THE USE OF MOBILE TECHNOLOGIES FOR MOBILE SERVICE DELIVERY AT MAKERERE UNIVERSITY LIBRARY: A PILOT STUDY

Mini-dissertation by

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DECLARATION

I hereby declare that this mini dissertation is my original work and that it has not been submitted to any institution or university leading to award of a degree. All the sources cited in this mini-dissertation have been acknowledged.

DEDICATION

This mini-dissertation is dedicated to my husband, James, my daughter, Jordin and to my mother MS Immaculate Alupo.

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LIST OF ABBREVIATIONS

AIM	**Association for Information Management**
BBC	**British Broadcasting Council**
CDMA	**Code Division Multiple Access**
CNN	**Cable News Network**
CD-ROM	**Compact Disk Read-Only Memory**
EDGE	**Enhanced Data Rates for Global Evolution**
4G	**Fourth Generations**
GDP	**Gross Domestic Product**
GPRS	**General Packet Radio Service**
GSM	**Global Systems for Mobile signaling**
HSCSD	**High Speed Circuit Switched Data**
IP	**Internet Protocol**
ISP	**Internet Service Provider**
ITU	**International Telecommunications Union**
MAN	**Metropolitan Area Network**
MAKLIB	**Makerere University Library**
MOPAC	**Mobile Online Public Access Catalogue**
PDAs	**Personal Digital Assistants**
QOS	**Quality of Service**

QR	**Quick Response**
RFID	**Radio Frequency Identifiers**
RSS	**Real Simple Syndication**
2G	**Second Generations**
SMS	**Short Message Service**
3G	**Third Generations**
TDMA	**Time Division Multiple Access**
WiFi	**Wireless Fidelity**
WiMAX	**Worldwide Interoperability for Microwave Access**

ABSTRACT

Current trends in libraries require that students are able to access information and services beyond library buildings. Makerere University Library (Maklib) faces a number of challenges with regard to online and remote access to library resources and services. One possible solution to this problem lies in the use of mobile technologies. This study attempted to investigate how mobile technologies can be used to provide mobile-based library services at Makerere University library. A pilot study was conducted involving 31 postgraduate and 37 undergraduate students using questionnaires as the data collection tool. Qualitative data was collected and analyzed using Google Drive and was presented in form of text and graphs. Findings indicate that majority of Makerere University students own mobile phones that are internet enabled and those who do not own them have expressed interest in acquiring them in order to stay abreast with new technology. Although students owned internet enabled phones, they mainly used these devices to make and receive calls, and access different kinds of information ranging from news, social media to academic information. The services that students wanted to access using their mobile devices were: search the catalogue, request an e-book, request an item, chat with a librarian, view library news, access subject guides, search the library database, view library opening hours, View library contact information, Quick response, renew library items, book study group rooms, text messaging, book computer labs and view library map. There are also various resources that students expressed interest in and these include: Google searches, Google scholar, e-books, reference materials and e-journals. Convenience, flexibility, time saving, affordability are some of the reasons for acceptability of Mobile library services and resources. The majority of the respondents were positive about the implementation of the mobile services at Maklib however, some of the challenges mentioned by students include high cost of the devices and the ability to access internet services while in office. The study concludes that:

- Mobile technology awareness is rapidly increasing among Ugandans especially students in higher education such as those at Makerere University.
- Ownership of mobile devices is widespread among both the postgraduate and undergraduate students.
- Both postgraduate and undergraduate students expressed their interest in accessing mobile library services and resources.

Recommendations that ought to be adopted by Maklib and any other academic library willing to implement mobile library services are discussed.

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CHAPTER ONE

INTRODUCTION AND OVERVIEW

1.1 Introduction

Mobile technology has systematically changed and transformed the communication and information behavior of the people (Paterson & Low, 2011:412). With the introduction of internet enabled devices such as smart phones, e-book readers, laptops etc., many institutions are using these opportunities to provide improved information retrieval and communication to their clients (Fling, 2009; Murray, 2010: 234). The widespread of mobile internet services which enables cheap and quick access to information has changed the information and knowledge environment among university students in particular (Smith & Caruso, 2010). Within this context, in order to remain relevant to their users, academic libraries need to provide library services that can be accessed by students regardless of their location (Paterson & Low, 2011:414; King & Brown, 2009).

In contrast to the "traditional" library where major library activities revolved around the physical collection, 21st century libraries are addressing the changing needs of users innovatively introducing services that are flexible, and more user-centered (Lippincott, 2008).

The use of mobile technologies is one of the latest innovations that libraries are using to offer services and resources such as instant messaging, mobile catalogs, mobile collection, incorporating Web 2.0 tools for communication hence facilitating access beyond the library

borders (Lippincott, 2010: 206; Vila, Galvez & Campos, 2010: 323; Pearce, Collard & Whatley, 2010: 250).

A survey conducted by EDUCAUSE showed that 85% of students from developing countries like Uganda at least owned laptops, music/video devices, game devices, wireless hubs, Personal Digital Assistants (PDAs), and smart phones (Smith & Caruso, 2010). From these statistics, it can be seen that mobile penetration has also increased worldwide with the result that the use of mobile devices for communication and information retrieval has become part of students' lives (Lippincott, 2008).

In Uganda, 14.7% of the population are internet users and mobile penetration is also expected to increase by 70.7% in 2014 (World Bank, 2012). This is partly due to the competition in market to force Internet Service Providers (ISPs) to provide competitive services and also the initiatives by the government to regulate the ISP in the country.

1.2 Aim of the study

Currently Makerere University library has a website. However, it is only designed to be accessed using desktop and laptop computers but not any other mobile device. Although users have access to services such as library opening hours, document delivery services, and the online catalogue through the library website, some of the content like e-resources may not display because the website was not designed to display mobile content. Besides, access to e-resources is available only within the campus parameters where the IP address is recognized or using passwords while off campus.

Furthermore, participation and collaboration is limited because the social media tools have not been fully implemented by the library. Communication is either through phone calls, or emails but these are relatively expensive for the users and emails are not reliable because it may not be possible to provide prompt response. Internet connectivity in most parts of Uganda is poor and too unreliable to use it for research purposes.

A possible solution to this could lie in the development of a mobile web so that users with mobile devices are able to access library resources and services from any location other than the library. Also the fact that most students are now using their mobile devices to access information

and communicate with others, provision of mobile services and resources would be a solution to facilitate communication between the librarians and library users.

In the light of the above it was deemed feasible to undertake a study to investigate how mobile technologies can be used to provide mobile-based library services to Makerere University students.

1.2.1 Problem statement

How can mobile technologies be used to provide mobile-based services at Makerere University Library?

1.2.2 Sub Questions

Sub-problems arise from the main problem and these can be addressed using the sub-questions below:

- What mobile devices do students own at Makerere University?
- What are students currently using their mobile devices for?
- What kind of information can students access through their mobile devices?
- What mobile services and resources can libraries adopt?
- Why is it necessary for libraries to adopt mobile technologies?

1.2.3. Objectives of the study

In order to achieve the aim of the study, the following objectives were identified:

- T o assess the perceptions and attitudes of library users towards mobile library services
- Identify the mobile devices that students own so as to determine what services and resources to make mobile.
- Identify the benefits and challenges of implementing mobile library services at Maklib

1.3 Limitations of the study

This study did not address the technical details of mobile technologies or its system installation requirements. It focused on the general use of mobile technologies in academic libraries for the provision of mobile library services and resources.

1.4 Methodology

A qualitative research approach was used for this study. The rationale for using this approach was that the researcher wanted to obtain an in-depth understanding of mobile technologies in academic libraries and also be able to access the students' perception of the phenomenon.

1.4.1 Pilot study

The application of mobile technologies in academic libraries is a new innovation that has not been fully explored in Uganda. In fact, this study is the first of its kind to address it in the context of academic libraries. The researcher therefore thought it necessary to involve a smaller population to investigate whether they were aware of the concept under study. In this way, this study was planned as a pilot study so as to provide informative results that can be used to determine the feasibility of the main study of the implementation of mobile library services at Makerere University Library in future.

1.4.2 Scope of the study

This study was conducted in Kampala city at Makerere University's main library. There were three reasons for choosing the Makerere University library. First, the researcher works in this library and is well acquainted with the information needs and behavior of the users. Secondly, technology can best be seen in this library because there are many technological innovations introduced in the library such as automation programs and so forth. Thirdly, the cost and time resources with which the researcher intended to conduct the study also had to be taken into consideration

1.4.3 Population and sampling

The study population was library users consisting of both undergraduate and postgraduate students of Makerere University.

This study applied random sampling so as to provide the population with an equal and positive chance of being selected for participation. A total of 68 respondents constituted the sample size with 37 undergraduate and 31 postgraduate students.

1.4.4 Data Collection Methods

A survey by means of questionnaires was used for collecting data in this study. The self-administered questionnaires consisting of ten (10) closed-ended questions and seven (7) open-ended questions were distributed to undergraduate students while entering the library as well as postgraduate students in the research commons. The distribution of questionnaires was done by two (2) research assistants.

1.4.5 Data Analysis and Presentation

Data analysis was guided by the research aim and questions. In this study, data was edited, coded and analyzed using Google drive.

1.5 Value of the study

The significances of this study include:

a) The library management could draw lessons from the findings of the study and develop mobile library services in order to meet the needs of the mobile users.

b) The study could furthermore be used as a guide for other academic libraries which may need to implement mobile technology to support the needs of the mobile users.

c) Findings from the study could also be used for continuous education of librarians to enlighten them in the emerging mobile technology trends.

1.6 Definitions of key terms

The key concepts in this study are: Information communication and technologies (ICTs), Mobile technology, mobile device, mobile library services, mobile service delivery and academic libraries

1.6.1 Information communication and technologies (ICTs)

ICTs are networks used in the handling and processing of information (Adebayo & Adesope, 2007). They are used to support teaching, learning and training through delivery of digital materials (Prytherch, 2000). For the purpose of this study, ICTs will refer to the different tools and techniques used for storing, processing and retrieving information such as computers, telecommunications, radios and mobile devices.

1.6.2 Mobile technology

Mobile technology is defined as a collective term used to describe the various cellular communication technologies such as Code Division Multiple Access (CDMA), Global System for Mobile Communication (GSM), Time Division Multiple Access (TDMA) etc B'Far (2005: 634). Kim, Mims & Holmes (2006: 79) define mobile technology as 'technology that uses radio frequency spectrum in any band to facilitate transmission of text data, voice, video, or multimedia services to mobile devices with freedom of time and location limitation'. In this study, the term mobile technology will mean the delivery platform using any of the communication technologies.

1.6 .3 Mobile device

This refers to the tools or gadgets that are used to access mobile library services and resources such as laptops, net books, notebooks, palm tops and mobile phones etc. (Walsh, 2010; Vandi & Djebbari, 2010:323)

1.6 .4 Mobile library services

These are library services that are designed for the mobile users and accessed through any mobile device (Paterson & Low, 2011; Vila, Galvez & Campos, 2010).

1.6 .5 Academic libraries

These are libraries in educational institutions such as universities, colleges, research institutions (Prytherch, 2000). These libraries support teaching and learning in institutions of higher learning.

1.7 Division of chapters

This study is structured in different chapters as set out below:

1.7.1 Chapter one: covers of the introduction to the study. It provides an overview and plan of the entire study including the statement of the problem methodology, as well as definition of key terms. Details of various aspects included in this chapter are covered in subsequent chapters.

1.7.2 Chapter two: presents a detailed literature review on the subject under study. The chapter discusses in detail access to information using the different technologies and also covers the use of mobile technologies in academic libraries.

1.7.3 Chapter Three: presents the methodology applied in this study. The selection of the research location, the identification of the target group and sampling strategy as well as the data collection method are discussed. Data analysis and presentation is also covered. This chapter concludes with a discussion on the confidentiality and ethical issues pertaining to the study.

1.7.4 Chapter Four: presents the data analysis, presentation and interpretation according to the research questions listed in chapter one and three.

1.7.5 Chapter Five: covers the conclusions and recommendations.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature that is pertinent to this study. Topics that are covered in this chapter include: access to information and its importance, as well as how ICTs can be used to facilitate this access. The author discusses why mobile technologies should be used to facilitate access to information by examining the various mobile technology standards and how they facilitate access. According to the Universal Declaration of Human Rights (1948), access to information is a basic human right. Although people are positioning themselves to promote access to information through ICTs, in developing countries there are problems with access using ICTs because of lack of proper infrastructure or skills (UNESCO, 2000). This problem is often referred to as the digital divide (Zickuhr & Smith, 2012). However, with the increase in mobile penetration, users in these countries have increased access to mobile technologies like cell phones (Goodall, Ward & Newman, 2010). This increased access to mobile technologies can assist these citizens in gaining access to information. The detailed access to information and its importance are discussed in the following section.

2.2 Access To Information

According to Inguitia-Oyieke (2008) access to information maybe a physical, psychological, social, cultural or political issue depending on how the users deem it. The Association for Information Management (AIIM) defines Information Access as the 'findability of information regardless of format, channel, or location' (2012). From this definition, it can be seen that people should be able to access information in a traditional format like from books, visits to the zoo, museum or libraries and newspapers or electronic format like videos, televisions without any difficulty. This study focuses on access to electronic information and this is discussed in detail later in this chapter. Any society that depends on information becomes an Information-based

economy/society, making access to information a necessity and a basic human right (UNESCO, 2000). This is discussed in detail in the following section.

2.2.1 Importance of access to information as a human right

Information is an important aspect of communication, and a significant resource for job performance in organizations (Masuki *et al*, 2010). According to the Universal Declaration of Human Rights (1948) access to information is a human right because of its importance as explained below.

Everybody requires access to information in order to make informed decisions and also for public participation at debates (Howes, 2000). Access to information is a public good which can provide people with a good life in three ways: Firstly, human beings desire information by nature because they need to know. Secondly, people need access to information in order to adequately meet their needs and also fulfill their planned goals. Thirdly, if anyone is to protect their rights they need adequate information (UNESCO, 2005; Mathiesen, 2008). However, much as access to information is a human right, it should be put into consideration that the information is of quality i.e. accurate, current, complete and comprehensive and it should be accessed in the right format or channel so that the users can benefit from it (Mathiesen, 2008).

Due to this importance of access to information, many countries have passed laws that permit everybody to have access to information. For instance, in the South African constitution Article 36(1) states that citizens have "the right to: (a) any information held by the state and (b) any information that is held by any person and that is required for the exercise and protection of any rights" (Constitution of South Africa, 1996). Article 41 of the constitution of the republic of Uganda (1996) clearly states that all citizens should have access to information of the state or any other organs. From the above articles, citizens are permitted to access information without any limitation regardless of who owns the information.

Unless people have access to the right information, they may not be able to defend their rights (Matheisen, 2008). This statement is supported by Myhill (2002) who states that in order for people to exercise their rights, they need to have access to adequate information. However, access to information doesn't mean that people have access to any information but rather access

information which will be relevant and can be accessed in the most reliable format (UNESCO, 2005; Matheisen, 2008)). This statement leads to the next discussion on how ICTs can be used to facilitate information access.

2.3 ICTS and access to information

The use of ICTs for information access is the "scientific, technological and engineering disciplines and the management technologies used in the handling of information, processing and application related to computers" (Adebayo & Adesope, 2007). ICTs may include hardware, software and telecommunications such as computers, scanners, digital cameras, handhelds/PDAs, phones, faxes, modems, CD and DVD players and recorders, radio and TV and programs etc. hence facilitating electronic communication and dissemination of information (Myhill, 2002).

The availability of ICTs enables people to acquire information that can be used to improve their social and economic status in society hence leading to an information society if the information acquired is well used (Sandys, 2005). ICTs offer opportunities that may improve the quality of people's lives (Greenberg, 2005) and many other benefits as will be discussed in the following section.

2.3.1 Benefits of using ICTS for information access

The use of ICTs for information access is crucial for sustainable development in communities because these communities have access to quick information via emails, telephones and e-discussion forums hence offer a greater chance to share and disseminate information (Nkanu & Okon, 2010). It is therefore important to deepen our understanding of what benefits are attained when people use ICTs to access information as discussed below:

2.3.1.1 Ability to access quality, current and up-to-date information: Millions of people quest to acquire specific information, knowledge and skills that may be used for their day-to-day activities (Goodall, Ward & Newman, 2007). ICTs make information available and accessible just-in-time ('acquisition of knowledge and skills as they are needed') (Makri, Blanford & Cox, 2008). Quality and current information and knowledge can be accessed and used for development so as to provide opportunities for life-long learning (Greenberg, 2005). Alemneh

(2006) is in agreement with the above when he states that access to computers and internet provides people with an opportunity to access information from well developed websites and other online resources. In this way, ICTs are considered a catalyst in advancing economic growth and poverty reduction in communities because they overcome barriers to communication brought about by distance and time since new information is quickly transferred, shared and disseminated among a large numbers of people (Nkanu & Okon, 2010) as discussed in the next section.

2.3.1.2 Access to information via ICTs enables quick and faster transfer of information: As explained above, ICTs are considered a catalyst for both economic growth and poverty eradication (Nkanu & Okon, 2010). This consideration is for the fact that the use of ICTs for information access enables a larger number of people to quickly access information either through radios, televisions, emails or mobile phones (Mohammed, 2003; Aguolu & Aguolu, 2002). However, it should be noted that the choice of ICTs to be used can be determined by the users as long as the media chosen facilitates information sharing as discussed in the section below.

2.3.1.3 ICTs support large scale information and knowledge sharing: Information sharing and dissemination are powerful contributors towards community development. The models such as information kiosks, telecentres have been used to widely transmit knowledge and information to communities especially those in rural areas using ICTs and this has been considered more effective in contributing to the growth of individuals and communities (Howes, 2000).

The Internet provides a virtual space in which intense interaction and sharing of resources and information takes place (Mohammed, 2003). This also has an impact on health, education & development. According to the International Telecommunication Union (2011), the internet has impacted on facilitating the flow of medical information from one person to another. Besides that, ICTs give people access to market information at a relatively cheaper cost compared to print (Myhill, 2002). Research conducted in both developed and developing countries, indicates that countries with higher levels of access to information using ICTs i.e. Thailand, India, United States etc have demonstrated highest levels in productivity and Gross Domestic Product (GDP). This can be contributed to the effective information and knowledge sharing through the use of

ICTs which stimulate economic growth and development (Pigato, 2001). However, the challenge still remains on how countries using less ICTs can benefit from such benefits so as to narrow the digital divide which is one of the benefits of accessing information using ICTs as discussed below.

2.3.1.4 Bridging the digital divide: The universe has changed due to globalization and technological innovations. These changes have led to the ICTs emergence in organizations and institutions leading to a revolution in information development, acquisition and dissemination hence changing their general operations (Tinio, 2002; Mlitwa, 2007). The changing trend in the digital age has created a platform for information and knowledge sharing worldwide (Nkanu & Okon, 2010). The traditional methods of accessing information have changed and this is evident through the different ICT devices like computers, CD-ROM; magnetic tapes, mobile phones etc that are used to access information, (Pigato, 2001).

With ICTs in place, we can have access to, retrieve and disseminate information regardless of location, time, package or user therefore knowledge can be transferred from one place to another at a faster speed hence bridging the digital gap between both the developed and developing countries (Mohammed, 2003; Aguolu & Aguolu, 2002). Although there are benefits of accessing information via ICT devices, there are also problems that hinder the ICT access to information. These problems are addressed in the following section.

2.3.2 Problems hindering ICT access to information

According to the Organization for Economic Cooperation and Development (2009), there are a number of barriers inhibiting the use of ICTs for information access such as poor network coverage, high illiteracy rates, costs, 'restrictive legislation' and 'strict technology protection measures'. These problems have led to information getting 'stuck in a groove' meaning that many people are not able to access information using this platform especially those in rural areas hence contributing to the digital divide (Nicholson, 2011:9; Maranto & Phang, 2010:9; Omona & Ikoja-Odongo, 2006). Salehi & Salehi (2012) classified these barriers as extrinsic or intrinsic. These are discussed in detail in the following section:

2.3.2.1 Extrinsic barriers: These barriers are those that are beyond the individual's control, such as lack of skills, poor/ inadequate infrastructure and economic problems as explained below.

2.3.2.1.1 Lack of skills and expertise in using ICTs: A skilled workforce and community is important for the successful use of ICTs, however, many of the communities in developing countries like Uganda are not computer literate and therefore few people can actually use this platform for accessing information especially computers (Saravani & Haddow, 2011). Although a lot has been done to improve access to electronic information through for example telecenters and information kiosks, people are still not able to access, process and use these facilitates without the help of the professional staff (Gatero, 2010:62; Salehi & Salehi, 2012:40).

Research by Saravani & Haddow (2011:185) stated that lack of 'training in digital literacy', 'lack of pedagogic' and lack of training in how to use ICTs and other technologies were barriers to using new technologies for any purpose. Training therefore is a necessity if people are to develop the required skills and competence in using ICTs for information access (Newhouse, 2002). However, besides training, developing countries like Uganda are faced with a challenge of poor/inadequate ICT infrastructure which hinders access as explained in the following section.

2.3.2.1.2 Poor/inadequate ICT infrastructure: The inability of accessing information via ICTs maybe as a result of inadequate or lack of ICT infrastructure (Howes, 2000). It is important to note that the provision of good infrastructure does not necessarily guarantee an increase in ICT usage although the availability of the ICT equipment and infrastructure such as reliable power are regarded as a positive step towards encouraging new methods of accessing information (Rodden, 2010:20).

A study by Du Plessis & Web (2012:313) indicated that lack of access to appropriate resources such as software, hardware and internet access limit the usage of ICTs and information access via these ICTs. Technology and globalization have compelled communities to adapt to new technology in order to be competitive, to survive, and to be successful through the use of information and communication technology. Therefore, to have a poor and inefficient ICT

infrastructure is tantamount to losing economic development (Haliso, 2011) as discussed in the next paragraph.

2.3.2.1.3 Economic problems: Inadequate budgets/funds are also a factor that hinders the access of information via ICTs especially in developing countries (Haliso, 2011). Governments especially those in developing countries like Uganda are still unconvinced of the importance of using ICTs for information access in creating economic growth and have paid little attention to the national need for ICT infrastructure and resources and diverted resources to other pressing concerns such as food security, defense and health care (Alemneh, 2006:11). This problem therefore leads to poor infrastructure hence high ICT transaction costs in developing countries (Africa Partnership Forum, 2008). According to International Telecommunication Union (2013), ICT costs in developing countries like Uganda still remain expensive with 30.1% average monthly incomes regardless of the high ICT penetration rates. Although the above hindrances are solely beyond the individuals, there are other problems that are about the individuals and these are referred to as intrinsic, a detailed explanation of these factors is presented in the next section.

2.3.2.2 Intrinsic factors: According to Salehi & Salehi (2012:41), these are the problems that are about the individual such as culture, attitudes, beliefs, practices and resistance. These are discussed in detail in the paragraph that follows.

2.3.2.2.1 Culture: Another factor that contributes to low access of information via ICTs is culture/beliefs/practices (Tully, 2003). System designers, programmers and implementers need to understand the different cultures in countries within which the different ICTs are implemented and information is accessed through (Haliso, 2011). Acceptability of any ICTs and access to information through these technologies depends on the culture, and this can be influenced by the age of the people and the environment in which one grew up (Tully, 2003).

2.3.2.2.2 Attitude: According to Adekunde, Omoba & Tella (2007), attitude is 'learned pre-disposition to respond in a consistently favorable and unfavorable manner with respect to a given object'. Positive attitude determines the level of integrating new technologies into human settings hence changing their lives by providing quick and easy access to information (Haliso,

2011). According to Papaioannou & Charalambous (2011:352), community, educators and leaders' attitudes towards ICTs and access to information via these ICTs should be a primary concern because positive attitudes, enthusiasm, and commitment towards ICT implementation and integration can play a significant role in promoting access to information which can lead a country to enjoying the benefits of ICTs in development.

Although there are many barriers to accessing information through the use of ICTs such as radios, televisions, computers and fixed telephones which were commonly used (Greenberg, 2005), innovations like mobile technologies have emerged to solve the barriers associated with access and infrastructure using the traditional tools, which lead to the next discussion on how mobile technologies can be used to facilitate access to information.

2.4 Mobile technologies

Mobile technology is defined as a collective term used to describe the various cellular communication technologies such as Code Division Multiple Access (CDMA), Global System for Mobile Communication (GSM), Time Division Multiple Access (TDMA) etc. (B'Far, 2005:634). Kim, Mims & Holmes (2006:79) define mobile technology as "technology that uses radio frequency spectrum in any band to facilitate transmission of text data, voice, video, or multimedia services to mobile devices with freedom of time and location limitation". They further stated mobility and computing as aspects that constitute mobile technology.

Mobile technologies facilitate information access and the provision of services that are portable and accessed using mobile devices that are enabled using Wireless Fidelity (WI-FI), Bluetooth, 3G, Global System for Mobile Communications (GSM) and General Packet Radio Services (GPRS) (Vandi & Djebbari, 2010: 15). For that reason therefore, it is necessary to look at the different mobile generations, what each entails and how each facilitates access to information.

2.4.1 Mobile wireless technology standards

The mobile technologies standards that will be covered in this study will include second Generation (2G) including 2.5G, Third Generation (3G) and Fourth Generation (4G).

2.4.1.1 Second Generation (2G) wireless standards: Before the revolution of the Second generation (2G) there was First generation (1G) which used the analog models that relied on Frequency Division Multiple Access (FDMA) methods to transmit multiple radio channels for communication with multiple users (Sunil, 2010). The 2G standards with digital mobile phones and digital mobile networks appeared in the 1990s, when the mobile communication industry experienced tremendous growth in relation to services and increased numbers of subscribers, this therefore replaced the 1G which had limited system capacity and poor voice quality (Akhtar, n.d.).

2G networks were developed to provide voice communication and data service at relatively lower rates because 2G allows limited data support that ranges from 9.6kbps to 19.2kbps which is not appropriate for multimedia applications and web browsing (Sunil, 2010).

The 2G networks are based on circuit-switching which uses the Time Division Multiple Access technology. It also deploys Code Division Multiple Access and Global Systems for Mobile Signaling technologies, which have an improved system capacity to provide service quality and information security (Akhtar, n.d.). These technologies are explained in the next paragraph.

2.4.1.1.1Time Division Multiple Access (TDMA): TDMA was developed in 1991 by Ericson to provide digital, circuit switched technology operating on the 824-894 MHz frequency band which allows 9.6 Kbps data transfer rate (Sunil, 2010). In TDMA the capacity of the network increases however it requires time synchronization between the users because of the shared bandwidth (Sunil, 2010) meaning that users will have to wait longer for data to be transferred to their respective devices hence providing slower connectivity. This is not appropriate technology to use in libraries for service enhancement because library users need just-in-time information whenever needed. CDMA was therefore introduced to solve the time problem associated with TDMA as discussed below.

2.4.1.1.2 Code Division Multiple Access (CDMA): CDMA is a second generation wireless standard that was developed by Qualcomm in 1993 (Sunil, 2010, Koseoglu, 2004). CDMA technology uses digital signals, packet switching and spread spectrum to modulate the digital

signal which gives it many advantages over the TDMA and FDMA standards. These advantages are:

- Higher communication security level
- Efficient use of bandwidth
- Quality voice calls

In CDMA networks, users are assigned separate codes but they access the same bandwidth enabling every user to transmit the signals on the same frequency (Koseoglu, 2004). However, CDMA technologies are not favorable for developing countries because of the limited bandwidth which would affect the flow and quality of information hence making Global systems for mobile signaling of more advantage as discussed below.

2.4.1.1.3 Global Systems for Mobile Signaling (GSM): Global System for Mobile Communications(GSM) is a digital mobile telephony system that provides communication over a particular coverage area which is defined by cell, location area, mobile switching centre areas and public land mobile network areas (B'Far, 2005:634; Koseoglu, 2004:11). The technology was developed in 1991 by the European Telecommunications Standards Institute (ETSI) and it was also designed to support both voice and data services (Koseoglu, 2004).

GSM is an important global digital technology which operates by dividing the available radio spectrum into channels which are also divided into "eight time slots to be used by eight users simultaneously", implying that GSM can be used to transmit information across distances by compressing data, and sending it to the recipient at its own time slot (Iwhiwhu, Ruteyan & Eghwubare, 2010:5).

According to Koseoglu (2004) GSM technology operates in different geographical areas in three different frequency bands i.e. GSM 900 (890-960 MHz), GSM 1800 (1710-1880 MHz), GSM 1900 (1850-1990 MHz). GSM is the world's leading and fastest growing mobile network technology being used by over 1billion subscribers across over 190 countries globally; it also provides the most secure public wireless network with over 75% GSM new mobile subscriptions (Koseoglu, 2004). With the increasing mobile penetration in Uganda, this technology would be the most appropriate for library users who are part of the population with mobile phones. However, GSM manages mostly limited data and with the emergence of other generations,

which operate at faster frequency band, this would not be appropriate as it may be slower compared to the newer technologies (B'Far, 2005:634). These new technologies are discussed in the following paragraphs.

2.4.1.2 Second Generation and a half (2.5G) standards: Phone companies and telecom operators spent a lot of money to buy third generation wireless technology (3G) licenses from the national governments yet the licenses were unable to provide 19 wireless services in a specific frequency band in certain geographical areas coupled with the high cost, operators found a cheaper solution and developed 2.5 Generation Wireless Technology (2.5G) (Koseoglu, 2004).

2.5 G technologies are an extension of the existing 2G networks but they have a faster data transfer speed, enabling internet connection and providing full service which can also be available in 3G wireless technology. Because of the popularity of GSM as a 2G standard, all the 2.5G technologies were designed to work on GSM networks (Sunil, 2010; Koseoglu, 2004). This is a more appropriate technology to use in Uganda for mobile library services because it is relatively faster than the other standards discussed above. High Speed Circuit Switched Data (HSCD), General Packet Radio Service (GPRS), Enhanced Data Rates for Global Evolution (EDGE) and IS-95B are 2.5G technologies (Akhtar, n.d.). These technologies are discussed in detail in the following section.

2.4.1.2.1 High Speed Circuit Switched Data: High Speed Circuit Switched Data (HSCD) was developed in 2000. It is based on GSM network and uses circuit switching technology. HSCD technology enables users to use PC cards or HSCD data terminals to get higher data rates on existing GSM networks enabling every user to get 9.6 kbps of bandwidth; mobile devices get data rates three times as much as reaching 28.8 kbps (Koseoglu, 2004). This is an appropriate technology for mobile users because it allows maximum data rates but this is relatively lower as compared to the GPRS which provides it with an advantage for library users as discussed below.

2.4.1.2.2 General Packet Radio Service (GPRS): GPRS is a service which enables information to be sent and received across mobile phone networks (Akhtar, n.d.). GPRS which is a connection link between GSM and 3G wireless services was developed in 2000 in order to provide data transfer rates that are three times faster than GSM network at an approximately estimated speeds of 171.2 Kbps.

GPRS uses a packet-switching technology which transmits data individually at a higher speed because the network carries more users (Akhtar,n.d.). Further, GPRS has major benefits i.e. wireless terminal is always connected to the network and also ensures there is availability of internet access (Koseoglu, 2004). Although GPRS has a speed advantage over the other networks explained above, it is not an appropriate technology for library users in Uganda because it is slower when it comes to downloading multimedia and large documents which could be a disadvantage for library users (Koseoglu, 2004). Due to that challenge, 3G technology was developed so as to resolve the challenge as discussed in the following section.

2.4.1.3 Third Generation (3G) standards: Third Generation Wireless Technology (3G) was developed to solve the problems of the previous generations such as inability to access multimedia, low speed etc. (Koseoglu, 2004; Sunil, 2010). 3G uses the packet-switching technology like GPRS, this is therefore an assurance that there is reliable internet connectivity providing approximately data rate of 2Mbps (Vandi & Djebbari, 2010:15).

3G has increased computing abilities through the availability of mobile internet implying that people are able to access, download and share multimedia information using mobile devices such as apple's iPhone, black berry, Motorola RAZR, Samsung, android phones etc. (Sunil, 2010). This study is on how mobile technologies can be used to access information; this technology would be appropriate because it enables users to access information using the mobile devices that they own.

In summary, 3G is viewed as the most suitable way to offer faster access to information because of the fact that it uses the packet-switching technology which provides fulltime access to internet and delivers high speed data transfer of up to 2Mbps (indoors) and 384 Kbps (outdoors) (Sunil, 2010). It is also a technology that can be used to deliver mobile-based services as those compared to applications of GPRS (Koseoglu, 2004). According to Sunil (2010), the main aim of developing 3G was to ensure "interoperability" and "standardized usage of spectrum frequency" which the technology currently provides. The following is a technology used in 3G.

2.4.1.3.1 Enhanced Data Rates For Global Evolution (EDGE): In 2001, Enhanced Data Rates for Global Evolution (EDGE) was developed basing on the GPRS network, EDGE is also based on packet-switching technology which transfers data at 384 Kbps speed, improving the performance and efficiency of the GPRS network (Sunil, 2010).

EDGE is designed to use the same channel and time slot structure as GSM and GPRS which allows data to be transferred faster and more efficiently because it handles more traffic (Sunil, 2010; Koseoglu, 2004). This is the most appropriate technology for Uganda because it is the service provided by the telecom companies and also for the fact that it enables library users' access fast and efficient information. However, it is also important to discuss WiMAX which is the fastest technology and can be considered for future implementation of mobile library services at Makerere University.

2.4.1.4 Worldwide Interoperability for Microwave Access (WiMAX): WiMAX is an "IP based, fixed wireless broadband access technology that provides performance similar to 802.11/Wi-Fi networks with the coverage and QOS (quality of service) of cellular networks" (WiMAX, 2012). It is the first 4G mobile wireless technologies with endless applications such as WiFi internet connectivity available through hotspots and IP enabled devices like mobile phones and video surveillance camera (WiMAX, 2012).

WiMAX also provides wireless Metropolitan Area Network (MAN) connectivity with speeds reaching 70Mbps, meaning that the WiMAX base station covers an average of 5 to 10 km with this capacity, institutions of higher learning and business entities can acquire the network by offering both the hotspot and mobile connectivity for their clients hence providing the portability and convenience advantages that mobile devices offer (Sunil, 2010). This technology would be the best for implementing mobile library services in future because WiMAX services for now are offered in urban areas hence limiting the rural users (ITU, 2013). With the different mobile technologies discussed, it is important to explain how the most applicable standard can be used in academic libraries to facilitate access. This is discussed in the following section.

2.5 Mobile technologies in academic libraries

The popularity of mobile technologies has led to the development of innovative information access platforms using mobile devices (Nicholson, 2011:9). With the availability of mobile broadband that offers faster connectivity and high rate of mobile, PC and internet penetration, many people are using mobile devices especially the mobile phones to access information to satisfy their information needs (Hobson, 2010).

Academic libraries are providing a wide range of mobile services in order to support teaching, learning and research (Lippincott, 2008). Some libraries are even taking a step forward to provide mobile devices that can be loaned to users for instance laptop loan programmes, cameras MP3 players IPod touch, e-book readers etc. For example, Princeton University introduced a Kindle loan programme in order to ascertain whether it can reduce the level of printing among students (Lippincott, 2010:209). These mobile services were reengineered to promote and improve reference services to suit all kinds of users, however, with all the different mobile devices in place and on sale, it is difficult to know which device and services will be appreciated by the users (Villa, Galvez & Campos, 2010).

An assessment study carried by Iwhiwhu, Ruteyan & Eghwubare (2010) explored prospects of providing library services at the Delta State University in Nigeria. This study revealed that mobile services could support "library-to-user online interaction, "user-to-library online" interaction, user-to-user online interaction and also attract users to the library. However, the provision of these serives was challenged by lack of infrastructure, high telecommunication costs, interconnectivity problems, neglect by the library management to innovations. This view is shared by Nicholson (2011) and Maranto & Phang (2010:9) who state that limited bandwidth and power fluctuations (among other hindrances) can hinder mobile access to information among the library users.

According to Lippincott (2010), libraries have gone through many changes ranging from automation to electronic resources. Librarians have turned to technology by automating most library functions, digitization and use of mobile services in order to enhance service delivery

(Vila, Galvez & Campos, 2010). The main objective of academic libraries is to support the teaching, learning and research activities of the parent institution. There is a need for libraries to provide services that invite more users into the library for instance through the use of Mobile and Web2.0 technologies; librarians should therefore develop an attitude of being increasingly client-centered in order to provide these services (Lippincott, 2010). It is therefore the role of the librarians to educate the library users how to use mobile devices to access library resources and services and also use these devices to facilitate communication (Lippincott, 2010:210). There are many different kinds, styles of mobile devices that can be used for information retrieval and access such as laptops, notebooks, PDAs, camera phones, cell phones and smart phones (Kroski, 2008:10). These devices other than the mobile phones are discussed in the next sections.

2.6 Mobile devices

Mobile devices are tools or gadgets used to access information, services and resources for example laptops, net books, notebooks computers, Palm tops and mobile phones (smart phones) etc. (Walsh, 2010; Vandi & Djebbari, 2010:15). They also include audio players such as MP3 players, cameras and e-book readers etc (Lippincott, 2010:206). These devices are internet enabled so as to facilitate access to information like video and voice data, e-mail services, text messaging, database searching, internet browsing, accessing the learning management system, photography and videography, games and access GPS (Lippincott, 2010:207). Mobile devices can be taken as tools for "storing, identifying and carrying information on the user" (Vandi & Djebbari, 2010:16).

2.6.1 Handheld computers: These are computers that are portable and easily stored in the pocket (Kroski, 2008). They are the most commonly used mobile devices in higher education because of their ability to connect to wireless internet connectivity (Kim, Mims & Holmes, 2006:84).There are many handheld computers as explained below:

2.6.1.1 Personal Digital Assistants (PDAs): These are handheld digital wireless devices which stores information and allow users to take notes (Kroski, 2008; Koseoglu, 2004). PDAs combine the functionality of computers and telephones (Kim, Mims & Holmes, 2006:84). They can be used for content management, information access, finance management, mobile conferencing (mobile PDA produce power point Presentation and distribute web-based images), vehicle locator, network data access Generally, PDAs are used as Personal information Management

tools (Koseoglu, 2004:43). Faculty, staff and students in institutions of higher learning use PDAs to access e-books and web pages i.e. the PDAs can as well be used as referencing tools because they are convenient to use (Cummings, Meril & Borrelli, 2010).

2.6.1.2 Laptop/Notebook computers: These are portable computers that can be used in temporary spaces like libraries, airplanes and meetings (Koseoglu, 2004).

2.6.2 E-readers: According to Kosturski & Skornia (2011:12), e-readers have been around decades but only became common in the last 5 years in libraries. Examples include e-book readers like Amazon's kindle, Barnes and Noble nooks, Sony digital reader and the border's kobo, Apple iPad, iPod, Samsung Galaxy Tab (Richardson & Mahmood, 2011:12; Kroski, 2008). E-readers are similar to notebooks in size, have long battery life, have an integrated Bluetooth and WLAN 802.11b which enable the use of wireless networks and therefore can facilitate access to information hence meet the information needs of the mobile users (Koseoglu, 2004:44; Lippincott, 2010:209).

2.6.3 Tablets: Tablet PCs such as ipads are acceptable gadgets although the prices are still high, however, prices are expected to drop (Kosturski & Skornia, 2011:12). The authors further stated that tablets are used to access information online implying that any library activities such as downloading articles, searching databases, audio-visual materials and catalogues can be done using this gadget hence providing "on-spot" convenient reference service (Lippincott, 2009:4).

2.6.4 MP3 Players: According to Kosturski & Skornia (2011: 12), there are many mobile devices that can be used to access audio or video tours in the library for example iPods or any other MP3 player. These devices provide students with the convenience of exploring the library and collection that meet their needs (Kosturski & Skornia, 2011: 12; Lippincott, 2010, 2008). Academic libraries are offering services that can enhance access to information via these mobile devices as discussed in the following section.

2.7 Mobile applications in academic libraries

Academic libraries are offering a range of services to users that can be accessed using mobile devices in order to enhance access to reference services and resources (Little, 2011:267; Villa, Galvez & Campos, 2010; Lippincott, 2010, 2008). According to Hahn (2008:84), mobile technology provides an opportunity to enhance traditional library services. In the following section various mobile applications that can be used to enhance access to information within an academic library context are discussed.

2.8.1.1 Mobile website: According to Kroski (2008), the mobile web can be defined as "World Wide Web accessed through a mobile device". The mobile website should have an interface that is compatible with the mobile devices and therefore should be able to display content and graphics that are visible to the users for easy access (Vila, Galvez & Campos, 2010:302). Through the mobile web, all the library services and resources can be made viewable to the mobile users (Kroski, 2008:33).

2.8.1.2 Mobile catalogues (MOPAC): Academic libraries have innovatively implemented access to information anywhere any time in order to facilitate access through the mobile devices (Vila, Galvez & Campos, 2010:327; Murray, 2010:238). Vila, Galvez & Campos (2010) further stated that, Mobile catalogues (MOPAC) have been implemented to facilitate fast and quick retrieval and also save time on the part of the users. This is in agreement by Paterson & Low (2011:418) who stated that 60 percent of students interviewed noted that it is important and easy to search the catalogue while on the move.

Academic libraries may provide catalogue searches in the mobile sites using options i.e. using the vendor-supplied version like the Innovative interface (AirPAC) or customizing their own individual websites (Kroski, 2008:33). However, costs and technical support associated with mobile catalogues should always be considered (Bridges, Rempel & Griggs, 2010:314).

2.8.1.3 Short Message Service (SMS) Notifications /text messaging : This is the most known application since the introduction of mobile technologies in academic libraries. These messages can be channeled to reach the users and alert them about the availability of a reserved book, library news etc (Pearce, Collard & Whatley, 2010:250). However, librarians need to get permission from users whether or not to send those SMS notifications through their mobile

devices in order not to inconvenience their users and also respect the privacy of users by sending an authorized message (Vila, Galvez & Campos, 2010: 331).

According to a study by Paterson & Low (2011: 412), students revealed that alerts are very important because they keep them updated about the library. Other SMS alerts can be created in relation to interlibrary loans (Vila, Galvez & Campos, 2010:331). Although some librarians have reported challenges of texting like receiving shallow reference questions and also difficulty to answer some of the queries via SMS, SMS reference services in academic libraries is growing because it is a fast and convenient way of communication (Luo, 2011:483; Pearce, Collard & Whatley, 2010:252 ; Brown, Vetter & Saunders-White, 2008).

SMS notifications can be modeled in such a way that SMS messages are sent to one dedicated number or the service model which converts the SMS into an e-mail so that the reference team can respond (Buczynski, 2008; Luo, 2011:484). The choice of which model to use therefore depends on the individual libraries and what best meets the needs of the users (Brown, Vetter & Saunders-White, 2008).

2.8.1.4 Quick response (QR): A QR code is a "system that stores information within a dot matrix or two dimensional barcode, which stores both textual and numerical information that can be read on a mobile device which has a QR application". Also referred to as "mobile tagging" (Vila, Galvez & Campos, 2010: 332). QR codes make use of both the vertical and horizontal dimensions that can be read by the mobile phone which has a camera and are internet enabled (Barker, 2012).

QR codes are used to market new web services and contain registration forms for users to access the computer labs (Vila, Galvez & Campos, 2010:332). They further state that QR codes allow users to keep data in their personal devices other than paper and also time saving for both the library and users. QR codes automatically capture and transfer data into the mobile users' phones, but it should be noted that not all mobile phones have QR readers, however, there are free mobile generators and readers that can be used to read and decode QR codes. Users therefore need to have mobile phones with a camera and are internet enabled and have QR code

readers in order to use this service. Examples of free QR generators and readers include (http://www.beetagg.com) , (http://www.2dsense.com), (http://www.kaywa.com) , (http://www.semapedia.com) (Little, 2011:267; Barker, 2012).

QR codes can be used to Link print and electronic resources, linking users to an alternative e-book, link Online audiovisual and video materials, outreach services, finding help, allows mobile tagging and generate catalogue record for items (Pulliam & Landry, 2011:68; Walsh, 2010:433).

2.8.1.5 Mobile collection and databases: Mobile collection span a wide range of content just as it is with the traditional collection. The nature of the collection dictates whether they will be accessed directly through the mobile device or they will be downloaded and saved onto the mobile device (Murray, 2010:240; Kroski, 2008:34). Some of the mobile resources that can be accessed via mobile include:

- Music and video files
- Audio book collections
- Reference collection like encyclopedias and almanacs

A number of database publishers have also made available mobile friendly versions of their content such as e-journals; e-books etc (Murray, 2010:241; Buczynski, 2008). Such publishers include social science research network (McKiernan, 2010). Ebscohost provides mobile interface for Ebsco products which can be useful for mobile library users (Hadro, 2009). Music online, which provides access to audio/video recordings and full text music reference (McKiernan, 2010). All these databases can be accessed through any kind of mobile device especially e-book readers like Amazon's kindle, Sony Reader and Nook hence making access to information while on the go possible (Murray, 2010:242).

2.8.1.6 Mobile instruction and tours*:* Every year universities get new students who need to be taken around the library. However, the time and staff to do this is a challenge for many libraries therefore there is a need for more innovative alternatives (Buczynski, 2008). Libraries have started using a number of tools to provide mobile instruction services such as orientation, information literacy programs, for example using You Tube for library tour videos (Kroski,

2008:35) and the use of podcasts to provide content to benefit distance students and those studying abroad (Murray, 2010; Choy, 2010).

Another mobile instruction service that can be applicable in academic libraries is the use of "Guide by call", which is a service that provides a toll free mobile number which users can dial and follow voice prompts according to their needs and what information they want to get (Kroski, 2008).

2.8.1.7 Mobile subject guides: In order to facilitate access to subject information and also provide students with reliable and trustworthy information, libraries are using mobile subject guides (Boruff & Bilodeau, 2012:58). Subject guides/webliographies/pathfinders may be created using either blogs or wikis which can be accessed through a mobile device (Choy, 2010). However, when designing subject guides, librarians should provide resources that are easily downloadable on mobile devices either online or offline, most important offline especially in areas where access to the internet is not reliable (Boruff & Bilodeau, 2012).

2.8.1.8 Mobile services for Visual and hearing impairments*:* Another innovative use of mobile technology is for libraries to use mobile phones to assist persons with visual or hearing disabilities, examples of these are: Mobile devices such as the iPad or iPhone which have inbuilt screen readers that can be used by especially the visually impaired to access information (Nicholson, 2011).

Users who have visual and hearing impairments can also use Mobile Accessibility facility, which is "a screen-access application which provides touch navigation, voice synthesis, email, calender entries, Global Positioning Systems, and access to social networking sites" (Nicholson, 2011:8).

The use of augmented reality (AR). AR refers to the "addition of a computer-assisted contextual layer of information over the real world, creating a reality that is enhanced or augmented using either text to speech" or vice versa (Nicholson, 2011:8). Nicholson (2011) further states that AR is another way of providing mobile services to the deaf and hearing impaired students so as to enhance access to information.

The following section discusses the advantages of implementing the above mobile services in an academic library.

2.8 Advantages of using mobile technologies as an information delivery platform in libraries

People have integrated mobile technologies into their personal lives especially cell phones which they have "embedded within their usual personal apparel and constitute the preferred electronic device of this mobile-generation (M-generation)" (Vila, Galvez & Campos, 2010:332) but librarians should be in place to explain the implication of these technologies to all the interested stakeholders (Lippincott, 2010). The advantages of integrating these technologies within an academic library context are discussed in the following section.

2.8.1 Exposure to new technologies*:* According to Hey *et al* (2007) and Murray (2010:243), the application of mobile technologies in libraries exposes students to the new technologies and also provides hands-on opportunities since they have to locate resources without the presence of the librarians. This is supported by Choy (2010:62) who states that due to the technological changes, libraries need to innovatively adopt services that are relevant to users such as mobile library services which are a new phenomenon and portray development.

2.8.2 Convenient and flexible*:* The use of mobile technology for the provision of library services is convenient for mobile users; for instance, it allows users to access reading materials outside the library and classroom (Hey *et al*, 2007:441; Murray, 2010:243). Choy (2010:65) also states that, library users need to get access to information that is convenient to use and access. A study by Hey *et al* entitled "Designing mobile digital library services for pre-engineering and technology literacy" revealed that the iPod was used to help elementary school students to study and access reading materials while at home. This study thus shows the power of using mobile technology for information access regardless of location.

Sheikh & Mills (2010:154) agreed that mobile technologies provide mobile access to course materials from anywhere. Vila, Galvez & Campos (2010:322) stated that mobile technology has become part of the students' lives in higher learning; students are using mobile devices as personal management tools. This advantage can be considered by libraries to provide information that can be accessed via mobile devices.

Furthermore, mobile devices make it very easy to move around with many reading materials all in one small device; for instance, users can upload many e-books for storage in a PDA and access whenever they feel like (Hey *et al*, 2007).

2.8.3 Provision of equal access: According to Mbambo-Thata (2010), providing mobile resources is an effective way to provide content to a wider range of library users as compared to the physical use of the libraries and computers to access resources within the library. Hey *et al* (2007:449) state that mobile technologies help libraries deal with the problem of limited space and IT infrastructure such as computers.

Using mobile technologies is a way to provide new library services and enhance traditional services that the library offers hence making them more relevant and accessible to users of all generations (Murray, 2010:233). The author further states that the mobile technologies have become the immediate and preferable mode of access to information especially among the generation X users and millennial users which constitute the highest number of students in institutions of higher learning.

Furthermore, the use of mobile technologies can enable libraries to access library users through familiar accessible services such as text messaging which is an "SMS reference service" (Cohen & Burkhardt, 2010; Brown, Vetter & Saunders-White, 2008). However, libraries need to evaluate whether this service will be relevant to their users and if it will be provided easily (Murray, 2010:238). Iwhiwhu, Ruteyan & Eghwubare (2010:5) complemented that mobile technologies in libraries attract users to use the library materials and also retain them hence providing equal access to all connected users.

2.8.4 Create a link between the library collection and the users: Mobile devices modify the relationship between the users and "users' habitual information ecosystem", therefore affecting the way users search the library and interact with their devices hence making them independent researchers (Vandi & Djebbari, 2011:15).

Vandi & Djebbari (2011) further state that the use of mobile technology involves the interaction between the user, system and the content. This improves the continuity between the pre/post library visits since the users tend to focus their attention on the library resource. As the mobile

device will act as a "cognitive tabular tool" (Walsh, 2010); for instance, storing bibliographical reference in a mobile device enables the users to access the corresponding material using QR codes, RFID tags even after they have left the library building (Vandi & Djebbari, 2011:17; Cohen & Burkhardt, 2010).

2.8.5 Access to information independently: According to Lippincott (2010:210), mobile devices provide personalized learning implying that this provides the users with the skills to work without supervision (Murray, 2010).

2.8.6 Wider penetration: Another benefit of implementing mobile technologies in academic libraries is its wide penetration in low-middle-income countries like Uganda (ITU, 2011). This is an advantage that academic libraries can consider to provide library services that users can access using their mobile devices. Although all these advantages can help the user to access information from the academic library, there are also challenges of using mobile technologies as an information delivery platform in academic libraries. These challenges are discussed in the following section

2.9 Challenges of using mobile technologies as an information delivery platform in academic libraries

Although mobile technologies have enormous advantages, it is important to discuss some of the disadvantages which libraries that implement them are likely to encounter. The following paragraph discusses such disadvantages.

2.9.1 Mobile device limitations: There are many challenges associated with mobile device limitation as explained below:

According to Lippincott (2008), viewing large images is made difficult by the use of the mobile devices especially phones because they have small screens. This is supported by Mbambo-Thata (2010:469), who states that some phones are limited to text, others to graphics only and colour capability. This means that these devices may not be convenient for use by users who may need to access information with text, graphics and colour.

- Mobile devices have slower connectivity due to limitation to bandwidth (Mbambo-Thata, 2010). This implies that the use of mobile technology may not fully support access to multimedia which requires faster connections (Sheikh & Mills, 2010:155).

- Although the use of mobile technologies supports portability, Sheikh & Mills (2010:115) suggest that, there is a risk of users downloading other software on the devices like viruses. Libraries planning to implement mobile services should take into consideration the challenges that they are likely to face while using this platform for service delivery and think of ways of how to address them.

- Limited storage memory: the use of mobile devices does not support the storage of large content (Parsons, 2010).

- Some mobile devices do not support or facilitate printing, this is a challenge that users may face and hence limit the use of mobile library services (Barnhart & Pierce, 2011:289; Sheikh & Mills, 2010:155; Mbambo-Thata, 2010; Parsons, 2010; Kumar & Chobe, 2011).

2.9.2 Cost of integrating new technology: According to Barnhart & Pierce (2011:289), some institutions especially those in developing countries are not ready to invest in piloting new technologies. Where the institutions are convinced about the technology, it is unlikely that they can provide individual librarians with the required equipment for the implementation process.

According to Parsons (2010), from the user perspective, it is costly to acquire any mobile device given the rapid technological advancements that require the users to keep changing devices.

2.9.3 Lack of /inadequate IT skills: as discussed in the previous section, a skilled workforce and community is important for the successful use of ICTs as well as skilled librarians, however, some librarians are not trained to provide the expertise required for mobile technology implementation (Saravani & Haddow, 2011:185). This implies that librarians need the required skills that can be used to implement and provide technical support to users using mobile devices to access information (Parsons, 2010:234).

2.9.4 Resistance to change: According to Saravani & Haddow (2011), lack of support from both staff and senior management is another challenge that academic libraries are likely to face because of lack of preparedness by both parties to accept the new technology.

Although there are many challenges associated with the use of mobile technologies ranging from the device limitations to resistance from the staff, the advantages are more compelling that Makerere University library has no choice but to go mobile so as to remain relevant to the different users. This is discussed in the next chapter.

Conclusion

The role of mobile technologies for information access in academic libraries can't be underestimated. In this chapter, literature related to the topic was reviewed. Access to information was reviewed and the theories provide the benefits and factors that limit access to information using ICTs. The different ICTs like television, radios etc were discussed and how they facilitate access to information.

Mobile technologies standards such as 2G, 3G, 4G, EDGE , WiMAX and how they facilitate access to information were also discussed in this chapter. The different mobile devices that can be used as delivery platforms were also tackled.

Mobile technologies in academic libraries were discussed highlighting the different mobile library services that can be implemented such as mobile online public catalogues, SMS/notification, mobile instruction, subject guides etc. Besides, the benefits and challenges of mobile technologies as an information delivery platform were discussed. From the literature it is apparent that libraries need to determine which reference services to offer so as to meet the needs of the users putting into consideration the available financial and human resources.

The next chapter discusses the research approach used to conduct the pilot study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The main aim of this study is to investigate how mobile technologies can be used to provide mobile-based library services at Makerere University. In this chapter, the research methodology and its application are dealt with: the research approach, selection of the research location as well as the target population are covered. The data collection methods used and the rationale for its selection is also discussed. Furthermore, this chapter also discusses the application of questions in order to provide a rationale as to why particular questions were asked. Data analysis and presentation is also addressed.

3.2 Research approach

This study applied a qualitative research approach. Kothari (2004) defines qualitative research as a personal evaluation of attitudes, opinions and behavior which is intended to generate results either in non-quantitative form or in a form that doesn't need too much numerical analysis. A qualitative research approach was used for this study as it examined users' attitudes, opinions and behavior concerning the use of mobile devices as a platform for provision of mobile library services. A qualitative approach was therefore deemed the most appropriate because it enables the researcher to obtain an in-depth understanding of the phenomenon under study.

3.3 The Pilot Study

A pilot study is referred to as a 'feasibility study that comprises 'small-scale versions of the planned study, trial runs of planned methods, or miniature versions of the anticipated research' in order to 'answer a methodological question(s) and to guide the development of the research plan' (Prescott & Soeken, 1989:60). It is a rehearsal or feasibility of the main study (Sarantakos, 2005:256). It is intended to test the methods or instruments that would be used in the main study

(Thabane *et al*, 2010; Jariath *et al*., 2000; Prescott and Soeken, 1989; Van Teijlingen *et al*, 2001). In agreement with the above authors, the researcher was prompted to plan this study as 'pilot' so as to guide the development of the research plan and the possible undertaking a further (main) study in future. The following reasons also served as the rationale for undertaking a pilot study:

- The topic under study is a new development in Uganda therefore probably not well-known to some students. It is important to do a pilot study so as to ascertain whether students really understand the new concept or not. By so doing, awareness is created among students about the existence of mobile technologies in libraries.
- The pilot study may provide informative results to be used to guide the possible implementation of mobile library services in Makerere University.
- These results can also form the basis for a more comprehensive study that could be undertaken later, which could lead to the actual implementation of such services.

3.4 Selection of research location

The pilot study was limited to the main library of Makerere University in Uganda. Makerere University is a large urban based public institution of higher learning and therefore the library is also one of the model academic libraries in Uganda (Musoke, 2012). The main library was selected for the study because:

- Makerere University library is the oldest and largest academic library in Uganda and one of the academic libraries in the country and the region rapidly responding to technology (Musoke, 2012). It was therefore considered appropriate for providing a focal point for the study of mobile library services.

- The library is the central point where students from almost all the colleges of the university come to access the resources and services. The choice of the location therefore offers students from all the nine (9) colleges and one (1) school an equal chance of being part of the study thus standing a chance of getting views from all the disciplines that students represent.

- Its physical location which is an advantage for the researcher who works in the main library. This therefore makes it easy for data collection which is time bound.

3.5 Target group and sampling

3.5.1 Introduction

In research, determining the target group and the sampling strategy is very important. In order to meet the goals and objectives of any study, the researcher has to determine the target group and how they were sampled (Sarantakos, 2005).

Sampling is a process of obtaining information from part of the entire population in order to make generalization or draw inferences about the parameters of the population from which the samples are drawn (Kothari, 2004). In other words, it is an approach of selecting a smaller group of the population that will accurately represent the larger population from which they were selected hence constituting a sample (Mugenda & Mugenda, 2003:10). A sample of both undergraduate and postgraduate students was used to obtain information representing library users in this pilot study.

3.5.2 Target population

Target population refers to the total number of respondents who will provide information related to the study (Sarantakos, 2005:152). Undergraduate as well as postgraduate library users were part of the target population.

The undergraduate students were selected because:

- They constitute the largest number of library users. Therefore in order to obtain any information which will lead to the improvement of service delivery, they ought to be consulted for their opinions and experiences about mobile technologies;
- Most of the undergraduate students are between the age bracket of 18-23 who according to Lippincott (2010:207) are using internet enabled mobile devices to access and share information. He also referred to students in this age bracket as the Net generation. Including undergraduate students in the study therefore would enable the researcher to understand students' perceptions and attitudes towards the topic under study.

Postgraduate students were selected because:

- They are experienced library users and can best advice on what services to implement;

- Most postgraduate students are working fulltime and therefore may not access the library frequently as expected, therefore the topic under investigation would be of specific interest to them.

3.5.3 Sampling procedure

For this pilot study, both undergraduate as well as postgraduate students were randomly selected for participation. The undergraduate students were selected as they entered the main library and the postgraduate students as they accessed the learning commons. Using random sampling, each member of the two target population groups had an equal and positive chance of being selected for participation in the study.

3.5.4 Sample size

In pilot studies, calculation of sample size may not be required. However, it is important that the sample is representative of the target population i.e. the sample size should be large enough to ensure that the researcher gets relevant information and also to assess the feasibility of conducting a larger study (Thabane *et al*, 2010). Although this is a pilot study, it is vital to discuss how the sample size would have been determined for the main study.

Determining the sample size depends on the methodology, nature of the study, time and resources available, homogeneity of the population i.e. the more the population is homogenous, the smaller the sample and vice versa, and level of accuracy i.e. the less accuracy needed the smaller the sample (Sarantakos, 2005:171). In qualitative research, sample sizes are relatively small compared to quantitative studies as the aim of a qualitative study is to obtain depth, complexity, rich and understanding rather than to generalize (Powell & Connaway, 2004: 189).

The researcher adapted the proportional allocation formula developed by the research division of the National Education Association in the U.S.A. This formula led to the development of a sample size table by Krejcie & Morgan (1970). In order to use the table to estimate the sample size, the researcher needs the total population size and then crosscheck with the table to get the estimated number for the sample.

The sample size of the main study would be determined by getting the total number of both registered undergraduate and postgraduate students at Makerere University. In 2011, the total

number of registered undergraduate students was 31,175 and postgraduate students were 1,672 (Makerere University Book of Facts, 2011). Using the table, the sample size would entail 379 undergraduate and 310 postgraduate students. As can be seen, the difference between the sample sizes of the undergraduate and postgraduate students i.e. 379 and 310 is quite small if compared to the big difference between the actual enrolment figures. The reason for this is because, as the population size increases, the required rate of increase in the sample size decreases; thus the increase in population in comparison to the sample size reduces (Powell & Connaway, 2004:107).

The total of the estimated sample would therefore have been 689 respondents if this was a main study and not a pilot study. According to Lackey & Wingate (1998) and Hertzog (2008) using 10% of the final study size is acceptable for pilot studies. The researcher decided that using 10% of 379 undergraduate as well as 10% of 310 postgraduate students was appropriate i.e. 37 undergraduate and 31 postgraduate students constituted the sample size giving a total of 68 respondents.

3.6 Data collection methods

Data collection methods are a process of collecting data and application of the techniques for processing and analyzing the data (Struwig & Stead, 2001:40). A survey by means of questionnaires was used for collecting data in this study. Surveys are one of the most common methods of collecting data in social research and also determine the present status of a particular phenomenon (Sarantakos, 2005).

Survey research was best suited for this study for a number of reasons such as:

- In surveys, it is possible to sample only a small population out of the large population (Powell & Connaway, 2004: 92).
- Surveys can be used to assess the attitudes, opinions and characteristics of a wide population (Ingutia-Oyieke, 2008). Here the attitudes, opinions and characteristics of both the undergraduate and postgraduate students could be assessed.
- Surveys tend to be less costly and shorten the data collection time hence reducing the overall costs (Powell & Connaway, 2004:92).

3.6.1 Questionnaires as a data collection tool

A questionnaire is a written list containing questions for respondents to answer (Kumar, 2005:126). The selection of this tool was guided by the nature of data collection, time limitation and the objectives of the study. The researcher used a semi structured self-administered questionnaire in order to prevent non response associated with other data collection methods such as distributing questionnaires via email. The self-administered questionnaires consisted of ten (10) closed-ended and seven (7) open-ended questions.

The questionnaires were distributed by two (2) research assistants. For the undergraduate respondents, a research assistant was situated at the main entrance of the main library to distribute questionnaires between 8:00 am and 12:00 pm and between 12:00 pm and 4:00 pm with the aim of targeting library users throughout the day. Questionnaires were distributed to two (2) respondents at an interval of one hour, for three (3) days in a row until 10% of the sample size was reached. A total of 37 questionnaires were distributed to undergraduate students.

Another research assistant distributed questionnaires to postgraduate students entering the research commons between 9:00am and 12:00pm and between 2:00pm and 4:00pm. The commons is closed between 12:00pm and 1:00pm for the lunch break. Questionnaires were distributed to two (2) respondents at an interval of one hour, for three (3) days in a row until 10% of the sample size was reached. A total of 31 questionnaires were distributed to postgraduate students.

The research assistants were also helpful in this pilot study because they were responsible for verifying student names in order to avoid duplicate selection of respondents.

3.6.2 Advantages of questionnaires

In any data collection technique, the focus of evaluation should not be on only the quality of the method but rather on its suitability to the study (Sarantakos, 2005). A questionnaire was considered the most suitable method for this study because of the following reasons:

- Questionnaires provide access to quick data/information in relatively limited time (Powell & Connaway, 2004:124; Kothari, 2004:100). Questions for this pilot study were

straight forward and therefore easily understood by the respondents. This enabled the respondents to complete the questionnaires in the shortest time possible.

- Questionnaires enable the respondents to freely express themselves because they offer great assurance of anonymity (Sarantakos, 2005; Kothari, 2004; Kumar, 2005:130). This particular advantage was applied to this study as the researcher clearly stated in the introduction of the questionnaires that the responses were to be treated as confidential. With this assurance, the respondents were able to freely express themselves without fear of their identities being revealed. Thus the researcher was able to get relevant information necessary for the study.

- Questionnaires are not affected by 'non- contacts' (Kothari, 2004:100) i.e. the respondents who are not available at the time of the study or those not willing to complete the questionnaires. For this particular study, questionnaires were distributed to the next available and willing person. This advantage therefore enabled the researcher to distribute the questionnaires in the allocated time thus eliminating delays that would have occurred while waiting for a specific contact.

3.6.3 Disadvantages of questionnaires

The use of questionnaires has a number of disadvantages but these were addressed by the researcher in this pilot study and the advantages of the questionnaires therefore prevailed over the disadvantages as discussed below;

- Partial response is possible due to lack of supervision (Powell & Connaway, 2004:125; Mugenda & Mugenda, 2003:71; Kumar, 2005:130). However, this was addressed by the availability of research assistants in this study who made sure that whoever was given a questionnaire returned it with all the questions answered.

- Respondents are often not able to probe, prompt and seek clarity to questions while using questionnaires (Kumar, 2005:130). In this study, the respondent could ask for clarity from the research assistants who were available at the entrance of the library and also in the research commons.

- It is also not possible to motivate the respondents to participate when using questionnaires (Sarantakos, 2005; Powell & Connaway, 2004:125). In this particular study, the topic under investigation is new and interesting in the Ugandan arena and it did not present a problem as students were eager to participate.

- It is also difficult to ascertain whether the questionnaire is completed by the actual targeted person or not (Sarantakos, 2005). In the case of this study, supervision from the research assistants ensured that the target person completed the questionnaire.

3.7 Application of questions to the study

The questionnaire was the only research instruments used in this pilot study, and therefore the researcher's main objective was to obtain as much information as possible from respondents in relation to the study. The questionnaire had adequate questions that would be used to meet the objectives of the study and also to ensure that the respondents feel part of the research process (Sarantakos, 2005: 242).

Denscombe (2010: 164) suggests that questions should not irritate respondents but rather portray that respondents have information or knowledge about the topic questions. The respondents were therefore asked questions appropriate to the research problem, without any leading questions, repetitions, or confusing terminologies and vague questions. Open-ended as well as closed-ended questions that covered all the aspects of the study were included.

For this study, each section of the questionnaire was designed to address a particular research objective as discussed below.

Section 1: Demographic information

In the questionnaire, this section was intended to distinguish between undergraduate and postgraduate students. The years of study were also important as it revealed the expertise of the students towards the topic under investigation.

Section 2: Mobile devices

Questions were posed in this section to know exactly what mobile devices Makerere University students owned and what they were using these devices for. With these questions answered, it

could help the institution to decide whether to implement mobile library services or not. In the questionnaire, the questions asked included:

- Do you own a mobile device?
- Which mobile devices do you own?
- What do you currently use your mobile device for?
- Do you have access to internet through you mobile device(s)?
- What kind of information do you access via your mobile device?
- Do you plan to acquire an internet enabled mobile device and why?

Section 3: Mobile library services and resources

It was further important to investigate and evaluate the services and resources that could enhance traditional library services; for example, suitability of the services needed to be determined before the library develops mobile services. The questions asked within this section were more open-ended and included:

- Would you like to access library services and resources through your mobile devices?
- What services and resources would users want to access?
- Why is it necessary for libraries to adopt mobile technologies?

3.8 Data analysis and interpretation

After data collection, the researcher needs to make sense of the data collected. Data analysis deals with how the collected data will be organized, interpreted and presented (Kothari, 2004). The data analysis was guided by the research objectives and questions in order to get meaning from the large amount of information collected. In this pilot study, the researcher applied the following procedure during data analysis;

3.8.1 Editing: This involved scrutinizing the data that was collected in order to check for the completeness of the answers, eliminating questions that are related to others to avoid double coding. This was applied to both the closed-ended and open-ended questions in the

questionnaires. In this study, there was no need to identify responses which did not "make sense" as the respondents were helped by research assistants in incidents where they did not understand a question.

3.8.2 Coding: Coding is a "the process of grouping information collected into themes using codes (Struwig & Stead, 2001:167). Open-ended questions were coded and grouped in categories and sub categories using codes created by the researcher.

Once the codes and categories were created, the researcher evaluated and analyzed data using Google drive.

3.8.4 Validity: According to Kumar (2005:153) validity is "the ability of an instrument to measure what it is designed to measure", an attempt to check whether questions asked are meaningful and easily interpreted by the respondents (Vithal & Jansen, 2010:33).

In this study, validity of the questionnaire was achieved by providing a detailed explanation of the significance of the research at the beginning of the questionnaire as part of the introduction. Definition of the terms was also provided so as to guide the respondents. There was room for further clarification during completion of the questionnaire.

3.8.5 Ethical Considerations: Neuman (2003:302) states that the major ethical issues in survey research are the "invasion of privacy". Goddard & Melville (2001) advises researchers to take the following into consideration: use of proper research methodology to obtain appropriate results; duplication of past information (plagiarism); ensure originality; not subjecting respondents to unnecessary research; and also avoid harming the respondents. The researcher took all the above ethical issues into consideration by:

- Acknowledging all sources and authors in order to avoid plagiarism.
- The questionnaire was also approved by the ethical committee of the University of Pretoria before data collection.
- Respondents had to provide their consent whether they would be part of the respondents by signing the consent forms.
- The identities of the respondents were not revealed in order to ensure privacy and confidentiality. The respondents were given assurance that the information they offered

would be treated with confidentiality as indicated in the introduction section in the questionnaire.

3.9 Conclusion

This chapter discussed the methods used when conducting the research. Data was collected using mainly questionnaires because of the advantages that were deemed necessary compared to other methods. A random sampling technique with a sample size of 68 undergraduate as well as postgraduate library users was employed. Results from the investigation were edited and, coded. Chapter four reports on the research findings derived from data collection and subsequent analysis of the data.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter focuses on the analysis and presentation of results obtained from the study. Questionnaires were the only data collection instrument used in this pilot study. Data analyzed in this chapter was captured from undergraduate and postgraduate students who were the target population for the study. The findings are presented in tables, percentages, frequencies, charts and text. Data was analyzed following the format of the questionnaire and the research questions.

A total of 68 questionnaires were randomly distributed to the target group by research assistants. This chapter is organized according to the following sections:

- Demographic information
- Mobile devices
- Mobile library services

4.2 Demographic information

The students' demographic information is important because it assists the researcher to understand the characteristics of the students so as to understand the different user needs.

In this pilot study, there were 37 undergraduate students and 31 postgraduate students. Out of the 37 undergraduate students, 16 (43%) were in their first year, 10 (27%) in second year, 7 (19%) in third year and 4 (11%) in fourth year. Out of the 31 postgraduate students, 14 (45%) were in their first year, 10 (32%) in second year, 3 (10%) in third year, 3 (10%) in fourth year and 1 (3%) in their sixth year of study. These figures reflect that the majority of the postgraduate and undergraduate respondents were first year students.

4.3 Mobile devices

In this section, findings were analyzed in the context of:

- Ownership of mobile device;
- Type of mobile device;
- Access to the internet through device;
- What the respondents used their mobile devices for;
- Type of information accessed through the devices.

4.3.1 Ownership of Mobile devices

To ascertain whether respondents owned mobile devices, the question on mobile ownership that required a Yes or No answer was asked.

Out of the 68 respondents, 65 (96%) of the respondents confirmed owning a mobile device. Only 3 (4%) did not own any mobile device. These statistics are in agreement with the ITU (2011) which stated that mobile penetration has increased by 76% in lower-middle-income countries like Uganda.

4.3.2 Type of mobile device owned

Out of the 65 (96%) respondents who indicated that they owned mobile devices, 42 (59%) owned regular cell phones, 23 (32%) owned smart phones, 5 (7%) owned laptops and 1 (1%) respondent owned an Ipod. However, it is worth noting that some respondents owned more than one mobile device hence the responses exceeded the number of respondents. Data indicates that the majority of the respondents owned mostly mobile phones i.e. regular cell phones and smart phones.

4.3.3 Access to the internet through the mobile device

The respondents were further asked whether the mobile devices they owned had access to the internet. Out of the 65 (96%) respondents who owned mobile devices, 43 (66%) indicated that they had access to the internet through their mobile devices. Only 22 (34%) of library users surveyed had no form of internet access through their mobile devices. The high response can be attributed to the fast growing internet and cellular penetration.

However, it is worth noting that the 3 (4%) respondents who didn't own any mobile device and the 22 (34%) respondents who had no form of internet access through their devices, when asked whether they planned to acquire an internet enabled mobile device, 23 (92%) of them indicated "Yes" and 2 (8%) indicated "No".

Respondents were also required to answer an open-ended question indicating why they wanted to acquire Internet enabled devices. The following were their responses:

- To have access to online information that is up-to-date so as to support their research while doing coursework and assignments
- Access to social media sites like Twitter, Facebook etc so that they are able to interact with library staff and their friends
- Sharing information with colleagues
- To research more conveniently without limitations
- For easy access to online business opportunities
- To be able to download heavy documents and attachments that could support their studies and also for leisure like downloading music and videos
- To catch up with technological advancements.

The 2 (8%) respondents who indicated that they don't plan to acquire internet enabled mobile devices also had reasons to support their decisions and these were:

- Ability to access the internet while in office. This therefore indicated that part of the 8% of the respondents were employed/had fulltime jobs and therefore didn't deem it important to have an internet enabled mobile device.
- High cost of the devices.

4.3.4 What the respondents used their mobile devices for

65 (96%) of the respondents who owned mobile devices were asked an open-ended question which required them to indicate what they used their mobile devices for. The following responses were received from the respondents.

- Receiving and making voice calls to relatives, friends

- Browsing the internet especially Google for news, emails, research articles, Wikipedia etc
- Reading downloaded documents
- Texting i.e. sending and receiving text messages
- Downloading and storing data for research purposes
- Listening to news through local radio stations
- Social networking sites
- Socializing with friends through chats
- For entertainment i.e. listening to music, playing games and watching videos etc
- Taking photographs and videos
- Making money transactions i.e. sending and receiving money
- Used as an organizer to access calendars, calculators, memos, clock etc.

From the above responses, it appears that the reasons for owning mobile phones were highly influenced by a complex mix of benefits which ranged from academic to personal reasons.

4.3.5 Type of information accessed through the mobile devices

With students using mobile devices for various reasons as seen from the above results, the respondents were asked through an open-ended question to indicate what kind of information they accessed using their mobile devices. The reasons given by the 43 (66%) respondents who accessed the internet through their mobile devices were:

- Academic information especially notes through email, online cases
- Google articles via Wikipedia, Google scholar
- News updates i.e. sports news, RSS feeds, news on intranet, international news i.e. BBC,CNN
- Social media notifications and messages e.g. facebook, twitter
- Business information like company advertisements
- Political information.

4.4 Mobile library services and resources

Currently, Makerere University library does not have services or resources designed for the mobile devices. This section provides findings on the perception of the respondents pertaining to

the use of mobile library services and resources. Respondents were asked whether they would want to access library services and resources using their mobile devices. They were also asked to tick all the applicable services and resources which they wanted to access. As a result of this, the number of responses exceeded that of respondents since more than one service or/and resource was preferred.

A total of 64 (94%) respondents indicated that they wanted to access library services, 4 (6%) indicated "No" to the same question. On the other hand, 65 (96%) respondents wanted to access library resources and 3 (4%) indicated that they did not want to access the resources through their mobile devices.

The 4 (6%) and 3 (4%) respondents who ticked "No" as answers to the question in the questionnaire asking them whether they would want to access library services and resources using their mobile devices were further required to answer an open-ended question as to why they didn't want to. The following were their responses:

- Costly for developing countries like Uganda which could lead to increment in tuition fees
- Ability to access the library services using desktops while in office
- Fear of network failure
- Mobile devices would strain the eyes because they have small screens.

From the responses above, the respondents were mainly afraid of paying extra funds so as to access these resources and services. These responses are therefore an opportunity for the library to market and create awareness among students who are not familiar with the technology.

4.4.1 Types of mobile library services

For the 64 (94%) respondents who indicated that they wanted to access mobile library services, the most preferred to the least preferred services were; search the catalogue 49 (10%), request an e-book 44 (9%), request an item 41 (9%), chat with a librarian 37 (8%), view library news 36 (8%), access subject guides 34 (7%), search the library database 34 (7%), view library opening hours 29 (6%), View library contact information 27 (6%), Quick response 27 (6%), renew library items 26 (6%), book study group rooms 23 (5%), text messaging 22 (5%), book computer labs 22 (5%), view library map 19 (4%) and other 2 (0%).

The figure below shows representation of the responses.

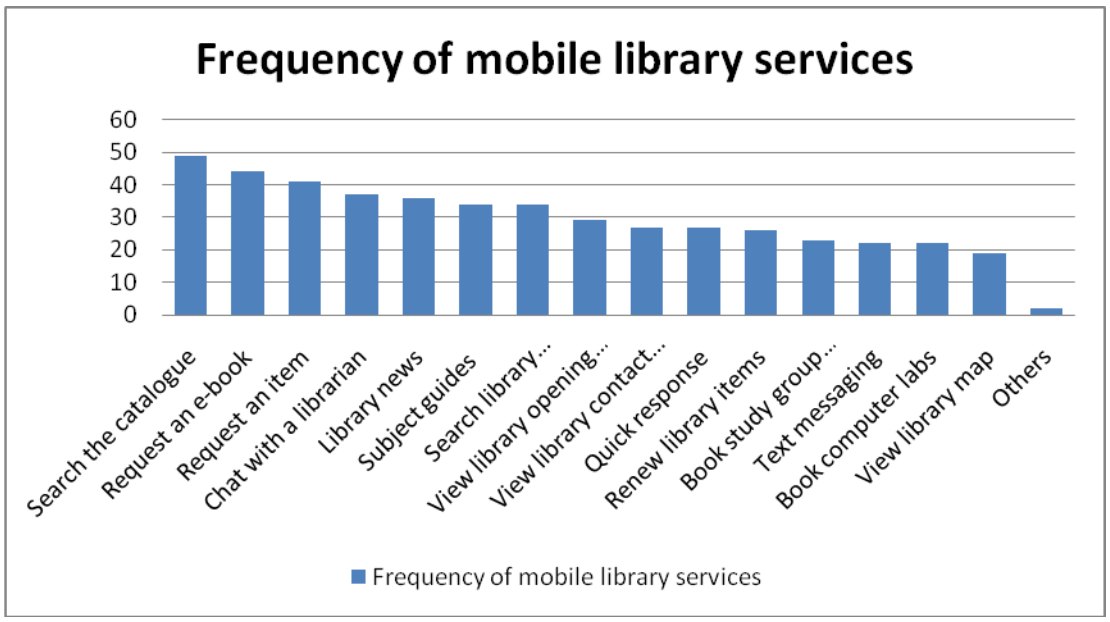

Figure 1: Frequency of the preferred mobile library services

4.4.2.Types of mobile library resources

Respondents were further asked to specify the library resources that they wanted to access on their mobile devices. For the resources that respondents indicated that they wanted, the most preferred to the least preferred were Google searches 51 (22%), Google scholar 49 (21.2%), e-books 47 (20.3%), reference materials 46 (20%) and e-journals 38 (16.4%). Once again, the respondents were asked to tick all the applicable services which they wanted to access. As a result of this, the number of responses exceeded that of respondents since more than one service was preferred.

The figure below shows representation of the responses.

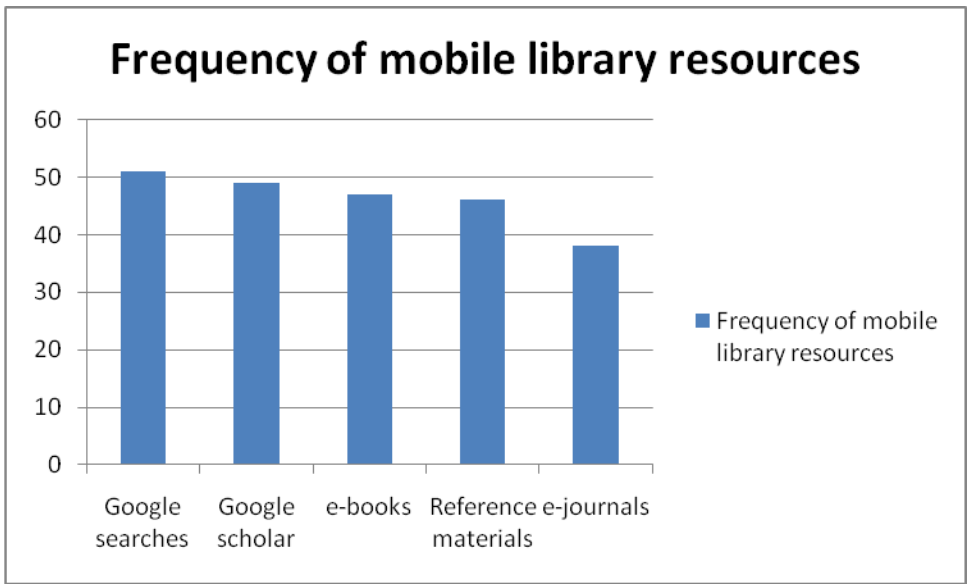

Figure 2: Frequency of the preferred mobile library resources

From the data, it is clearly illustrated that Google searches and Google scholar had the highest frequency.

4.5 Why mobile library services and resources

In order to ascertain the respondents' opinions towards mobile library services, they were asked an open-ended question why they wanted to have access to mobile services and resources. Out of the 68 respondents, 65 were able to give their opinions. Their opinions were coded and classified according to some of the benefits of using mobile platform for information access discussed in chapter 2 (see 2.9) and others were formulated by the researcher. These opinions and the response rates were:

- Convenient and flexible 57%
- Time saving 45%
- Offers wide and equal access 12.3%
- Affordability 2%
- Easy communication 8%
- Easy access 31%
- Exposure to new technology 2%

From the data above, it is noted that the respondents are more interested in mobile technologies because of the convenience and flexibility that they offer.

Conclusion

In conclusion therefore, Makerere University students own mobile phones that are internet enabled and those who do not own them have expressed interest in acquiring them in order to stay abreast with new technology. Although some of the students didn't express interest in accessing mobile library services and resources, the majority of the respondents were positive about the implementation of the mobile services at Maklib. This data is therefore an eye-opener for Maklib to implement services that can be accessed using the mobile phone platform so as to meet the needs of the mobile users.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

Current trends in libraries require that students are able to access information and services beyond library buildings. Makerere University Library faces a number of challenges with regard to online and remote access to library resources and services. One possible solution to this problem lies in the use of mobile technologies.

This pilot study aimed at investigating how mobile technologies can be used to provide mobile-based library services for both postgraduate and undergraduate students at Makerere University. In order to ascertain that, questionnaires were administered to the respondents and data was collected, analyzed and interpreted. This chapter concludes the study by presenting a discussion of the findings of the study, recommendations as well as suggestions for further research.

5.2 Discussion of findings of the study

5.2.1 Mobile device ownership among students at Makerere University

Developments in Information and Communication Technologies are rapidly changing social and economic circumstances worldwide. The cost of ICTs is continually falling and yet their capabilities are continually enhanced. From the literature review, it was seen that a wide variety of mobile devices are available, ranging from laptops, net books, notebooks computers, Palm tops and mobile phones (smart phones), MP3 players, cameras and e-book readers. (Kroski, 2008:10). From the empirical investigation, the majority of Maklib users indicated that they owned at least one type of the mobile devices listed in the questionnaire. Taking this into consideration, Maklib should therefore, implement mobile services using devices compatible with the devices that the students own, which were mostly mobile phones.

5.2.2 Type of mobile device owned

The majority of the users owned regular cell phones and smart phones. The researcher assumes that, the fact that students do not currently own iPods, iPads, and e-book readers is mainly due to the cost consideration as these are still expensive for the citizens especially students of Uganda because of the bad economic conditions in the country (ITU, 2013). However, regardless that the students didn't own iPods, iPads, and e-book readers, Maklib can make a decision to implement mobile services that can be delivered using the devices that students own – the mobile cell phones.

5.2.3 Access to the internet through the mobile device

Mobile technologies facilitate access to information and the provision of services that are portable and accessed using various mobile devices. This pilot study showed the majority of the students indicated that the mobile cell phones that they owned were Internet enabled. This data is important as it provides Maklib with an opportunity to provide mobile library services and resources that can be accessed via the internet using mobile phones.

Furthermore, the number of students with internet enabled devices is also expected to increase because the few who never owned mobile devices and those who didn't have any form of internet access indicated that they planned to acquire them. This result is supported by the literature which indicates that people have integrated mobile technologies into their personal lives especially cell phones which they have "embedded within their usual personal apparel and constitute the preferred electronic device of this mobile-generation" (Vila, Galvez & Campos, 2010:332).

It is therefore important to note that the popularity of mobile technologies and the ownership of internet enabled mobile phones has led to increased mobile information access hence providing an opportunity for Maklib to innovatively develop services and resources that can be accessed through these platforms.

5.2.4 Uses of the mobile devices

Usage defines one's ability of using a device as it is meant to be used (Lippincott, 2010). The basic aim in a question in this regard was to understand what the students used their mobile devices for. Findings revealed that students mainly used their mobile phones for making calls

and receiving phone calls. However, they also indicated using their mobile phones for accessing information for personal as well as academic purposes. Overall, findings revealed that students are using their mobile phones as multi-purpose devices i.e. they can be used for many functions other than receiving and making calls. This offers Maklib an opportunity to develop tasks and services that can be ported to a variety of mobile platforms thus promoting outreach services beyond the library building.

5.2.5 Type of information accessed by students using their mobile devices

Although the different uses of the mobile devices were identified, it was also important to explain what information students are actually accessing using these devices. Students indicated the kind of information they accessed using their mobile devices ranged from academic information to social media. These findings indicate that Makerere University students are considering their mobile devices, especially their mobile phones, as their first point of communication and information access. With the wide range of communication capabilities that the mobile phones offer, Maklib can take this opportunity to offer reference services that can be accessed using this platform.

5.2.6 Mobile library services and resources

As discussed in chapter two, the popularity of mobile technologies has led to the development of innovative information access platforms using mobile devices (Lippincott, 2010). Academic libraries are providing a wide range of mobile services in order to support teaching, learning and research. Such services and resources include: Web 2.0, augmented reality, mobile subject guides, mobile instruction, mobile collection, QR, text messaging, and mobile OPACs. Data from the questionnaires indicated that the majority of the students piloted indicated that they would like to access a wide variety of mobile library services and resources ranging from searching the catalogue (ranked highest) to viewing maps (ranked lowest). A number of resources such as Google Scholar, e-books, e-journals and so forth were also on their “wish list”.

Although the majority of the respondents were in favour of the implementation of the mobile library services and resources, those ranked lower could be attributed to the limited number of

computers with reliable access in the library and especially the lack of reliable Internet access that Maklib faces from time to time.

However, much as the majority of students support the implementation of mobile library services and resources, such a move comes with challenges which should be noted and minimized to ensure a successful implementation process. Some of the challenges include small screens of mobile phones specifically, limited memory for saving documents, inability to print documents, and short battery life – all of which were also mentioned by the few students who indicated that they did not feel the need for mobile services. Maklib therefore has to provide more training and awareness to the students before implementation in order to limit or overcome some of the challenges mentioned above.

5.2.7 Why it may be necessary for libraries to adopt mobile technologies

Respondents were asked to indicate why they wanted to access mobile services and resources. Response from the participants covered the following:

5.2.7.1 Convenience and flexibility. According to Hey et al (2007), the use of mobile technology for the provision of library services is convenient for mobile users because it allows users to access reading materials outside the library and the classroom. In Maklib, for students to access any service or resources, they need to present their IDs or admission letters hence confining students to specific rules and regulations. Students therefore supported mobile services and resources because they want to have unlimited access to services and resources when and how they need it.

5.2.7.2 Time saving: The fact that students rated searching the library catalogue by means of their mobile devices highly, clearly indicates that they want to save a lot of time rather than lining for computers so as to access the online catalogue.

5.2.7.3 Offers quick and broader access to resources: Students also indicated that by using their mobile devices they would be able to access a wider range of resources and services as compared to the physical usage of the library and its computers. From this finding, it can be concluded that the physical resources in the library, especially the books, are not enough to meet the needs of many students.

5.2.7.4 Affordability: The majority of the students piloted indicated that they owned mobile devices regardless of whether they were Internet enabled or not. These statistics indicate that that overall the students can afford these devices, particularly mobile phones. Students who do not own mobile devices expressed interest in acquiring internet enabled mobile devices. In effect, this means that the number of students owning internet enabled devices will increase in a short period of time providing Maklib with a reasonable motivation for starting on a programme of introducing mobile library services.

***5.2.7.5 Easy communication*:** Data from the questionnaires indicated that respondents were interested in chatting with the librarian so as to get help with their research work. The researcher therefore concludes that students still rate librarians important regardless of technological developments thus they still trust the librarians with their academics. The researcher further observed that using mobile services students are able to interact with library staff at any time; for instance, there are times when staff are not at their desks yet students need help. In such situations, students can send their queries through the chat system which staff can reply to using their devices.

5.2.7.6 Easy access: According to Hey et al (2007), mobile devices make it very easy to move around and access many reading materials. The students who participated in this study also indicated easy access to resources as one of the reasons they wanted to have access to mobile library services and resources.

***5.2.7.7 Exposure to new technology*:** With the new technological advancements using ICTs to access information, Makerere University students indicated that the use of mobile services would enable them adopt and stay abreast of the new technology. This data therefore provides Maklib with the revelation that if they implemented mobile library services, then perhaps students would embrace them just to keep up with technology.

The following section discusses recommendations based on the findings of this pilot study.

5.3 Recommendations

Arising from the data collected and interpreted in chapter four, the following recommendations for implementation in Maklib are suggested:

5.3.1 Develop a mobile strategy: Makerere University has a large number of students who need to have access to library resources. With the increasing cuts in library budgets, the ratio of students to books; for example, is less leaving them to scramble for the limited resources. From the pilot study it was seen that students therefore rated access to e-books as one of the resources they wanted to access via their mobile devices. As Maklib plans to take on the challenge of developing mobile library services and resources, it is necessary to develop a strategy that will be followed during the implementation process as explained below:

5.3.1.1 Conduct a user needs assessment: Before any academic library can develop mobile library services, it's important to conduct a survey to investigate mobile ownership, find out what information users want, and what type of library users want to access. The services to be provided should be determined after the user needs assessment (Lippincott, 2008:80). Although this pilot study provides answers to some of the questions, a wider study is necessary as it will also reflect the changing needs of the users at both undergraduate and postgraduate levels.

5.3.1.2 Develop a mobile infrastructure: One of the reasons that respondents gave for not accepting the implementation of mobile library services was poor infrastructure. Maklib needs to survey the existing infrastructure whether it can support mobile technologies for instance Wi-Fi services and coverage. Evaluation of other mobile technologies that may be available in the market should be done.

5.3.1.3 Define mobile users: According to Lippincott (2010), mobile users can be distance students, correspondence students also referred to as "blended learning students", field attachment students or any other category of users. The services to be provided will therefore differ from the type of mobile users which libraries can determine by assessing all the types of library users.

5.3.1.4 Investigate and implement services that enhance library services: From the findings, it was revealed that, not all services are rated important by the students. It is also important to implement services and resources according to the suitability of the content to the users. Hence Maklib should investigate how each of the preferred services and resources can meet the needs of their target users.

5.3.1.5 Develop a mobile web: According to Kroski (2008), the mobile web can be defined as "World Wide Web accessed through a mobile device". The mobile website should have an interface that is compatible with the mobile devices and therefore should be able to display content and graphics that are visible to the users for easy access (Vila, Galvez & Campos, 2010: 302). At Maklib, most users own internet enabled mobile phones therefore a mobile web should be content simplified to display only important content because mobile phones possess smaller screens as compared to the desktop computers. Library users are continually seeking services that are convenient to use like Google. It is therefore important to consider the different components that make up a mobile library website in order to develop a winning strategy (Bridges, Rempel & Griggs, 2010:313).

There are many ways that libraries may choose to create a mobile web for mobile devices and these include:

- ***Mobile cascading style sheet (CSS):*** The style sheet is simplified the layout and interface of content to be displayed on the mobile device screen (Kroski, 2008). Kroski further states that this method is appropriate for organizations and libraries with simple and basic websites with content that can easily be reduced. However, CSS cannot be supported by all mobile devices but it is a fast way to develop mobile website without creating a separate web (Kroski, 2008:40).

- ***Transcoded websites:*** "Transcoding is a technology that takes a regular website and reformats it to display on a mobile screen" (Kroski, 2008:41). There are many transcoding application that libraries may use to reformat their websites for instance "Skweezer" (www.skweezer.com) and "Mowser" (www.mowser.com). However, the challenge with using free software is that most may not meet the needs of the developing libraries and others are prone to virus attacks. According to Kroski (2008), a mobile web doesn't mean transforming the original web into mobile web but rather providing information that the librarians deem relevant to the users for instance push alerts, "location based services: and content download.

- ***Mobile-only website:*** This method applies to libraries who would like to particularly create a mobile-specific website providing them the opportunity to design their own

portable web page (Kroski, 2008). It is the most appropriate method to use since the library will have identified the mobile needs and therefore the mobile web will address those needs (Lippincott, 2010). Without taking into account the device type, the library mobile site should be consistent, have a well designed layout that can serve all the target users.

5.3.1.6 Develop a marketing and evaluation strategy: As academic libraries choose to introduce mobile services, incorporating a marketing plan is one of the most important strategies that can be used to promote and make known the introduced services (Munro et al, 2011). Maklib has to develop a marketing strategy and develop a user feedback mechanism so as to know what users are saying about the mobile services and also create awareness about mobile technologies presented by the library.

5.3.1.7 Provide information literacy/user education: As technologies continue to evolve, it is the role of the librarians to assess the mobility and flexibility of users towards new developments. For the librarians who are not familiar with the new technologies, there is need for training so that they can equip users with the skills to use and access information using mobile devices (Munro et al, 2011). In spite of the fact that most of the current library users are technologically literate and are in most cases able to operate mobile devices, many still need information literacy specific skills in order to be able to access and use sources to their best advantage. In contrast to these users, some librarians may not be as technologically literate as the library users, therefore, the need for in-house training.

5.4 Suggestions for future research

- A larger coverage of Makerere University students need to be investigated as this was only a pilot study and the findings were only limited to data obtained from 68 respondents.

- A study should be conducted to evaluate mobile services for library users with disabilities (PWDs) that Maklib can implement.

5.5 Conclusion

This study revealed that mobile technology awareness is rapidly increasing among Ugandans especially students in higher education such as those at Makerere University. Ownership of mobile devices is widespread among both the postgraduate and undergraduate students, which has facilitated access to different kinds of information. Both postgraduate and undergraduate students expressed their interest in accessing mobile library services and resources. There is need for Maklib to take advantage of this technology and develop services that can be accessed using this platform so as to satisfy the needs of the mobile library users. However, for those few students who didn't approve of the services, there is need for awareness training so as to help them understand the concept better and its importance in enhancing their studies at Makerere University.

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Appendix 1

I am a student at the University of Pretoria pursuing a Master's Degree in Information Technology. As part of the programme, I am conducting a pilot study on the topic "the use of mobile technologies for mobile service delivery at Makerere University". The purpose of this pilot study is to investigate how mobile technologies can be used to provide mobile based services in academic libraries. The outcomes of this pilot study will provide strategies to be adopted by Makerere University for the introduction of mobile services. The researcher therefore kindly requests you take off 10-15 minutes of your time and respond to this questionnaire. As part of the University of Pretoria policy, your opinions and responses will be treated as confidential and will be used for academic purposes only.

The following definitions are provided to help you get a better understanding of the most common terminologies used in the questionnaire that may hinder your full participation.

Mobile technologies: In this questionnaire, the term mobile technologies will refer to the mode of delivery or the delivery platform (Walsh, 2010:429).

Mobile device: In this questionnaire, the term mobile device refers to the tools or gadgets used to access mobile library services and resources such as laptops, net books, palmtops, note books, mobile phones etc. (Walsh, 2010).

Mobile library services: In this questionnaire, the term mobile library services refers to library services that are designed for mobile users and can be accessed through any mobile device regardless of the location (Paterson & Low, 2011; Vila, Galvez & Campos, 2010).

Thank you for your participation and opinions towards this project.

Caroline Ilako (researcher).

Instructions:

Please select the applicable option by marking X inside the appropriate option box provided, and/or by adding other applicable options.

Section 1: Demographic information

1. What is your current level of studies?

   Undergraduate [ ]

   Postgraduate [ ]

2. What is your current year of studies?

   First year [ ]

   Second Year [ ]

   Third year [ ]

   Fourth year [ ]

   Others (Please specify).....

Section Two: Mobile devices

3. Do you own a mobile device (smart phone, cell phone, lap top, Personal Digital Assistant, E-book reader etc)

   Yes [ ]

   No [ ]

4. If you answered No to question 3, please proceed to question 10

5. If you answered Yes to question 3, which of the following mobile devices do you own?(Tick all that is applicable)

   Smartphone [ ]

   Regular cell phone [ ]

ipod Touch [ ]

ipad [ ]

Personal Digital Assistant (PDA) [ ]

Ebook reader (i.e. Kindle) [ ]

Others (please specify).....

6. Please specify what you currently use your mobile device for?

   .....

   .....

   .....

   .....

   .....

7. Do you have access to the internet through your mobile devices?

   Yes [ ]

   No [ ]

8. If you answered No to question 7, please proceed to question 10.

9. If yes to question 7, what kind of information do you access via your mobile device?

   .....

   .....

   .....

10. Do you plan to acquire an internet enabled mobile device?

    Yes [ ]

    No [ ]

11. If you answered yes to question 10, please specify why?

    .....

.....

.....

12. If you answered no, please specify why?

.....

.....

.....

Section Three: Mobile library services

13. Would you like to access library services through your mobile device?

Yes	[ ]
No	[ ]

14. If you answered yes to question 13, which of the following services would you like to access via your mobile device?(tick all the appropriate)

Chat with a librarian/get research help	[ ]
Searching the catalogue	[ ]
Library news	[ ]
Subject guides	[ ]
Quick response	[ ]
Text messaging/notifications	[ ]
View library map	[ ]
View library hours	[ ]
Renew library items	[ ]
View library contact information	[ ]
Search library database	[ ]
Request for an item	[ ]
Book computer labs	[ ]
Read e-Books	[ ]
Book study group rooms	[ ]

Others (Please specify)…….. .....
.....

15. If you answered No to question 13, please explain why?

……

……

……

……

16. Would you like to access library resources via your mobile device?
    Yes [ ]
    No [ ]

17. If you answered yes to question 16, which of the following resources would you like to access via your mobile device?

    E-journals [ ]

    E-books [ ]
    Google scholar articles [ ]
    Research articles [ ]
    Reference materials (Dictionaries, Encyclopaedias [ ]

    Others (Please specify).....
    .....

18. If you answered No to question 16, please explain why?
    ……
    ……..
    ……..
    ……

19. If you answered yes to question 13 and 16, please state why you would like to have access to library resources and services via mobile?
    ……..
    ……
    ……
    ……