reasons, if any of the choices above is Disagree, strongly disagree or never used

- | | | | | | | | | |
|------|-------------------|--------------------------|-----------------------|--------------------------|-------------------------|--------------------------|-------------------|----------------------|
| 5. A | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 5. B | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 5. C | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 5. D | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 5. E | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 5. F | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |

13. The following Moodle Learning Management System assessment and grading functionalities are easy to use.

- | | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Never used |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| A. Administering Online quizzes /exams | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| B. Managing student assignments | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| C. Managing grades | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| D. Using Choice of multiple responses | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| E. Workshop peer assessment | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

ii) Give reasons, if any of the choices above is Disagree, strongly disagree or never used

- | | | | | | | | | |
|------|-------------------|--------------------------|-----------------------|--------------------------|-------------------------|--------------------------|-------------------|----------------------|
| 6. A | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 6. B | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |
| 6. C | Navigation issues | <input type="checkbox"/> | Lack of accessibility | <input type="checkbox"/> | Poor / Lack of training | <input type="checkbox"/> | Others: (specify) | <input type="text"/> |

6. D Navigation issues Lack of accessibility Poor / Lack of training Others: (specify)
6. E Navigation issues Lack of accessibility Poor / Lack of training Others: (specify)

14. The following Moodle Learning Management System assessment and grading features meet my teaching expectations.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Never used
A. Online quizzes /exams	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Managing student assignments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Managing grades	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D. Using Choice of multiple responses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E. Workshop peer assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ii) Give reasons, if any of the choices above is Disagree, strongly disagree or never used

7. A Navigation issues Lack of accessibility Poor / Lack of training Others: (specify)
7. B Navigation issues Lack of accessibility Poor / Lack of training Others: (specify)
7. C Navigation issues Lack of accessibility Poor / Lack of training Others: (specify)
7. D Navigation issues Lack of accessibility Poor / Lack of training Others: (specify)
7. E Navigation issues Lack of accessibility Poor / Lack of training Others: (specify)

15. Would you use a mobile device such as a Mobile phone or tablet to access the Moodle Learning Management System if the system can be operated on the device?

Yes No

Thank you.

Appendix III

Survey questionnaire to be filled in by Students of Uganda Martyrs University who have not used Moodle Learning Management System.

Objective: To collect data which will be used to determine factors that hinder the accessibility and usability of the Moodle Learning Management

My name is Richard Ntwari, a student of Masters of Information Communication Technology Policy and Management at Uganda Martyrs University. As part of my Masters research Thesis, I am conducting a survey to identify the factors that influence the adoption and usage of Moodle Learning Management System among university students, and how mobile devices can be used to enhance electronic learning. The results will be used to develop a framework for use of mobile devices in the learning processes. The framework will be used by stakeholders in institutions of higher learning in the implementation of mobile learning. Information gathered during this survey will strictly be used for academic purposes and shall be treated as confidential.

Thank you!

Instruction: Check the correct option(s).

1. i) Were you trained on how to use the Learning management system

Yes No

ii) If no, what is the reason for not being trained?

E. Lack of interest in using the system

F. The training team used an approach I did not like

G. Training was not relevant to my needs

H. Others (please specify below)

2. What is/are the reason(s) for not having use the Moodle learning management system

A. Lack of internet access

B. Lack of device to access the Learning Management system

C. Lack of training on how to use the Learning Management System

- D. Unavailability of learning materials on the Learning Management System
- E. Unavailability of the Learning Management System
- F. The Learning Management System is difficult to use
- G. I have not heard of Moodle
- H. Others (please specify below)

3. Would you prefer accessing learning materials using electronic methods?

Yes No

4. Would you use a mobile device such as a Mobile phone or tablet to access the Moodle Learning Management System if the system can be operated on the device?

Yes No

5. i) If there were technological constraints hindering the availability of all services, which one would you take as a priority to access using a mobile device such as a mobile phone or tablet?

- G. University Library services
- H. University email
- I. Lecture Notes and Course tutorials
- J. External Tools
- K. Not interested in any
- L. Others (specify)

ii) If you have selected “Not interested in any”, what is the reason?

6. If you were to learn a new application, which training approach would you prefer to be given?

- E. I prefer to be trained in a peer group setting
- F. I prefer to learn on my own using try and error
- G. I prefer to learn using a tutorial.
- H. I prefer to have someone teach me how to use a new application

End

Appendix IV

Survey questionnaire to be filled in by Lecturers of Uganda Martyrs University who have not used Moodle Learning Management System.

Objective: To collect data which will be used to determine factors that hinder the accessibility and usability of the Moodle Learning Management

My name is Richard Ntwari, a student of Masters of Information Communication Technology Policy and Management at Uganda Martyrs University. As part of my Masters research Thesis, I am conducting a survey to identify the factors that influence the adoption and usage of Moodle Learning Management System among university lecturers, and how mobile devices can be used to enhance electronic learning. The results will be used to develop a framework for use of mobile devices in the learning processes. The framework will be used by stakeholders in institutions of higher learning in the implementation of mobile learning. Information gathered during this survey will strictly be used for academic purposes and shall be treated as confidential.

Thank you!

Instruction: Check the option(s) that apply.

7. i) Were you trained on how to use the Learning management system

Yes No

ii) If no, what is the reason for not being trained?

- I. Lack of interest in using the system
- J. The training team used an approach I did not like
- K. Training was not relevant to my needs
- L. Others (please specify below)

8. What is/are the reason(s) for not having used the Moodle learning management system

- I. Lack of internet access
- J. Lack of device to access the Learning Management system
- K. Lack of training on how to use the Learning Management System

L. Learning Management system is not applicable to my class

M. Unavailability of the Learning Management System

N. The Learning Management System is difficult to use

O. I have not heard of Moodle

P. Others (please specify below)

9. Would you prefer delivery learning materials via electronic methods?

Yes No

10. Would you use a mobile device such as a Mobile phone or tablet to access the Moodle Learning Management System if the system can be operated on the device?

Yes No

Thank you.

Appendix V

Interview guide

Interview guide for the Systems Administrator

I thank you for accepting to take part in this interview. My name is **Richard Ntwari**, a student at Uganda Martyrs University (UMU). Currently, I am carrying out research which is titled “*Framework for Adoption of Mobile Learning in Institutions of Higher Education. Case Study: Uganda Martyrs University.*” This Interview is intended to gather information that will help to identify the requirements of the proposed Framework. The interview that you have agreed to participate in today is part of research dissertation which will be submitted in partial fulfilment for the award of Masters of Science in ICT Policy, management and architectural design.

Do you have any inquiries before the interview commences? Thank you.

Part I: Current E-Learning System

1. How is the current E-Learning system (Moodle) managed?
2. What modules of the E-Learning system are activated?
3. Who are the stakeholder of the current E-Learning system?
4. What are the procedures for one to enroll as a user in Moodle?
 - b) What are the challenges encountered in the processing stage of students’ results?
5. What are the procedures followed when training users in particular;
 - a) students
 - b) Lecturers?
6. Explain the types of reports that are generated by the E-Learning system?
7. Which reports are accessed by each of the stakeholders mentioned below in the current system?
 - a) Students,
 - b) Lecturers,
 - c) Campus administration
8. Please briefly describe the current IT infrastructure in your campus.
9. Mention briefly the data backup procedures in the current E-Learning system
10. How do individuals access the E-learning system?
11. What network infrastructure is in position to support the E-Learning system?

PART II: Proposed requirements for the framework

12. What are the general challenges you would want the framework to address?
13. What suggestion do you have to solve the above challenges?
14. How can reporting be improved in the new system?

15. What are some of the challenges that the proposed framework is likely to face?

Conclusion

Do you have any other information you would like to provide me with? Those are the questions I had for you today.

I thank you for the opportunity to interview you.

Appendix VI

Document review checklist

1. Moodle Training Manual.
2. Moodle training reports
3. University Academic Policy
4. ICT committee meeting minutes.
5. Institution's academic policy,
6. Moodle management records,
7. E-Learning policies, and procedures
8. University strategic plans
9. Pedagogy training workshop manuals and reports.
10. Student orientation reports.

Copies of documents were obtained with permission from the heads of departments of the respective departments.