The use of mobile technologies for Web 2.0 based service delivery to graduate students in Ghanaian Universities: The case of the University for Development Studies (UDS), Ghana.

Mini dissertation by

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Declaration

I hereby declare that this mini dissertation is my own original work and that this work has not previously been submitted to any institution or university for a degree. All the sources cited have been duly acknowledged.

Dedication

This mini-dissertation is dedicated to my children, Mwinbemasim, my son and Li-Anewin, my daughter.

Acknowledgement

I am most grateful to the Lord God Almighty for his immense grace and for giving me this opportunity and keeping me throughout the duration of this programme.

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May the good Lord richly bless you all.

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List of abbreviations

2G	Second Generations
3G	Third Generations
CDMA	Code Division Multiple Access
ECSD	Enhanced Circuit-Switched Data
EDGE	Enhanced Data Rates for Global Evolution
EGPRS	Enhanced General Packet Radio Service
ETSI	European Telecommunications Standard Institute
FDMA	Frequency Division Multiple Access
GPRS	General Packet Radio Service
GSM	Global Systems for Mobile signaling
HSCSD	High Speed Circuit Switched Data
IEEE	Institute of Electrical and Electronic Engineers
IM	Instant Messaging
IP	Internet Protocol
ITU	International Telecommunications Union
LAN	Local Area Network
MA	Master of Arts
MOPAC	Mobile Online Public Access Catalogue
MPhil	Master of Philosophy
MSc	Master of Science
OBEC	Offices of the Basic Education Commission
OFDM	Orthogonal Frequency Division Multiplexing
OPAC	Online Public Access Catalogue
PDA	Personal Digital Assistant
PhD	Doctor of Philosophy

RSS	Real Simple Syndication
SMS	Short Message Service
SNS	Social Networking Sites
SPSS	Statistical Package for the Social Sciences
TDMA	Time Division Multiple Access
UDS	University for Development Studies
UMTS	Universal Mobile Telecommunications Systems
UNDP	United Nations Development Programme
WAP	Wireless Application Protocol
WCDMA	Wideband Code Division Multiple Access
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wide Local Area Network
WWW	World Wide Web

Abstract

This study attempted to find out how mobile technologies could be used to implement Web 2.0 based service delivery to graduate students based in the Graduate School of the University for Development Studies (UDS) Library. A 23 item questionnaire was administered to a sample of 155 participants who were selected by means of simple random sampling. A total of 119 questionnaires were retrieved and found to be adequate for analysis and interpretation. The collected data was analyzed and interpreted using the SPSS package and Microsoft Excel and was presented in the form of text and graphs. Findings indicated that graduate students overall had very good abilities with regards to the usage of the Web 2.0 applications; that they will like to access their library's resources through the Web 2.0 applications using their mobile devices and the services they will like to access include reference services, circulation services, searching the OPAC, accessing library news, e-resources and subject guides in that order. There are varied kinds of mobile library services, examples of which are MOPACs, mobile reference, mobile instruction, mobile collection and mobile tours. However, the UDS Library does not provide any Web 2.0 mobile based services. The main challenges in implementing these Web 2.0 mobile based services include cost of Internet access, slow Internet connectivity and insufficient funds to acquire needed equipment. Based on these findings, some recommendations were given.

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CHAPTER ONE

1.1. Introduction

The University for Development Studies (UDS) in Ghana is one of the six public universities and also one of the youngest in the country. The University was established in 1992 by the Provisional National Defence Council Law 279 (PNDC Law 279) (UDS Graduate School Handbook, 2011). UDS was set up with the aim of combining academic studies with field practical training. This aim is achieved through the Trimester system the University operates where the first two trimesters are dedicated to classroom study and the third trimester dedicated to field practical programmes. This makes UDS unique from all the other universities in the country. The University also runs a multi-campus system with campuses located in the Upper East, Upper West and Northern Regions - three of the 10 administrative regions of Ghana. All campuses of the University offer both undergraduate and graduate courses. The graduate programmes include MA/MSC, MPhil and PhD and are offered on a regular as well as 'sandwich' basis. Sandwich programmes are run only during vacations i.e. between semesters of the regular academic programmes.

Each of the campuses has a library which serves the information needs of its specific users. However, because the UDS library's services are currently not online to enable the students access its resources remotely, students are limited to only the resources available at their various campus libraries. The graduate students, particularly the sandwich students, are challenged in their information seeking efforts because they spend less time on campus. This makes it difficult for them to easily access the library's resources. As such they are unable to access the library's resources from outside the campus. This situation makes it imperative that the UDS library finds suitable ways of delivering services in more convenient ways to all its clients especially the graduate students. Although the library is still basically a traditional library

as many of its operations are performed manually, the library has made efforts to automate some of its functions using the Alexandria 6.0 Integrated Library System.

The functions that have been automated so far include cataloguing, circulation and reference services. The library took the initiative to automate because it realized that it will be left behind by other academic libraries in the country. This move was also to enable the library join the global trend of libraries leveraging technology to enhance their service provision.

Although some of the functions have been automated, nothing is online yet. Students are therefore still unable to access any of the library's services online. These graduate students therefore have a problem with regards to conveniently accessing their library's collections remotely.

The solution to the problem of meeting the information needs of the UDS library's users could therefore be the provision of mobile services. This could enable the library to reach out to all of its users in more convenient ways. Users would be able to access the library's resources remotely. However, the future of providing effective and meaningful service lies in not only the use of mobile technologies but also in the use of Web 2.0 applications. A combination of these Web 2.0 applications and mobile technologies have been reported in the literature as being very effective in delivering library services to distant students and have been used by academic libraries to facilitate their library services delivery.

The researcher believes this could be of great benefit to the UDS library since the University runs a multi-campus system with campuses located hundreds of miles apart. The implementation of some of these applications would thus enable the UDS library to serve its users better because it would afford students the opportunity to access the library's resources irrespective of the campus where they are based. In this way, the implementation of these technologies would keep the UDS library relevant to its users in their information seeking efforts

and the subsequent successful completion of their studies. This study will therefore investigate how Web 2.0 applications could be used to deliver library services to the graduate students based in the Graduate School of the University through their mobile devices.

1.2. Research problem

1.2.1 Main research problem

The central research problem is formulated as follows:

How can mobile technologies be used to implement Web 2.0 based service delivery to graduate students by the UDS library?

1.2.2 Sub-problems

Arising out of this research problem, the following sub-problems were formulated.

- What is Web 2.0 and how can Web 2.0 applications be used in an academic library for enhanced service delivery?

- What are the types of mobile technologies currently available?

- What are the advantages and challenges in using mobile technologies in the academic library?

- Which library services can be provided through Web 2.0 applications making use of mobile technologies?

1.3 Scope

The study covers only graduate students in the University for Development Studies Graduate School. These included MA/ MSc, MPhil, PhD, both regular and sandwich students.

1.4 Research methodology

1.4.1. Sampling

The target group for this study were the graduate students based in the Graduate School of the University. Simple random sampling was used to select the sample for the study. The entire graduate student population in the Graduate School was 265 out of which a sample size of 155 was chosen.

1.4.2. Data collection

Questionnaires were used to collect the data for the study. This data collection method was chosen because it saves time and offers fast data within a relatively short period. It also has less bias and is convenient because questionnaires provide the respondent the flexibility of when to complete them.

Apart from obtaining the normal demographic information of respondents, the questionnaire aimed at obtaining the following information: If respondents knew what Web 2.0 applications were; whether they used them; their abilities in using these applications and whether they accessed them through their mobile devices. The questionnaire also attempted to elicit information on whether graduate students owned any mobile devices, whether the devices had internet capabilities and what they respondents used their devices for. Finally, the questionnaire covered the question as to whether the respondents would like to access their library's services through their mobile devices.

1.4.3. Data analysis and interpretation

This was done by means of the Statistical Package for the Social Sciences (SPSS) and Microsoft Excel. The SPSS was used for the analysis and generation of the tables and cross tabulation while Microsoft Excel was used to draw the graphs. These, together with a study of relevant literature were used for the interpretation of the results.

1.5. Value of the study

This study will be very useful since it will serve as:

- A basis for improving the service provision of the UDS library to graduate students of the University. This is deemed very important because services provided by the UDS library are still manual based, as such this does not make for effective service delivery. The introduction of these technologies will therefore help enhance these services.
- A guide for the UDS library to follow when introducing the use of mobile technologies to implement Web 2.0 applications for service delivery to other students of the University.
- A foundation on which further research could be conducted to ascertain how academic libraries in Ghana could implement some of these technologies in their service delivery.

1.6. Clarification of terms

The following are definitions of terms that were used in this study:

- **Web 2.0 applications**

Considered as a phase in the development of the Web (Berners-Lee, 2006), Web 2.0 views the 'entire network as a platform, involving all connected devices' with Web 2.0 applications making the most of the intrinsic advantages of that platform. With these applications, software is delivered as a continually-updated service that gets better the more people use it (O'Reilly, 2005a). It involves sharing, collaboration, participation, ease of use and accessibility among

others. Examples of these applications include Social Networking, Bookmarking, Wikis, Blogs, RSS Feeds, Video Sharing, Photo Sharing, and Instant Messaging.

- **Web 2.0 based library services**

These are basically library services which makes use of the Web 2.0 platform (Chew, 2008). These library services (acquisitions, cataloguing, circulation, reference etc.) when delivered by means of Web 2.0 applications such as Social Networking, Wikis, Blogs, RSS Feeds, Social Bookmarking, Microblogging, Video Sharing, Photo Sharing etc., are then termed Web 2.0 based library services.

- **Mobile technologies**

Basically a term used collectively to refer to the various mobile communication technologies that have been developed (B'Far, 2005). Examples may include the 3G, 4G, EDGE, GSM, Code Division Multiple Access (CDMA), and Time Division Multiple Access (TDMA).

- **Mobile devices**

Generally it is viewed as a small autonomous gadget unobtrusive enough to accompany us in every moment and can be used for educational purposes. In common use they refer to PDAs and digital cell phones (Trifanova et. al., as cited in Avenoglu, 2005). Examples may include laptops, tablet PCs, notebooks, eBook readers, iPads, handheld devices (PDAs, SmartPhones) and portable storage devices (USB flash drives) .

1.7. Division of chapters

1.7.1. Chapter one

In chapter one the introduction to the study is provided. The research problem and sub-problems are stated. The scope of the study is provided. The research methodology which

includes the target group for the study, the sampling and sample size, the data collection (questionnaires and what they contained), data analysis and interpretation are given. The value of the study is also discussed. The chapter concludes with clarifying important concepts and a brief discussion on the division of the chapters.

1.7.2. Chapter two

Chapter two consists of a detailed review of the literature. The researcher used a thematic approach to review the literature. Major themes that were reviewed include literature on Web 2.0 applications, the underlying principles and the practical use of Web 2.0 in academic libraries. Mobile devices were discussed followed by mobile technologies. This included the types of mobile technologies available, the benefits and challenges of using them in academic libraries. Finally, types of mobile library services were discussed and a conclusion to the chapter provided.

1.7.3. Chapter three

Chapter three covers the methodology that was used to conduct the study. This consisted of the selection of study location and target group for the study. The sampling and sample size were discussed. The data collection method (questionnaires), their advantages and disadvantages were discussed. Then an application of the research problems to the study was also provided. Finally, there was a discussion on how the data was analyzed and interpreted to answer the research problem and sub-problems.

1.7.4. Chapter four

Chapter four is made up of the presentation of the analyzed data in the form of text and graphs. There was a detailed analysis of the data. This was then given an interpretation by using the

literature that was reviewed in chapter two to explain why the results appeared the way they did. The findings from the study were then discussed.

1.7.5. Chapter five

Chapter five contains the conclusion and the recommendations of the study. The conclusion was made up of a discussion of each of the sub-problems and how they were answered by the study that was conducted. Some recommendations were then given based on the outcome of the study.

CHAPTER TWO

REVIEW OF THE LITERATURE

2.1 Introduction

This chapter presents a review of literature relevant to the research topic of how mobile technologies could be used to implement Web 2.0 based service delivery to graduate students in the University for Development Studies Library, Ghana. The purpose of a literature study is to provide an overview of existing scholarship; to get to know more about investigations and perspectives relating to a particular topic and thus be more informed and more effective in attempting one's own research. It is within this context that this chapter will look at how mobile devices have been used by other academic libraries in their implementation of Web 2.0 applications with the aim of improving services delivery.

The chapter is divided into five sections. Section one provides an overview of descriptions and principles underlying the concept of Web 2.0. Section two comprises the practical application of Web 2.0 in academic libraries. Section three consists of the definition of mobile devices. Section four discusses a number of mobile technologies such as GSM, EDGE, 3G, WiMAX as well as the benefits and challenges of using mobile technologies in an academic library. The chapter concludes with a discussion on mobile library services.

2.2. What is Web 2.0?

2.2.1 Introduction

The term Web 2.0 was coined by Dale Dougherty in 2004, who was then the Vice-President of O'Reilly Media Inc. and was subsequently defined by O'Reilly (2005b) as

> "...the network as platform, spanning all connected devices; Web 2.0 applications are those that make the most of the intrinsic advantages of that platform: delivering software

> as a continually-updated service that gets better the more people use it, consuming and remixing data from multiple sources, including individual users, while providing their own data and services in a form that allows remixing by others, creating network effects through an "architecture of participation," and going beyond the page metaphor of Web 1.0 to deliver rich user experiences"

From O'Reilly's definition it can be assumed that Web 2.0 is defined based on its characteristics and explicit technologies as well as its rich user experience. However, the founder of the Web namely Tim Berners-Lee, disagrees with O'Reilly's definition which creates the impression that Web 2.0 is an entirely new concept and not a phase in the development of Web 1.0. Berners-Lee argues that Web 1.0 was all about connecting people and so Web 2.0 is only an aspect of this idea of a World Wide Web, which he states is a tool which generates and collects knowledge as a result of human communications and co-operations. He therefore considers Web 2.0 as merely a phase in the development of the Web towards its ultimate goal (Berners-Lee, 2006).

Apart from the above-mentioned viewpoints there are also a number of other definitions by Web 2.0 proponents in describing Web 2.0. These include Miranda *et al*. (2009) who views Web 2.0 as the next group of software and services which are web centered; Ian Davis (cited in Secker, 2008) who posits that Web 2.0 is an attitude and not a technology; O'Reilly who also described it as an innovative business ideal (O'Reilly, 2005a); Miller (2005) who views Web 2.0 as a revolution and a set of models for development and Anderson (2007) who sees Web 2.0 as a web which is more socially connected so that people are able to contribute as much as they are capable of consuming.

It is obvious from these various definitions and viewpoints that the Web 2.0 concept is a complicated one and therefore makes it difficult to give it a formal definition. However, some

principles or elements were developed by some Web 2.0 experts to help explain what the concept is. The next paragraph discusses these principles.

2.2.2 Principles underlying Web 2.0

One of the solutions to the above problem of defining Web 2.0, proposed by Rollett, *et al* (2007), was to look at Web 2.0 applications and characterize them by means of keywords used by people to describe these applications. Another was offered by Graham (cited in Khiwa, 2010) who attempted to describe Web 2.0 with what he called 'elements'. At the Web 2.0 conference in 2004 (O'Reilly, 2005a) Tim O'Reilly and John Battelle listed a set of preliminary principles underlying the concept. These principles O'Reilly enumerates in his article "What is Web 2.0" (O'Reilly, 2005a). Miller (2005) also came up with his own set of Web 2.0 principles by modifying O'Reilly's original set of principles.

Taking these approaches into consideration, and based on information found in the literature, the concept of Web 2.0 will therefore be discussed based on the following set of principles:

2.2.2.1 *Web as platform*

The first principle underlying the concept of Web 2.0 is that of the network as platform or the "network effect". The network effect can best be seen in the popularity of online Social Networking Sites (SNS) such as Facebook, MySpace, Flickr and YouTube which have enabled the meeting of people and like minds discovering each other as well as sharing content on the web. The effects of these SNS have also led to the harnessing of collective intelligence and the generation of user content (see the following section 2.2.2.2).

Anderson (2007) introduced the concept of the "long tail" which further builds on the idea of the network effect. In the context of Web 2.0 applications, the long tail simply means that the Web depends mostly on the large numbers of specialized topics and small communities rather than

the most popular topics or best sellers. Applications which take advantage of this situation can therefore be termed as a Web 2.0 application (Rollett *et al,* 2007). With the long tail, a number of people participate in a place where things really matter to them (Anderson, 2007).

2.2.2.2 *Harnessing collective intelligence*

Underlying the principle of harnessing collective intelligence lies the idea of getting new users, learning from them and building on their contribution. In other words, harnessing the "power of the crowd" (Anderson, 2007; O'Reilly, 2005a). A number of examples of this on the Web are:

- Wikipedia, an online encyclopedia which is based on anybody who uses the web adding entries and anybody being able to edit these entries. Wikipedia is a great transformation in the dynamics of creating content. Wikipedia is built through the explicit contributions that people make to it by adding or editing articles (Ulrich *et al*, 2008).

- Delicious and Flickr make use of "folksonomies" which is a way of collaboratively classifying sites by using keywords termed *tags* which are freely selected by users (Ulrich *et al*, 2008).

- There are also collaborative spam filters such as *Cloudmark* which cumulatively collects and decides which email are spam and which are not. This system of filtering outperforms other spam filtering systems (Rollett *et al,* 2007).

- It is also a fact that many of the successful Internet businesses do not advertise their products but market them through the recommendations circulating among users which is termed "viral marketing" (O'Reilly, 2005a). Some examples include the following:

    - Amazon's collaborative filters are used to make suggestions about the existence of additional materials to people. For instance, this system will suggest to people who buy a particular book about how others who bought the book also bought

these other books. This information is very valuable to people especially when they do not know about the availability of such books (Ulrich *at al.,* 2008).

- e-Bay is a product of its users' collective activities. It grows gradually according to its users' activities. It also creates an enabling environment for these activities to happen (O'Reilly, 2005a).

- The power of the Web also lies in the fact that it can be used to harness collective intelligence through services such as hyperlinking (O'Reilly, 2005a). A service like Yahoo started as a directory of links and is in effect the accumulation of the best output of millions of web users. Though it has started creating other types of content it is mainly a portal to the collective output of users of the net.

2.2.2.3 *Participation, collaboration and sharing*

Web 2.0 has changed the way in which information is accessed, collected and used. It has transformed the Web into a highly dynamic and flexible space for collaboration, conversation, and interaction (Coombs, 2007). The traditional Web has been viewed as being one-sided where a few authors provided content for a large audience of passive users. Web 2.0 changed all that by enabling users to actively participate through adding, editing, commenting and providing content for many other users (Lemley & Burnham, 2009). Active participation of every user, according to Darwish & Lakhtaria (2011) is one of the main defining elements of Web 2.0. Web 2.0 services make use of various methods to increase participation and contributions of users by making it possible for users to have access to whatever data they want through explicit licenses like the Creative Commons and by making their content available to others through RSS Feeds (Ulrich *et al.*, 2008).

Web 2.0 applications are meant to gather knowledge through human interaction and collaboration and thus facilitate collaboration and information sharing (Khiwa, 2010). Various

authors such as Lemley & Burnham (2009) and Boulos & Wheeler (2007) have stated that the Web 2.0 applications had come at an opportune time as they have made it possible for online collaboration. Collaboration is a feature which is needed for the success of any web-based environment.

Through the use of Web 2.0 applications, content is shared everyday among the web community. Sharing code, content, information, ideas, experiences and so forth is what Web 2.0 is basically all about (Casey & Savastinuk, 2006; Miller, 2005).

Other Web 2.0 applications which enhance sharing among people such as the multimedia applications like Flickr, Podcasts and Vodcasts are now being used more often than the text-based applications like Blogs, IM and Wikis (Cardon & Okoro, 2010). They have also been noted that Social Bookmarking applications such as Delicious have made it possible for people to build up a collection of their own web resources. These web resources can be organized and classified using their metadata so that they could be shared with others (Abedin, 2011).

Web 2.0 applications also allow users to add value to content that is created which makes users an integral component of the content creation process. An excellent example is Wikipedia where users are allowed to create and evaluate content for others to use (Rollett *et al.,* 2007). A related concept to this principle is “peer production” where content is generated by distributed peers and not from a central authority. Delicious is an example of a social booking site which makes available people’s bookmarks in an aggregated manner. Another concept which explains the principle of users adding value is the concept of co-creation (Rollett *et al,* 2007). This is a situation where many people can work on the same creative activity such as writing books together like it is done in Wikibooks. This facilitates cooperation, communication and a high sense of participation by users in order to succeed.

Web 2.0 applications also encourage active participation of users by providing them the ability to access whatever information they want and download this information for storage through the provision of explicit open licenses such as Creative Commons. Users can also share this information with others through other applications such as RSS Feeds (Ulrich *et al,* 2008).

2.2.2.4 *Ease of use and accessibility*

The high adoption of SNS attests to the fact that many people feel comfortable using them (Ulrich *et al*, 2008). This could be accredited to the ease with which people can become members and use the services. Web 2.0 applications such as Blogs, Wikis and SNS like Facebook and MySpace allow users to easily create or edit content when using them (Ulrich *et al*, 2008).

These applications also offer users additional features such as being able to use multiple devices without having to incur extra cost such as purchasing additional programming on their mobile device in order to be able to access the services (Rollett *et al*, 2007). This is due to the fact that users who own mobile devices with WAP (Wireless Application Protocol) can access the Web 2.0 applications on such devices as these applications are compatible with WAP. These features of the Web 2.0 applications therefore make them easily accessible by anyone with an Internet enabled mobile device.

Web 2.0 applications such as Wikis allow for editing to be done by any individual member because it provides users with easy to understand guidelines and directions on how to use it. This as well encourages collaboration and participation among people because they are able to easily edit each other's entries and in the end come out with a whole document authored by all. This has led to people involving themselves in virtual Communities of Practice where they can easily learn interactively as well as share their knowledge (Boulos *et al,* 2006).

Another Web 2.0 application which is easy to use is Blogs. This is because of the ease with which people can create and manage their own Blogs, they have attracted a large patronage. Their easy to use applications have made it possible for many people to create their own web diaries and manage their content easily (Boulos & Wheeler, 2007). This has also encouraged collaborative and participative work among people who are now freely sharing their knowledge, reflecting and debating issues leading to blogs attracting large and dedicated readership from around the world (Boulos *et al*, 2006). Other applications such as podcasting are very easy and interesting to use and so many people who are interested in audio and videos are able to easily create their own digital files which they can share with other interested persons anytime and anywhere (Boulos *et al,* 2006). The fact that these audios and videos can be downloaded and transferred to mobile devices like MP3/MP4 players, laptops and others that have Internet capabilities has led to wide patronage (Abedin, 2011).

As Web 2.0 applications updates are usually small and therefore do not require much bandwidth, thus it is not very expensive to update. This makes it affordable to use since its usage comes with very little or no cost at all (Strictland, 2012). Many academic libraries have implemented these Web 2.0 applications due to the benefits these features present with the use of these applications. The next paragraph will discuss the practical use of these Web 2.0 applications in academic libraries.

2.3. Practical application of Web 2.0 in Academic Libraries

2.3.1 Introduction

A study of the available literature concerning the use of Web 2.0 in academic libraries reveals that the implementation of Web 2.0 in libraries is growing at a fast rate. This has become necessary because studies have shown that many students use the Web 2.0 applications in their free time and as a source of entertainment (Sponcil & Gitimu, n.d.). Academic libraries are

therefore taking advantage of this trend to introduce these applications in their service delivery processes since many students are already using them and as such are familiar with them. Many researchers, such as Haranarayana & Raju (2010); Mahmood & Richardson (2011); Ouyang & Chu (2009) and Shrager (2010) have shown that Blogs, Instant Messaging (IM), Real Simple Syndication (RSS) Feeds, Social Networking Sites (SNS), Podcasts, Videocasts and Mashups were the applications that were mostly accepted, although Wikis, Presentation Sharing, Virtual Worlds, Photo Sharing, Microblogging (Twitter) and customized webpages were also implemented by many libraries. This section will discuss some of these Web 2.0 applications and how they have been applied in various academic libraries.

2.3.2 *Blogs*

In a study done by Harinarayana and Raju (2010), it was found that blogs are the most used Web 2.0 application in academic libraries. The ease with which content can be published and its ability to let people record their comments has led to the transformation of online content publishing, and many libraries are leveraging the tool in innovative ways to deliver a variety of library services.

One of the more general uses is that of libraries using the tool to disseminate library news, informing the users of library activities, and even publishing the library newsletter via a blog (Hiranarayana & Raju, 2010; Mahmood & Richardson, 2011; Ouyang & Chu, 2009; Shrager, 2010)

Academic libraries also use blogs to promote and market their services (Harinarayana & Raju, 2010; Mahmood & Richardson, 2011).

2.3.3 *RSS Feeds*

RSS feeds as a Web 2.0 application has been noted in the literature as being an effective application for managing and reducing information overload (Harinarayana & Raju, 2010). Many academic libraries have therefore taken advantage of the capabilities of this application to manage and share contents on their websites (Harinarayana & Raju, 2010). Some of the uses of these academic libraries have put the RSS Feeds application to include the dissemination of library news, for library announcements, for the exhibition of new and already existing acquisitions, as well as for reference services (Harinarayana & Raju, 2010; Chua & Goh, 2010; Shrager, 2010; Mahmood & Richardson, 2011).

2.3.4 *Wikis*

A Wiki is another Web 2.0 application which has been used by academic libraries due to its ability to promote and manage their resources. A study of the literature has revealed that many academic libraries use Wikis to manage their internally produced resources such as committee minutes, procedures, rules, policies and project management. It has also been used to develop subject guides, build and remove resources, archive past questions on library services and to request feedback from their users about their services (Mahmood & Richardson, 2011; Harinarayana & Raju, 2010; Shrager, 2010; Chua & Goh, 2010).

2.3.5 *Podcast and Vodcast*

Podcast is an audio recording which is made available for subscription and downloading via the Internet through RSS aggregators or MP3 players. Vodcast is a podcast with video content. Academic libraries are adopting these applications to help improve their relationship with their users through collaborations via these applications. Harinarayana & Raju (2010) noted in their study, Podcasts and Vodcasts are Web 2.0 applications which can enhance information dissemination. They found that academic libraries used Podcasts and Vodcasts to deliver

information on library services, resources as well as share knowledge with users who have subscribed to the library's podcast and vodcast. They are also used to conduct library tours and library instruction tutorials to users on how to effectively and efficiently use library resources to benefit their research efforts (Harinarayana & Raju, 2010; Kim & Abbas, 2010).

2.3.6 *Instant Messaging (IM)*

IM is a Web 2.0 application which allows for real time communication (Harinarayana & Raju, 2010; Shrager, 2010; Chua & Goh, 2010). Many academic libraries in various countries have leveraged this application to enhance their reference service delivery processes because it allows them respond instantly to enquiries from their users. An example of this is users asking questions through the chat messenger and getting instant responses through the same means. This ensures that the library stays relevant to its users since it will be able to provide real time services to them.

2.3.7 *Social Networking Sites (SNS)*

Social Networking Sites are Web 2.0 applications which enable the sharing of information online. It has therefore been adopted by academic libraries to enhance their communication efforts with their users. A number of authors show that many academic libraries are using SNS such as FaceBook, MySpace, YouTube and Flickr for general sharing of information, allow users search their catalogues, market their services, create image databases, share their photos and tagging them by keywords, share videos and PowerPoint presentations, communicate with potential library users and so forth. The academic libraries are able to do this by uploading stream live videos or through discussion forums (Mahmood & Richardson, 2011; Harinarayana & Raju, 2010).

2.3.8 *Social Bookmarking/User Tagging*

Social Bookmarking/User tagging are Web 2.0 applications which can be used to link users to free bookmarking sites online. The literature has shown that these Social Bookmarking/User tagging have been utilized by academic libraries to connect their users to online bookmarking sites. These sites also allow legitimate users to also create their own tags (keywords) for contents that they like as well as tag items they found useful in the library's OPAC (Harinarayana & Raju, 2010; Mahmood & Richardson, 2011). It can be noticed from the discussions above that academic libraries are implementing these Web 2.0 applications in order to enhance their services.

As the main objective of this study is to find out if the UDS library can implement some of these Web 2.0 applications through mobile technologies it is appropriate that the researcher discusses some of these mobile devices and technologies. In the next section, the researcher will discuss these mobile devices and technologies in order to enable the reader to understand what these technologies are and how they could be applied in this study.

2.4 Mobile devices

2.4.1 Introduction

Discussing mobile technologies in academic libraries invariably has to do with the use of mobile devices as a platform for library service delivery (Paterson & Low, 2011). It is therefore necessary that at this point the researcher discusses what mobile devices are and the various types of mobile devices which have the capacity to support these technologies.

According to Trifanova *et.al*. (cited in Avenoglu, 2005) mobile devices can be defined as follows:

> "In general by mobile device we mean PDAs and digital cell phones, but more generally we might think of any device that is small, autonomous and unobtrusive enough to accompany us in every moment and can be used for educational purposes."

The University of Michigan (n.d) on their Information Security Services website has defined mobile devices by classifying them according to the following categories: portable computers (laptops, tablet PCs, notebooks), handheld devices (PDAs, SmartPhones) and portable storage devices (USB flash drives).

Mobile devices cannot be used to implement the Web 2.0 applications without them working with a specific mobile technology. Various mobile technologies are therefore discussed next.

2.5 Mobile technology

2.5.1 Introduction

Mobile technology is claimed to be the only technology to have been accepted so extensively and so rapidly (Castells, *et al*., 2007). This assertion is re-affirmed by the World Bank (cited in UNDP, 2012) which states that mobile technology is the only technology to have become accessible by such great numbers of people in numerous countries within a very short time (World Bank, as cited in UNDP, 2012).

This high accessibility is also reflected by the mobile penetration statistics of Ghana. Latest reports on mobile penetration rates in Ghana show that Ghana has exceeded 100% (Joy Online, 2013). The ITU also reported that Ghana has the highest mobile broadband penetration in Africa (Ghana MMA, 2013). This high mobile adoption rate in Ghana can be attributed to the many challenges that fixed-lines service pose in the country (BusinessGhana, 2012).

The profusion of mobile technology has the possibility to enhance the varied ways in which library services are provided (Herman; Karim *et al.,* as cited in Choi, 2009). This could be the

reason why libraries are experiencing a decline in physical access by faculty and students who have turned to electronic sources available online. This situation, Lippincott indicates, has thrown the academic library into a state of instability (Lippincott, 2010a). As such, the adoption of mobile technologies could serve as a viable alternative means of addressing this problem by providing real time access to data and thus making it possible for their users to access instant and current information.

In order to have a better understanding of what mobile technologies are and how they could be used to benefit users, it is essential that a definition is provided, as such one is given below.

2.5.2 Definition of mobile technology

Mobile technology has been defined as a term which is collectively used to refer to the various mobile communication technologies that have been developed (B'Far, 2005). These include the 3G, 4G, EDGE, GSM, Code Division Multiple Access (CDMA), and Time Division Multiple Access (TDMA). Mobile technology was also defined by Kim, Mims & Holmes (2006) as a:

> "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".

As there are a number of these technologies available, the researcher will discuss the most prolific types of mobile technologies in the following paragraph.

2.5.3 Types of mobile technologies

The mobile technologies that will be covered in this study will include 2G technologies (GSM), 2.5G technologies (EDGE, GPRS), Third Generation (3G) technologies, and 4G technologies (WiMAX). Vandi & Djebbari (2010) explain that these mobile technologies enable the provision of services that are accessible through the use of mobile devices. Mobile technologies are

discussed in this study because the purpose of this study is to find out how mobile devices can be used to implement Web 2.0 applications in library service delivery. It has therefore become very imperative that the various types of mobile technologies available are discussed to better position the implementing institution to decide on the most appropriate mobile technology that will support efficient and effective library service delivery.

2.5.3.1 2G Technologies (Global systems for mobile signaling (GSM))

This system of naming mobile phone technologies by generations started in the early 1980s (Akhtar, n.d). The First Generation comprised of analog models. In the 1990s the Second Generation (2G) of digital mobile phones as well as the first digital mobile networks appeared and was termed Global Systems for Mobile signaling (GSM). GSM was developed by the European Telecommunications Standard Institute (ETSI). 2G witnessed an unprecedented growth in subscription as well as newly developed value added services (Akhtar, n.d; Sunil, 2010) and was the fastest and leading growing mobile technology in the world (Koseoglu, 2004). It was during this generation that mobile phones started becoming the preferred way of carrying out personal communication which has made mobile phones the biggest consumer in the electronic industry in the world (Sunil, 2010).

GSM was developed to enable basic voice and data services (Koseoglu, 2004) and comprises out of two technologies namely Frequency Division Multiple Access (FDMA) and the Time Division Multiple Access (TDMA). The first GSM systems made use of a 25MHz frequency spectrum in a band of 900MHz (Sunil, 2010). GSM supports limited data between 9.6 Kbps to 19.2 Kbps (Akhtar, n.d). The 2G wireless networks are digital and are often based on circuit-switched technology. The 2G wireless technology can also manage certain data capabilities like short message service and fax up to 9.6 kbps data rates, this is not however appropriate for multimedia applications and web browsing. This system may thus not be effective for mobile

library systems since it is unable to support the transfer of large data and the high cost associated with its use.

However, the 2G circuit-switched wireless systems effective data rate is comparatively slow especially compared to current Internet systems. This resulted in systems such as the GSM as well as other TDMA-based mobile system suppliers and carriers developing the 2G+ technology. This technology is pocket-based and enhances the speed of data communication up to 384kbps. The underlying technologies of the 2G+ systems include High Speed Circuit-Switched Data (HSCSD), Enhanced Data Rates for Global Evolution (EDGE) and General Packet Radio Service (GPRS) technologies (Sunil, 2010). These 2.5G technologies will be discussed in the following paragraph.

2.5.3.2 2.5G (General packet radio service (GPRS) technology

GPRS is a transitional phase designed to enable GSM users to use full variety of Internet facilities without having to wait for the utilization of a complete 3G wireless system (Sunil, 2010). It was developed in 2000 and still operates on the basic GSM technology (Koseoglu, 2004). GPRS is just an extension of the 2G technology as it uses the same circuit-switching to transmit voice as well as packet switching to transmit data. This has made this technology very popular because the packet switching makes a more efficient use of bandwidth and can carry many more users and offer higher data transfer speeds (Akhtar, n.d).

The GPRS network offers three times faster data transfer rates than GSM networks. Some of the benefits of using the GPRS technology include the fact that it offered users for the first time full internet access as well as allowing continuous connection to the network. This technology furthermore allows users to be charged only for the data they download and not for the internet connection time unlike GSM which charges for total connection time. Although faster and comparatively cost effective, this technology would not be appropriate for the implementation of

a mobile library service system because of its inability to display video and all the web pages because it is not fast enough (Koseoglu, 2004).

Due to these challenges, another technology called EDGE (Enhanced Data Rates for Global Evolution) was developed to help resolve these challenges. EDGE is a designated standard which allows GPRS and HSCSD technologies to improve the throughput for each timeslots and will be discussed below as such. This enables GSM and TDMA technologies to handle 3G mobile phone services. The enhancement for HSCSD is termed Enhanced Circuit-Switched Data (ECSD) and that of GPRS is Enhanced General Packet Radio Service (EGPRS) (Sunil, 2010).

2.5.3.3 Enhanced data rates for global evolution (EDGE)

EDGE technology was developed in 2001 and is based on the GPRS network in order to enhance the performance efficiency of the GPRS network (Koseoglu, 2004) which was extremely slow (Sunil, 2010). The EDGE technology is an indicated standard to improve the throughput for each timeslot for the GPRS and the HSCSD technologies. It is often considered a 3G technology but it is not as sophisticated. EDGE is therefore considered a simple software upgrade by many GSM/GPRS networks (Koseoglu, 2004).

EDGE was developed to support large data transmissions at high speed of about 384 kbps (Koseoglu, 2004). Its data capacity is about three times what GPRS offers, thus operators using EDGE can manage more subscribers up to three times more than GPRS, data rate per subscriber will also be tripled and their voice communications capacity will be enhanced. EDGE also makes use of the frame structure of the Time Division Multi Access (TDMA), logic channel and a carrier bandwidth of 200 kHz just like what is used in current GSM networks. This makes it possible for existing cell plans to stay undamaged (Sunil, 2010). EDGE is not a very expensive technology to use on GSM and GPRS networks (Koseoglu, 2004). This could be very

useful for the implementation of mobile library services in Ghanaian universities because it would afford many students the opportunity to use such a service since it is a relatively inexpensive network. This is because Ghana is a lower-middle income country (ITU as cited in UNDP, 2012) and as such cost could be a hindrance to people using such services.

2.5.3.4 Third Generation (3G)

The 3G networks were developed to help resolve the problems of the 2G and 2.5G networks such as low speeds and incompatible technologies (Akhtar, n.d). These different technologies include Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Wideband Code Division Multiple Access (WCDMA), Code Division Multiple Access 2000 (CDMA), Universal Mobile Telecommunications Systems (UMTS) and Enhanced Data Rates for Global Evolution (EDGE) (Akhtar, n.d). The 3G services are based on high-speed mobile access and Internet Protocol (IP), multimedia and video on demand (Koseoglu, 2004). Besides the numerous benefits such as fast mobile connection to the World Wide Web (WWW) through the resolution of slow connectivity problems, clumsy equipment, and fixed access points it also facilitates new methods of communication, information access and how business is conducted and learned (Sunil, 2010). 3G networks are faster than other existing networks because it has a data transfer rate of 384Kbps. This technology also uses packet switching which enables mobile terminals to be connected to the network at all times (Koseoglu, 2004).

It can be deduced from the discussion above that the main aim of using 3G networks and services is to have access to the same services that the other networks are providing but with a data connection speed that is faster. The success of 3G can be said to be as a result of its ability to provide Internet access through the use of data cards slotted into laptops. Hence, 3G networks are providing the same services as LAN and WLAN (Sunil, 2010). According to Lee (2005), the main aim of the 3G concept is to ensure “interoperability” and “standardized usage

of spectrum frequency". He further states that application of 3G is about the universality of service including the freedom and convenience of doing business devoid of place and time barriers. This, he indicates will facilitate the extension of person –to-person communication worldwide. However, there is also the concern that some developing countries may never deploy 3G because of its high cost but rather low performance (Akhtar, n.d) but fortunately Ghana has. Nonetheless, this technology would not be very beneficial for implementing mobile based Web 2.0 library services due to the high cost associated with its usage.

2.5.3.5 4G - Worldwide interoperability for microwave access (WIMAX)

4G or Fourth Generation mobile services is the latest technology for mobile devices. It has evolved to help resolve the slow connection speeds of GSM which has led to its ability to meet the needs of users. Most service providers are therefore looking for other technologies which are more robust and can meet the demands (Akhtar, n.d). 4G technology is expected to offer universal roaming across various kinds of wireless and mobile networks, such as satellite to Wireless Local Area Networks and mobile networks (Akhtar, n.d). 4G network is based on IP mobile network which uses radio access technologies to offer roaming services that are seamless and always providing connection only through the best accessible network (Zahariadis & Kazako, 2003). A 4G system is expected to have speeds of over 100Mbps in stationary mode and about 20Mbps averagely in mobile stations. This decreases time for downloading graphics and multimedia components to as low as ten times when comparing to 3G systems which is 2Mbps (Akhtar, n.d).

The underlying technology for WiMAX is RF technology known as Orthogonal Frequency Division Multiplexing (OFDM) (Roh & Yanover, n.d). The air interface for WiMAX is IEEE 802.16b (Institute Electrical and Electronic Engineers) and was approved by the IEEE in 2005. A WiMAX based technology facilitates a universal wireless broadband service delivery for both

mobile and fixed users. WiMAX is also being adopted by higher educational institutions due to their ability to offer on- the- go communications by providing mobile phone users better accessibility than current technologies (Cobb as cited in Bradford, 2010). According to Cobb (2007) there are high expectations for the WiMAX because it is expected that it will be used with handy computers and other portable devices that can be carried in the pocket but which screens and keyboards will be larger than today's mobile devices. WiMAX is currently in a number of African countries and has been in Ghana since 2010 and it is operated by Skyburst, an Internet operating company in Ghana (Internet Ghana Co. Ltd, 2010). This technology would be the best for implementing mobile library services due to all the advantages mentioned in the discussion above though not nationwide yet. It is however expected that WiMAX would be nationwide in Ghana by June 2013 (Internet Ghana Co. Ltd, 2010).

The benefits academic libraries would derive from implementing mobile technologies in their library systems will be discussed in the next paragraph.

2.5.4 Benefits of using mobile technologies in academic libraries

There are many benefits associated with the application of mobile technology in academic libraries. These benefits include the following:

- The use of mobile technologies could afford academic libraries the opportunity of providing equal access to services for all their users as well as reaching a wider variety of their users in a much more effective way. Hey *et al* (2007) are of the opinion that this helps resolve the challenges that the physical library services and library computer access to resources pose. They further indicate that due to the portable nature of the mobile device, it makes it easy to carry it around loaded with a whole collection of information resources which can be accessed when needed.

- Another benefit academic libraries are deriving from the application of mobile technology in their service delivery is being able to retain their users who now have convenient access to library resources without having to physically go to the library (Murray, 2010). Mobile technology has become part of the daily lives of most students of higher education as they are increasingly using mobile devices as tools for managing their personal lives (Choy, 2010). Academic libraries should take advantage of this situation by providing these students with information through their mobile devices (Vila, Galvez & Campos, 2010).

- Murray (2010) also explains that the use of the mobile technologies will enable libraries to have access to their users through services that they are familiar with, like the use of SMS in a library reference service system to reach users.

- The use of mobile technology consists of users, systems and content interacting with each other and the mobile device therefore acts as the intermediary among them. This process leads to users focusing their attention on library resources which enhances the relationship between the users and the library before and after they have visited the library as well as enriching their learning experience (Vandi & Djebbari, 2011).

- Mobile technologies such as GPRS or 2G, UMTS or 3G which are making use of megabit instead of the per second billing has cut down greatly on cost of being online. This has therefore encouraged the “always on” by users without incurring excessive costs (Wentzel *et al.,* 2005). GPRS also provides a faster throughput than that of the GSM since data are simultaneously sent through different radio channels. This makes it possible to read and send emails, IM and browse the Internet at the same time (Wentzel *et al*., 2005).

- It provides students an opportunity to have practical experience of searching library resources since the students will now have to find information resources by themselves instead of waiting to be assisted by a librarian (Murray, 2010). Choy (2010) emphasized this point by noting that libraries needed to be innovative and creative in adopting such services as mobile library services which are relevant to their users.

It is however important that when the benefits are discussed, the challenges should also be mentioned since they could to some extent impede the successful implementation of these technologies. Some challenges are discussed in the following paragraph.

2.5.5 Challenges of implementing mobile technology

It is important that libraries, before considering the use of mobile technologies as a platform for the implementation of any mobile service system such as the use of Web 2.0 applications, consider both the benefits as well as the challenges that they could encounter in the implementation process. Some of the attendant challenges of mobile technologies include those identified by Sheikh & Mills, (2010); Kumar & Chobe (2011) and Saravani (2010):

- The slow connectivity nature of some mobile devices is one of the major challenges libraries would face if they would want to use mobile technologies to provide access to material such as multimedia which needs quicker connectivity.

- The small screens of mobile devices could pose problems with their use especially for downloading large data.

- Another challenge is the fact that some of the mobile devices do not facilitate printing. One therefore needs to acquire another application to enable this function which may not be possible because the device may not support this application.

- Due to the limited memory of some of the mobile devices such as mobile phones, it may be difficult to store bigger content.

- Another challenge is that users would want to download some software from the Internet which could lead to picking up viruses and this could affect the effectiveness of their mobile devices.

- There are no standardized procedures for libraries to follow for the provision of mobile services. This leaves each library to decide on which procedure to adopt. This lack of uniformity has made it difficult for interoperability among libraries.

- Lack of knowledge and skills in Information and Communication Technologies by librarians who are supposed to implement these technologies make it difficult for the implementation and maintenance of projects of this nature.

- Resistance to change by library staff and users who feel comfortable with the traditional ways of delivering and accessing library resources. Some library staff fear the introduction of these technologies could cost them their jobs.

Since these mobile technologies would be used by libraries to deliver mobile services to their users, a number of possible types of mobile services would be discussed in the following section.

2.6 Types of mobile library services

2.6.1 Introduction

Libraries are offering a broad variety of mobile services to their users. Various libraries are making efforts to promote and improve their reference services in order to meet the needs of their users as well as the variety of mobile devices that they use. It is however very difficult to

determine which devices and services users will most appreciate (Lippincott, 2010a). Libraries can however facilitate, enhance and improve access to their resources by incorporating such services as discussed below in their various mobile websites (Villa, Galvez & Campos, 2010).

2.6.2 Mobile online public access catalogues and websites

Libraries are implementing portable versions of their Online Public Access Catalogues (OPACS) termed Mobile Online Public Access Catalogues (MOPAC) in order to enable the provision of services to their users through their mobile devices. One such product which enables the implementation of the MOPAC is the AirPAC which was designed by Innovative Interfaces for the Millennium integrated library system. The implementation of AirPAC will allow library users various levels of access to the content in the traditional OPAC and other circulation services which enable librarians to assist users to check out library materials while off-site as well as update inventory items while around the library. Librarians are also able to assist users with services such as being able to access information about the availability of library materials, due dates, fines, place or cancel holds and to renew library materials through their mobile devices (Kroski, 2008; Murray, 2010).

2.6.3 Mobile reference services

Another service which libraries have implemented is Mobile Reference Services which have greatly enhanced their service delivery (Vila, Galvez & Campos, 2010). Reference service is a personalized service provided by libraries. It is usually a one-on-one interaction between a user and a reference librarian in the form of questions and answers in an attempt to assist the user to access the various information sources available in the library to meet their information needs (Maharana & Panda, 2005). Reference librarians could therefore be performing these reference services remotely through the use of mobile devices and not the traditional face-to-face interaction between the reference librarian and the user. Reference queries are usually sent by

Short Message Service (SMS) or text messages, e-mail, Instant Messaging, audio or video chat to a reference librarian and the response is given through the same means (Lippincott, 2010b; Kroski, 2008).

Although not all reference questions can be handled in this manner, mobile reference services would enable not only the expansion of the library's service points and outreach prospects (Tao *et al.,* 2009) but also have the additional benefit of enabling synchronous reference transactions in a fast and convenient way.

2.6.4 Mobile instruction

Instruction services such as library orientation, information literacy and other awareness programs are other services that libraries are also providing by means of mobile devices. For example, libraries are able to use YouTube to provide library tours to users and use podcasts to afford distance users access to library content (Murray, 2010). Other services such as "self-service" library instructions (Murray, 2010) and "Guide by call" services (Kroski, 2008) have been developed by librarians to guide users on the use of the library and its resources. These include services such as how to select search terms and use the Boolean operators in their search efforts, how to search for articles in their online databases and "ask a librarian" services, which can all be accessed through mobile devices such as personal computers, mobile phones with MP3 players and MP3 players (Kroski, 2008; Murray, 2010).

2.6.5 Accessing mobile collections and databases

Libraries are providing their users with digital media collections which make it possible for users to benefit from library services remotely (Murray, 2010). This effort can be seen in the way database publishers are now introducing mobile versions of their databases to ensure that users can access their e-books and e-journals through their mobile devices (Lippincott, 2010b). Another example is Google Books which can be linked to the library's OPAC so that it can be

directly accessed via Google mobile version. With this, users can access abstracts and full text of books of interest to them through their mobile devices (Kroski, 2008; Lippincott, 2010b; Murray, 2010).

2.6.6 Mobile tours

Libraries are now developing new ways of making their guided tours more convenient for their users. So users now have a choice between registering for a traditional guided tour or doing it themselves through audio tours via their mobile devices. This therefore makes it more convenient for both the librarians and their users. Again instead of a user going to schedule an appointment to learn how to use a new technology in the library, they simply download the audio tours onto their mobile devices and use them at their convenience (Kroski, 2008; Murray, 2010).

2.6.7 Simple message service (SMS) notifications

SMS notifications are also being used by libraries to provide added services such as speedy notifications and quick news announcements about important library events or provide requested information to their users. With the use of the SMS notification systems, e-mail and Instant Messaging, libraries allow their users access to quick news, announcements and responses to queries (Kroski, 2008; Lou & Bell, 2010). For instance, this service can be used to remind users of due dates for borrowed materials and alerts on reservation and holds placed on library materials. This has enabled libraries provide convenient services in order to stay relevant to their users (Kroski, 2008).

2.7 Conclusion

This chapter reviewed the literature related to the research topic. The aim of this chapter was to find out what has already been done in this research area, provide a basis for establishing the

value of the study as well as a standard for comparing the results of the study with other findings. The topics were discussed in five categories.

Firstly, literature on the definition of Web 2.0 applications as well as their underlying principles which includes the Web as platform, harnessing collective intelligence, participation, collaboration and sharing, ease of use and accessibility were reviewed in relation to the topic under study.

Secondly, studies on the practical uses of some Web 2.0 applications in academic libraries were then examined.

Thirdly, there was a definition and a discussion on mobile devices.

Fourthly, mobile technologies were defined and the various types discussed, such as 2G (GSM), 2.5G (EDGE, GPRS), 3G and 4G (WiMAX). Literature on the benefits as well as the challenges of using mobile technologies in academic libraries were then examined and discussed.

The various mobile library services including mobile public catalogues and websites, mobile reference services, mobile instruction, accessing mobile collection, mobile databases, mobile tours, SMS notifications and SMS references were discussed.

The following chapter will discuss the methodology that was used to conduct this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The purpose of this study is to determine how mobile technologies could be used to implement Web 2.0 based service delivery to graduate students in the University for Development Studies (UDS) Library, Ghana.

This chapter discusses the methodology used in conducting this study. This comprises the selection of research location, target group and sampling (sampling technique and sample size). The data collection method (questionnaire) including its advantages and disadvantages are discussed. The application of the questions to the study is discussed. Finally, the data analysis and interpretation which involves the preparation of data, entering of data, presentation of data, and data analysis and interpretation are also explained.

3.2 Selection of research location

UDS is a multi - campus University with four campuses in three of the ten administrative regions in Ghana. The Tamale campus where the Graduate School is located was chosen for this study because, first of all, the research is based on library service delivery using mobile technologies to implement Web 2.0 applications to graduate students of the University. The Graduate School was therefore the obvious choice for this study as it is the main campus for graduate studies.

As the main campus for graduate studies and thus containing the majority of graduate courses and students, the Graduate School would represent the whole graduate student population better. Generalization could thus be drawn from the results obtained to the entire graduate student population of the University.

3.3 Target Group and Sampling

The target group and sampling will be discussed in the following paragraphs.

3.3.1 Target Group

The target group for this study consisted of graduate students in the Graduate School at the Tamale Campus of the University pursuing any of the graduate programmes. The programmes on offer at the Graduate School consist mainly of MA/MSC, MPhil and PhD programmes. The total population of the graduate student population in the Graduate school is 256 (UDS Graduate School Handbook, 2011). The researcher chose this target group because:

- Graduate students usually have an overall need for information to fulfil their research obligations (Hoffman *et al*, 2008).
- It is this group of students who usually turn out to become the future faculty of the University hence they need to be given extra support to enable them to migrate from learner researchers to full scholars (Rempel & Davidson, 2008).
- It is expected that since this group has successfully completed their undergraduate programmes already, they stood a better chance of being more experienced in library usage as compared to the undergraduates. It is therefore assumed that they are more likely to offer better information on which library services should go mobile and which Web 2.0 applications would better serve their information needs.
- Most graduate students are full-time employees, as such going to the library to find information can sometimes be a daunting task to them. It was therefore envisaged that they are more likely to appreciate the efforts and contribute enthusiastically to the research process since the outcome could benefit them directly.

3.3.2 Sampling

Sampling is a very significant component of all research. This is because a sample that is not representative of the population notwithstanding its size is insufficient for the purpose of testing. Thus generalizations cannot be drawn from the sample to the population from which it was taken (Wimmer & Dominick, 2011; Blanche & Durrheim, 1999).

Due to the significance of representativeness of the sample population, it is important that researchers choose their samples carefully. The researcher therefore drew the sample for this study from the total population of the graduate students pursuing their programmes at the Graduate School of the University. The following section discusses the sampling technique used.

3.3.2.1 Sampling Technique

Sampling refers to the process of getting information concerning the total population by examining only a fraction of it. This involves the use of systematic methods in the selection of subjects for a study. The researcher chose to use simple random sampling to select the sample for this study. Simple random sampling is a type of probability sampling in which the elements constituting the population are given numbers. A set of randomly generated numbers is then used to select the elements with the corresponding numbers for inclusion in the sample (Babbie, 2010).

The researcher found simple random sampling to be the most appropriate for this study because it gives each element in the population an equal chance of being selected which makes it more representative. It also eliminates bias and makes sampling easy since the researcher would only need a complete list of the population under study from which the participants are randomly selected.

In this study, the sample was drawn from the entire population of the UDS graduate students of 256 at the Graduate School. A complete list of students obtained from the Graduate School registry was used to draw the sample.

3.3.2.2 Sample Size

The methodology and nature of a study, availability of resources, and heterogeneity of the population among others help determine the sample size of a target group for a study. So when a population is homogeneous the sample size tends to be smaller as compared to a heterogeneous population (Singleton &Straits, 2005). The researcher decided to use a table by

Sarantakos (2005), adopted from Krejcie and Morgan (1970), to help determine a sample size. This table, of which the formula used for the calculation of sample sizes was developed by a division of the National Education Association in the USA, is easy and simple to use (Powell & Connaway 2004).

Many social science researchers have used this table to help them determine the sample sizes for their various surveys. They include Jajaee & Ahmad (2012) who used the table to determine sample size in their article which focused on evaluating the relationship between service quality and customer satisfaction in the Australian car Insurance Industry.

Nitiprechanon (2012) in an article which investigated best practices in research management of Offices of the Basic Education Commission (OBEC) also made use of this table to determine his sample size.

The table was further also adopted by Karimi & Behrngi (n.d) in their study which demonstrated how the use of new teaching models in teaching supervisory science could improve instructional effects and the development of socio-cultural and human values of learners.

From the above, it can be seen that the table has been successfully applied by other social science researchers in their various research endeavours and would therefore be of practical value for this study.

According to the table's instruction, sample size is calculated by placing chi-square for 1 degree of freedom, while the population and the proportion are fixed at 0.50 and the degree of frequency placed at 0.05. Taking into consideration this formula, as well as the ranges of population sizes and their corresponding sample sizes calculated according to the above formula, the sample for this study was set as 155 out of the total of 256 graduate students based in the UDS Graduate School.

3.4 Data Collection Methods

The researcher used only one data collection method in this study. A questionnaire was deemed most appropriate for this study as questionnaires are thought most suitable for the

collection of diverse and extensive information within a relatively shorter time (Stangor, 2004). The use of the questionnaire also helps to collect data about how people think, who they are and what they do, thus offering the opportunity to collect descriptive information about a group of people with the sole aim of getting an overview of opinions, attitudes or behaviours of a given people at any given time (Babbie, 2010; Sarantakos, 2005; Stangor, 2004).

The questionnaire consisted of both open-ended and close-ended questions. This offered the researcher the opportunity of eliciting both qualitative and quantitative data from the respondents which provided the researcher with extra information about what the respondents' views were about the topic. This, Babbie (2010) notes as an advantage in data collection. Other advantages of questionnaires are discussed in the following section.

3.4.1 Advantages of Questionnaires

Some advantages of questionnaires as postulated by Sarantakos (2005); Babbie (2010); Creswell (2009) and Singleton & Straits, (2005) include the following:

- Questionnaires save time because they are able to provide the researcher with fast data within a short period. This was especially significant for this study because of the time constraints the researcher faced. This therefore afforded the researcher the opportunity to gather the data required within a relatively short period to enable the successful completion of this study.
- Questionnaires have less bias associated with their use unlike interviews where the interviewer could influence the responses the respondent gives. The researcher in this case had the chance of getting respondents' candid opinions since they were dealing with just the questionnaire with very little interference from the researcher.
- Questionnaires are convenient in that they offer the respondent the flexibility of when to complete them. This was very helpful to the researcher since the target group are students who have very little time to spare when they come to campus. It was therefore difficult getting them to complete the questionnaire immediately. The questionnaire was

thus given to the respondents who had a choice of either completing it immediately or at a later more convenient time. This was convenient for both the researcher and the respondents since the researcher was able to administer the questionnaire and pick it up at a later time.

However, there are also some disadvantages associated with the use of questionnaires. These will be discussed in the following section.

3.4.2 Disadvantages of Questionnaires

Some disadvantages as postulated by Sarantakos (2005), Babbie (2010), Creswell (2009) and Singleton & Straits (2005) include the following:

- Questionnaires do not offer the respondent the opportunity to ask for clarification, probe, motivate or even prompt the researcher when need be.
- Due to lack of supervision, there are likely to be partial responses and also the researcher may not be able to ascertain if the questionnaire was answered by the selected respondent or by someone else.

The researcher tried to reduce or mitigate these disadvantages where possible. The researcher was at hand to answer any questions while respondents who decided to complete the questionnaire immediately did so. This was to ensure that whatever clarifications or explanations that were needed were given to respondents. The researcher was also able to explain further the significance of the study to the respondents themselves. This was a way of motivating them to complete the questionnaire.

The researcher was able to personally retrieve questionnaires that were answered in her presence; she was thus able to check through the completed questionnaires for mistakes. In instances where some questions were unanswered, she tried to motivate the respondents to complete it in more detail.

3.5 Application of Questions to Study

The researcher made use of only one research instrument which was the questionnaire. The researcher therefore had to ask questions that would elicit as much information as possible from the respondents. The questionnaire was therefore carefully prepared in order to address all the research objectives (Sarantakos, 2005).

Section A of the questionnaire endeavoured to capture the demographic details of respondents while section B of the questionnaire asked questions related to the respondents' use of Web 2.0 applications. The researcher tried to find out whether respondents used these applications, which ones they used, what they used them for and if they thought it was useful for their library to deliver services through these applications.

Section C asked questions on whether the respondents owned mobile devices and if they had Internet capabilities, whether they thought it was useful accessing library services through their mobile devices and the kind of library services they thought should be delivered through these mobile devices.

The following paragraph will explain the methods that were used in the analysis and interpretation of the data that was collected.

3.6 Data Analysis and Interpretation

The concern of data analysis is to develop and apply methods and techniques for the organization and analysing of data. This entails a comprehensive study of collected data, dividing it into patterns that can be managed and knowing the trend in order to respond to research questions (Babbie, 2010; Sarantakos, 2005; Singleton & Strait, 2005).

The qualitative data was analysed using qualitative methods of description and thematic text analysis. The quantitative data was interpreted using quantitative methods such as inferential or descriptive numeric analysis (Creswell, 2009). The basic aim of statistical analysis is to encapsulate the data that has been collected in a form that will answer the research questions, hence enabling conclusions to be drawn from the data (Powell and Connaway, 2004).

The researcher analysed the data through the following phases;

- **Preparation of data**

The data was prepared by editing and coding it.

  - The editing involved scrutinizing the collected data (questionnaire) to find out if questions were fully answered and to help avoid duplicated coding by ensuring that related questions were excluded. This phase also enabled the researcher identify irrelevant answers which were removed. The researcher together with the research assistant edited all the questionnaires that were returned to ensure that only questionnaires which were completed were included in the coding process. This was done to ensure that the coding was correctly done.
  - The coding of the closed-ended questions was done by translating the responses into numerical codes (Sarantakos, 2005) and by employing descriptive coding (Kumar, 2005). The answers to the open-ended questions were written out. Similar answers were grouped together. Recording the open-ended questions this way allowed for easy analysis and interpretation as they were all explained in the analysis and interpretation processes.

- **Entering of data**

  After editing and coding of the data, the data were entered into the SPSS system. The data was then run in the system to generate the results which were used for the analysis and interpretation. This made it easy for tables to be drawn and for cross tabulation of the results. Microsoft Excel was then used to draw the graphs.

- **Presentation of Data**

  This phase followed next after the data was entered in to the system and the analysis completed. The analysed data was presented in the form of text and graphs which were drawn using Microsoft Excel.

- **Data analysis and interpretation**

  The data that was presented was analysed through the processes mentioned above. The analysed data together with the literature as well as the researcher's background knowledge of the study area were used for the interpretation.

  The interpretation was done according to the sub-divisions that were provided in the questionnaire. Each analysed question (both closed and open ended) were taken and an interpretation given to each of them by way of discussions using the literature or knowledge of the research area to either support the findings or explain why the results are the way they are.

3.7 Conclusion

This chapter outlined the research methodology adopted for this study. The chapter comprised an explanation for the selection of the research location and target group for the study. The sampling techniques and sample size were also discussed. The data collection methods were explored, a single method was used (a questionnaire) to collect data from 155 graduate students through simple random sampling. The researcher discussed advantages as well as disadvantages associated with this data collection instrument. There was a brief discussion on the application of the research questions to the study. The SPSS package was used to analyse the data and Microsoft Excel was used to draw the graphs. These were used to interpret the data which was presented in the form of text and graphs. The following chapter will report in detail the findings from the data that was collected and analysed.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1. Introduction

This chapter provides a presentation of the data collected by means of questionnaires administered to graduate students of the UDS in Ghana, as well as the analysis and interpretation of the data that were collected. It focuses on addressing the study's main problem and sub-problems and brings these in line with the literature.

A total of 155 questionnaires were distributed, 119 questionnaires were retrieved and found useful for analysis, thus achieving a response rate of 76.7%. This is regarded as very good for analysis and reporting (Babbie, 2010).

The chapter has been organized into the following sub headings according to the sub sections of the questionnaire:

- Demographic details of the population
- Use of Web 2.0 applications
- Use of mobile devices

4.2 Demographic details of the population

4.2.1 Age of respondents

Out of the total number of 119 respondents, 31 (26.1%) were younger than 30 years, 57 (47.9%) were between the ages of 30 and 39 years, 25 (21%) were between the ages of 40-49 years and 6 (5%) were 50 years and older. From these figures it can be seen that the majority 88 (73.9%) of the graduate students are under 40 years old. Only 31 (26.1%) respondents were above 40 years. This age range reflects the general trend in student ages of the University as

the University's statistics show that majority (85%) of students of the University fall between the ages of 20 and 40 years (UDS Graduate School handbook, 2011).

4.2.2 Gender of respondents

Out of the total number of 119 respondents, 74 (62.2%) were male and 45 (37.8%) were female. This is representative of the situation in Ghanaian universities where male students out number female students. This is affirmed by Wilson-Tagoe & Tete-Mensah (2011) when they assert that the enrolment of women in tertiary education in Ghana is highly inadequate as compared to males.

4.2.3 Programmes pursued by graduate students

Out of the 119 respondents, 44 constituting the highest percentage of 37% were pursuing MA courses. Those pursuing MPhil were 39 thus 32.8% of the target population. MSc students were 30 (25.2%) while PhD students were only 6 thus 5% of the target population. Therefore an overwhelming 113 students (95%) were pursuing Masters Programs with only 6 (5%) pursuing PhD programmes. Many of the graduate programmes on offer at UDS are at the Masters level with only a very few PhD programs. UDS is a very young University (20 years) and as such emphasis has been on undergraduate and more recently Masters programmes (UDS Graduate School handbook, 2011). This could account for the low number of PhD students.

In the following section, the researcher will discuss the use of Web 2.0 applications by UDS graduate students.

4.3. Use of Web 2.0 applications

As discussed in chapter two, many libraries especially in the United States are riding the wave of Web 2.0 applications to promote many interactive services. These include the provision of real time services such as the use of Instant Messaging, RSS Feeds, and Bookmarking, etc.

(Chua & Goh, 2010; Harinarayana & Raju, 2010). To ascertain whether respondents used such Web 2.0 applications, they were asked to indicate their use or non–use of Web 2.0 applications in general. Out of the total of 119 respondents, 106 (89.1%) answered in the affirmative while 13 (10.9%) answered in the negative.

With a view to future implementation in the library this response was found to be encouraging to the researcher because it meant that the majority of the respondents knew what these applications were and used some of them.

However, it is worth noting that the main reasons respondents who answered in the negative gave for not using these applications were “not having the ability to use them or not having access to them”. The researcher does not view this as a drawback but an opportunity to introduce and train the few non-users to these Web 2.0 applications and also inform them about the benefits they stand to gain from using them.

4.3.1 Types of Web 2.0 applications used

Out of the 106 respondents who indicated they used Web 2.0 applications, the most used Web 2.0 applications were Social Networking Sites with 105 (99%) respondents, Instant Messaging with 66 (62.2%) respondents and Video Sharing with 65 (61.3%) respondents respectively. Other applications used were Microblogging 44 (41.5%), RSS Feeds 43 (40.5%), Blogs 42 (39.6%), Wikis 36 (33.9%), Photo Sharing 32 (30.1%) and Social Bookmarking 17 (16%).

Responses exceeded the 106 respondents because respondents could give multiple responses to this question. 105 out of the 106 respondents indicated that they used Social Networking Sites (SNS). The high usage of Social Networking could be attributed to the ease of use of these applications (Ulrich *et al*., 2008). This then provides an opportunity for the UDS library to take advantage of this phenomenon to share information among its users through these Web 2.0 applications.

The findings further show that other Web 2.0 applications such as Social Bookmarking, Blogs and Wikis are less used by the respondents even though these are very important applications that libraries have implemented to enhance their library services (Mahmood & Richardson, 2011; Hiranarayana & Rayu, 2010; Shrager, 2010; Ouyang & Chu, 2009). The low usage of these applications could possibly be because these applications are more often used for academic purposes (in places they are used), however in respondents' academic environment, these applications are not used much, hence the incidence of low use by these respondents.

Some respondents however indicated that they used "Dropbox", "Skype" and "WhatsApp" which are Web 2.0 applications that were not mentioned by the researcher. It was, however, recognized that most of those who used these applications appeared to be very conversant in the usage of a number of the listed Web 2.0 applications.

The graph below is a representation of the responses.

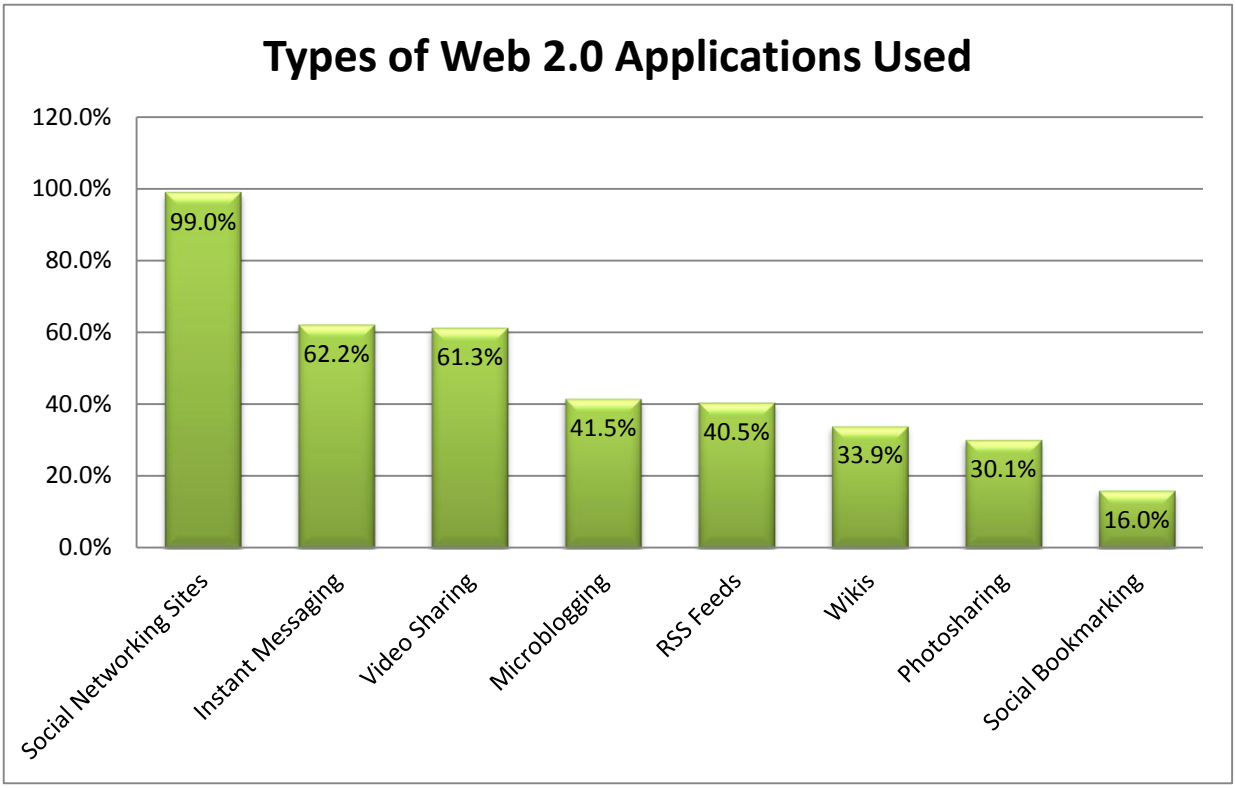

Fig. 1: Types of Web 2.0 applications used by respondents

4.3.2. The frequency of usage of Web 2.0 applications

A five point Likert scale was used to ask respondents how often they used the various Web 2.0 applications mentioned above. SNS was indicated as the most frequently used by respondents. 41 (38.6%) of the 106 respondents who indicated they used the Web 2.0 applications stated that they used SNS on a daily basis with only 3 (2.8%) indicating that they had never used it. This 2.8% could be using some of the other Web 2.0 applications listed. Instant Messaging followed closely with 28 (26.4%) of the 106 respondents using it daily with 5 (4.7%) respondents never using it. Besides these two applications, the other Web 2.0 applications were hardly used by respondents on a daily basis.

Figure 2 below depicts the frequency of usage by respondents.

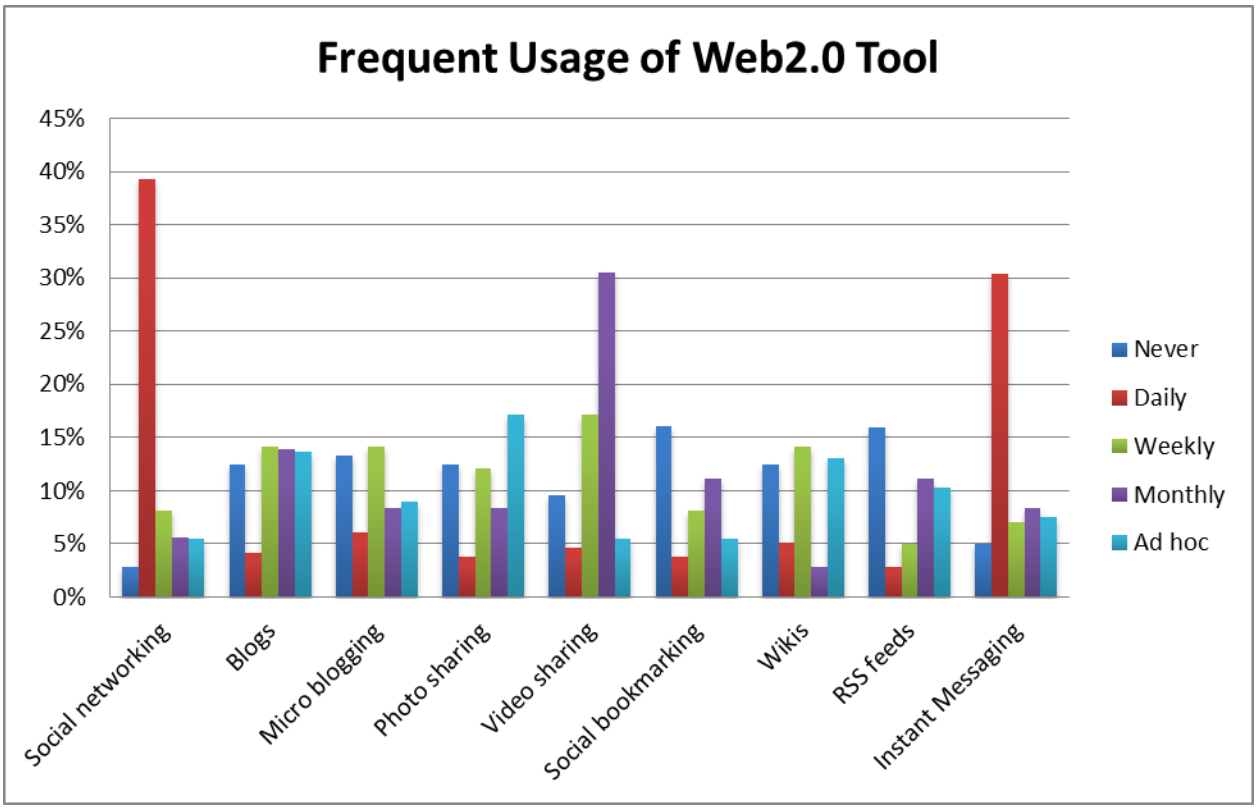

Fig. 2: Frequency of usage of Web 2.0 applications

4.3.3 Use of Web 2.0 applications in library service delivery

Respondents were asked to indicate whether Web 2.0 applications could be used to deliver library services and if the UDS Library used any of those applications to deliver library services. Out of the total number of respondents (119), 110 (92.4%) indicated that Web 2.0 applications could be used to deliver library services with 8 (6.7%) indicating that it could not be done. There was however 1 (0.8%) respondent who did not answer this question. Reasons given by the 6.7% who indicated that it could not be done were:

- That there was either very limited, slow or virtually no Internet connectivity. Such a network could therefore not be used to undertake this endeavor of using Web 2.0 applications to deliver library services.

- Lack of ability by respondents in using the Web 2.0 applications.
- Inadequate resources of the library such as insufficient funds to implement such a project. For instance, funds to acquire needed equipment and to train staff to adequately manage the system.

The positive response on the possibility of delivering Web 2.0 based library services affirms what has been noted in the literature namely, that libraries the world over are leveraging Web 2.0 applications to enhance their library services (Hiranarayana & Raju, 2010; Mahmood & Richardson, 2011; Ouyang & Chu, 2009; Shrager, 2010). This can also be seen in the light of McManus' (2009) assertion that academic libraries do not have a choice but to integrate these technologies into their services otherwise they will lose their relevance since these Web 2.0 applications have become a major aspect of the lives of their users.

As to whether the library used Web 2.0 applications to deliver services, 96 (80.7%) out of the 119 respondents indicated in the negative with 19 (15.9%) indicating that the library used the Web 2.0 applications to deliver services. The remaining 4 (3.4%) did not respond to this question.

Although it is a known fact that the UDS library does not deliver Web 2.0 based library services, some respondents indicated in the positive. It could be inferred from the positive responses that those respondents never used the library and so may be ignorant of the services provided or they were ignorant of what constituted Web 2.0 applications. Any regular user of the UDS library would be aware of the non-existence of these services, and would therefore not have answered in this way. On the other hand, users who did not know what constituted Web 2.0 based library services may have misconstrued some of the e-resources which they accessed within the library to be Web 2.0 based library services. The researcher is, however, of the opinion that the former is the case.

4.3.4 Usefulness of Web 2.0 applications in libraries

Web 2.0 applications are noted to facilitate sharing, networking and disseminating information among friends and other professional groups (Tripathi & Kumar, 2010). As a result of the numerous touted benefits of Web 2.0 applications (McManus, 2009; Ouyang & Chu, 2009; Hiranarayana & Raju, 2010; Shrager, 2010; Mahmood & Richardson, 2011), the researcher decided to find out respondents' perception of the usefulness of delivering Web 2.0 based library services in their library.

On a five point Likert scale, respondents (119) were asked to rate the possible usefulness of certain Web 2.0 applications in a University library. The responses were as follows; Instant Messaging 50 (42%), SNS 44 (36.9%) and Social Bookmarking 29 (24.3%) were those deemed as being 'extremely useful' whilst Photo Sharing 4 (3.3%), Video Sharing 4 (3.3%) and Microblogging were the applications very few respondents thought as being 'extremely useful'.

On the whole, the ratings indicated that most of the respondents viewed the Web 2.0 applications as being useful to the library environment. Very few respondents (ranging from 4 (3.3%) for Instant Messaging and Blogs to 10 (8.4%) for Microblogging, Photo Sharing and Video Sharing) thought otherwise. This could be because respondents who used the Web 2.0 applications in everyday life were aware of the benefits of these applications and were therefore of the opinion that their application in the library could be highly beneficial to them. The diagram below illustrates the ratings of respondents.

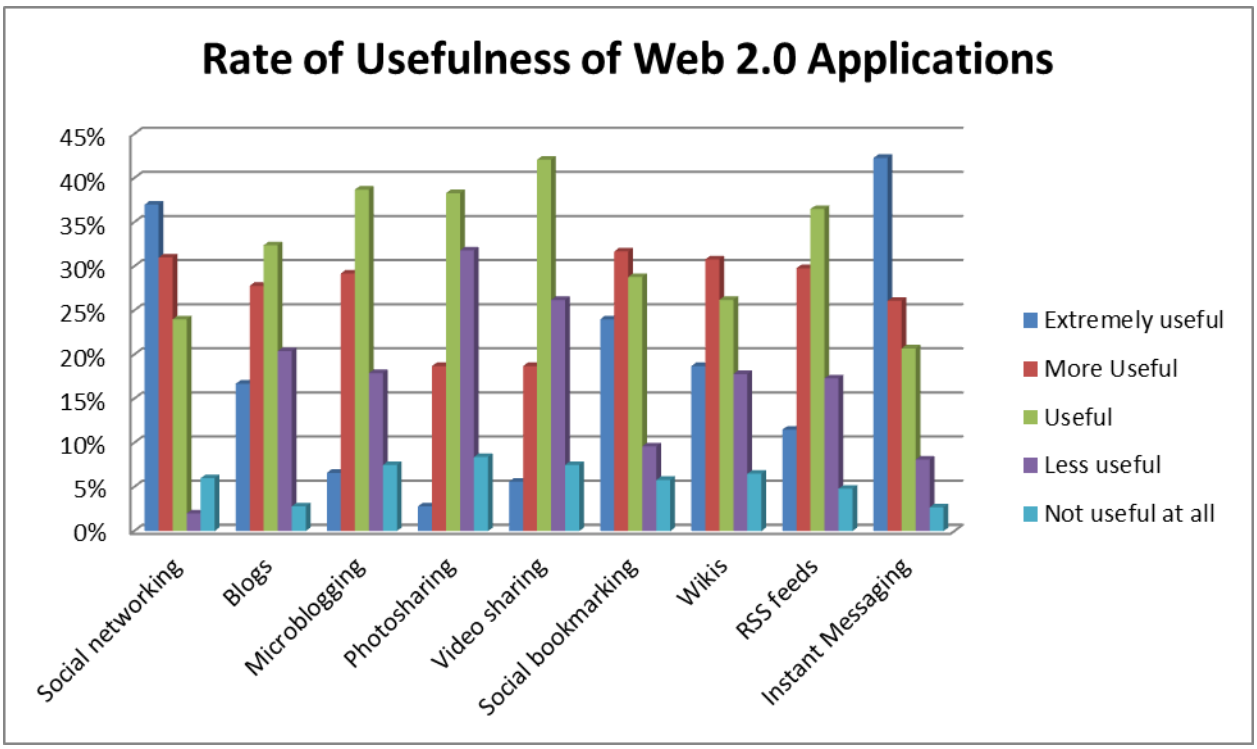

Fig. 3: Rating of usefulness of Web 2.0 applications

4.3.5 Abilities of respondents in the use of Web 2.0 applications

The researcher wanted to ascertain the abilities of respondents in the use of the Web 2.0 applications used for the study. On a five point Likert scale, respondents were requested to rate their abilities in using the applications. The 106 respondents who indicated they used the Web 2.0 applications rated their proficiency in using them as follows; SNS and Instant Messaging were leading with 49 (46.2%) and 33 (31.1%). Very few respondents indicated that they had excellent abilities in the other Web 2.0 applications with RSS Feeds being the lowest with 2 (1.8%). This difference could be attributed to the fact that SNS and Instant Messaging have been reported earlier as being the most often used Web 2.0 applications by respondents. The high usage of these two applications is a confirmation of respondents' earlier indication that they had acquired excellent abilities with regards to the use of these applications as a result of their constant use of them.

On average, many respondents also indicated that their abilities with regards to the usage of Web 2.0 applications were either ‘very good’ or ‘good’- Video Sharing 56 (52.8%), Instant Messaging 50 (47.1%) and SNS 46 (43.3%) were the applications with the highest such responses. Then Wikis 45 (42.4%), Photo Sharing 41 (38.6%), Microblogging 39 (36.7%), Blogs 35 (33%), RSS Feeds 33 (31.1%) followed in that order with Social Bookmarking being the least with 30 (28.3%).

Also, the high responses for the Video Sharing, Instant Messaging and Social Networking could possibly be attributed to the regular use of applications such as YouTube, to download films and music, Google chat, Facebook chat and WhatsApp which many of these students used regularly to pass time and finally Facebook for socializing and entertainment purposes.

It can thus be concluded from the responses that the frequent use of these Web 2.0 applications by respondents for socialization and entertainment purposes has led to their proficiency in the use of these applications.

Fig. 4 shows the respondents’ responses with regards to their abilities to use the Web 2.0 applications mentioned. The use of mobile devices by graduate students of UDS will be discussed in the next section.

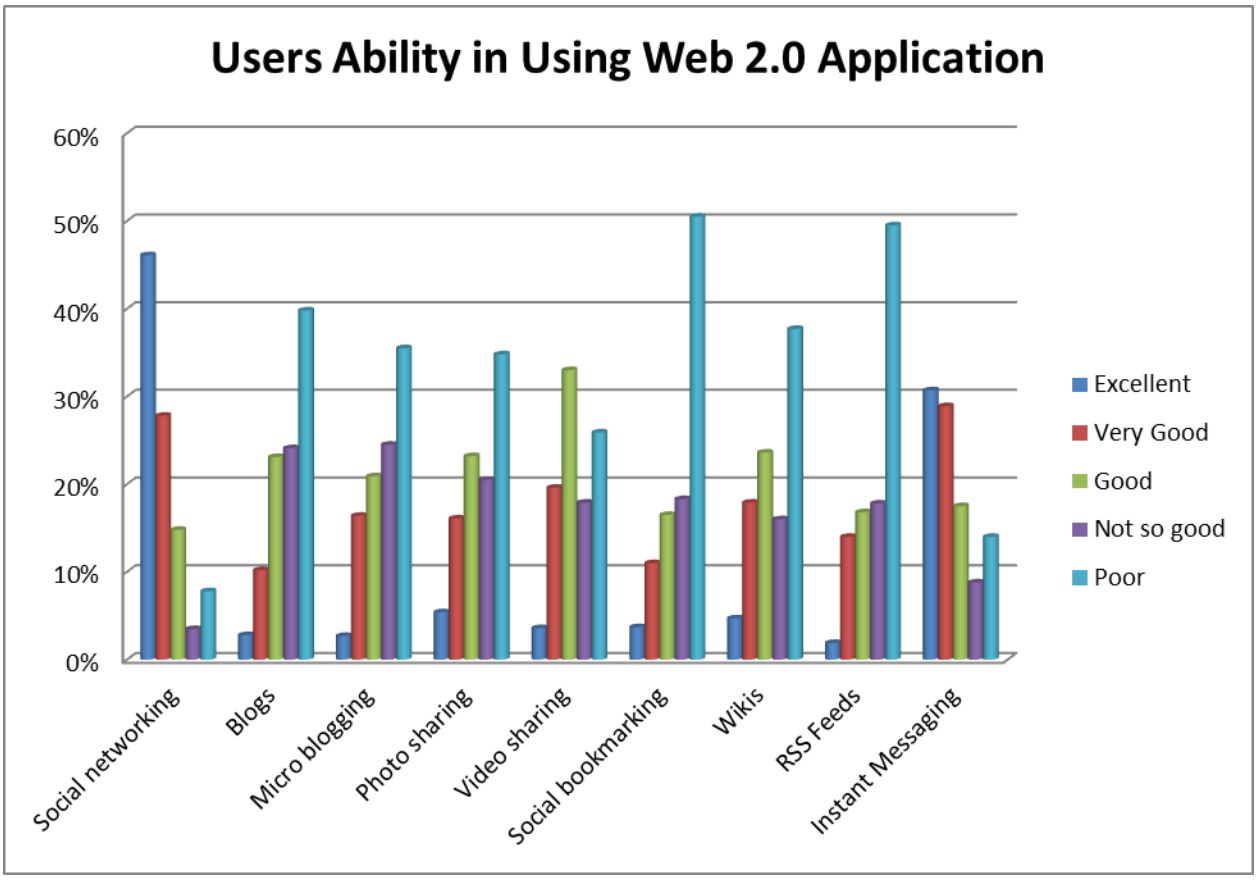

Fig. 4: Users' ability in using Web 2.0 applications

4.4 Use of mobile devices

Respondents were asked to indicate whether they owned a mobile device. All respondents (119) answered in the affirmative. This goes to affirm the ITU's claims that mobile phone penetration rates in low-income countries is 45% and that of lower-middle-income countries is 76% (ITU as cited in UNDP, 2012). Ghana falls within the second category, which means that about 76% of people living in Ghana own or have access to mobile phones. This could therefore explain why all respondents said they had at least one or more mobile devices.

A question was then posed to respondents (119) to indicate all the types of mobile devices they owned. Of all mobile devices indicated by respondents, 117 owned a mobile phone and this constituted 52.7% of all the devices owned by respondents with the laptop following with 82

(36.9%), the iPad 13 (5.8%), iPod touch 4 (1.8%), and Galaxy tab 3 (1.4%). Ownership of the PDA and the eBook reader constituted 3 (1.4%).

Below is a diagram showing the mobile device ownership of respondents.

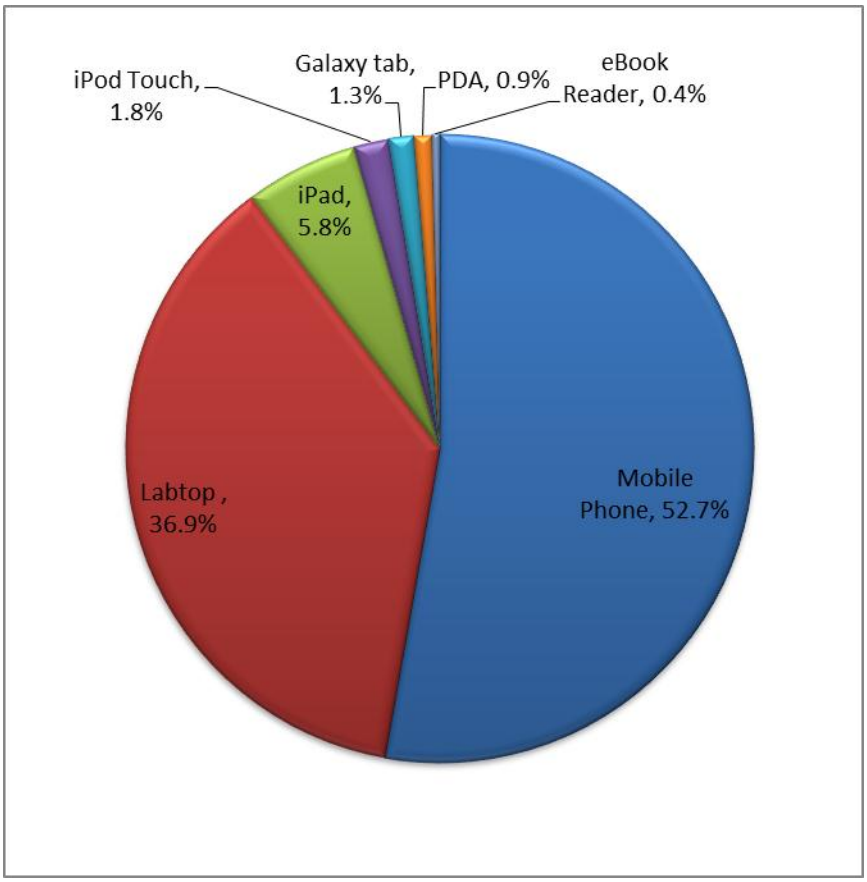

Fig. 5: Mobile device ownership

It is worth noting that because respondents had to indicate all the mobile devices they owned, the number of mobile devices counted exceeded the number of respondents since some respondents owned two or more mobile devices.

A further question was asked as to whether their mobile devices could access the Internet. Here 104 (87.4%) out of the 119 respondents stated that their mobile devices could access the Internet with 12 (10.1%) indicating otherwise. There were however some respondents 3 (2.5%)

who did not respond to this question. This high response rate supports the fact that Internet penetration in Ghana is growing at a fast rate as stated by the Government of Ghana official portal (2012) of about 5% within a year (from 5.2 % in 2010 to about 10 % in 2011) (Government of Ghana official portal, 2012).

4.4.1 How respondents used their mobile phones

As mentioned earlier, the findings indicated that all 119 respondents owned a mobile phone. It was therefore deemed necessary to determine what respondents used their mobile phones for. As stated in chapter two, the latest figures from ITU (2011) indicate that mobile phone penetration rates stand at almost 45% in low income countries and 76% in lower-middle-income countries of which Ghana is one. The researcher, as a result of this report, assumed that most respondents would at least own a mobile phone. This assumption was confirmed when data gathered from the study indicated that all respondents (119) had a mobile phone.

Respondents were therefore asked to indicate the uses to which they put their mobile phone so as to verify if accessing the Internet was a part of their normal activities on their mobile phones.

Respondents indicated that they used their mobile phones for a variety of purposes listed as follows:

- All the 119 respondents, constituting 100% response for this question used their mobile phones to make/receive calls.
- Text messaging followed with 117 (98.3%).
- Listening to the radio was next with 97 (81.5%).
- Taking photographs then followed with 91 (76.4%)
- Surfing the net was 90 (75.6%)

- Send/receive emails was 79 (66.3%)
- Playing games was 73 (61.3%)
- Viewing maps 52 (43.6%)
- Recording video clips 49 (41.1%)
- The least was watching television programmes 23 (19.3%)

According to BusinessGhana (2012), as a result of the many challenges Ghanaians face with fixed-line communication among which are overall poor infrastructure, power supply problems and the high cost of satellite bandwidth, many Ghanaians have resorted to the uptake of mobile communications. This could probably explain why there was a 100% response rate for the make/receive calls with regards to uses to which respondents put their mobile phones.

4.4.2. Web 2.0 applications used by respondents through their mobile devices

It was deemed necessary to ascertain whether respondents used their mobile devices to access Web 2.0 applications. A question to this effect was thus posed to respondents.

The majority of respondents 99 (83.2%) out of the 119 indicated that they used their mobile devices to access some of the Web 2.0 applications earlier mentioned, with 20 (16.8%) indicating they did not access any of those applications with their mobile devices. Some of the reasons given by the few respondents who do not use their mobile devices to access any of the Web 2.0 applications included the Web 2.0 applications not being accessible to them and not knowing how to use these applications.

The major reason given by respondents was, however, that their mobile devices did not have Internet capabilities. This the researcher presumed could be attributed to a number of factors such as a respondent having just an old mobile phone with no Internet capabilities as her/his

only mobile device. Other factors could be respondents staying in an area where there is no Internet coverage or network access challenges, cost, respondents not knowing how to use the wide and powerful array of functionalities of their mobile devices to access these Web 2.0 applications (Saravani, 2010). Lastly, the researcher gathered from the data collected that some respondents' misapprehended mobile phones for mobile devices and as such when they used their laptops to access the Internet, they did not consider the laptops as mobile devices.

It is notable that in an earlier section of this chapter when respondents were asked if they used the Web 2.0 applications, 106 (89.1%) of respondents said Yes while 13 (10.9%) said No. However when they were asked if they used their mobile devices to access these applications 99 (83.2%) said Yes while 20 (16.8%) said No.

It can thus be noted that not all respondents who used the Web 2.0 applications accessed them through their mobile devices because the percentage of those who indicated that they generally used Web 2.0 was higher than those who used Web 2.0 applications through their mobile devices. It could therefore be assumed that the difference could be as a result of some respondents using the Web 2.0 applications through other devices such as desktop computers in their homes or in the library.

4.4.3 Usefulness of accessing library services through mobile devices

Respondents' views were sought as to the usefulness of accessing their library's services through their mobile devices. This was to determine opinions of respondents on the usefulness of such services and their interest and desire to patronize such services. With regards to the usefulness of accessing library services through their mobile devices, 110 (92.4%) of the 119 respondents indicated they wished they could access their library through their mobile devices with 9 (7.6%) indicating otherwise.

Most of the 9 (7.6%) respondents who indicated it would not be useful did not state reasons for their stance. The only reason presented against the usefulness of accessing the library through mobile devices had to do with cost. This confirms Lippincott's (2010b) finding that many students state cost as the main reason for not using the Internet capabilities of their mobile devices. The UNDP (2012) further states that for people at the bottom of the pyramid, the price of mobile services still remain high as it can amount to 15.75% of monthly average per capita income in countries with low income. This is made worse by the non-existence of mobile telephone service coverage in remote and marginalized areas.

All 119 respondents were then asked to specifically indicate the kind of library services they would like to access on their mobile devices. Of the library services respondents indicated they would want to access on their mobile devices, the most preferred were Reference Services and this was by 110 respondents constituting (92.4%) of total number of responses. This was followed by access to E-resources 96 (80.6%), Library news 89 (74.7%), Searching the OPAC 88 (73.9%) Circulation Services 86 (72.2%) and finally Subject Guides 71 (59.6%).

It is again worth noting that responses exceeded the number of respondents because there were multiple indications of choices by respondents.

The figure below shows the responses.

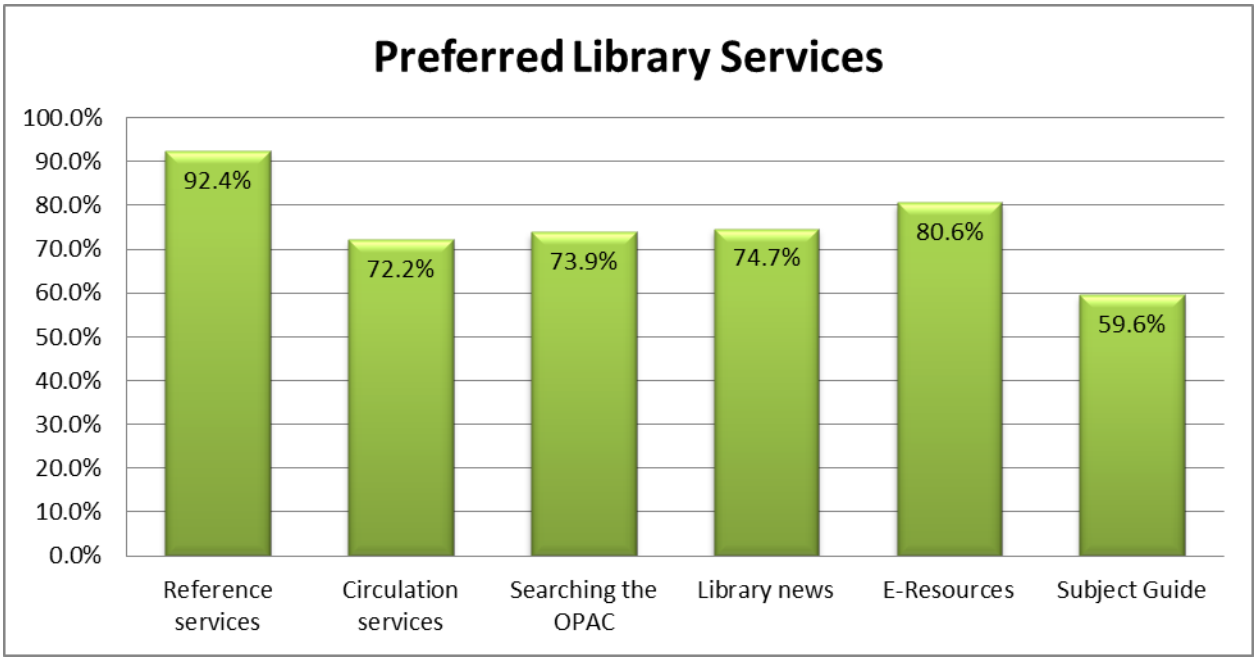

Fig. 6: Preferred library services

4.4.4 General comments

To ensure that respondents could express their opinions on the questionnaire and its subject matter, the opportunity was provided to respondents to make a few general comments with regards to the questionnaire by means of open-ended questions. Comments were made by 8 (6.7%) out of the 119 respondents. The comments that were made included the following:

- Hopes for the implementation of Web 2.0 applications in the library
- The use of Web 2.0 applications could
  - facilitate easy access to the library's resources
  - enhance teaching and learning for graduate students.
  - enhance information dissemination.

- High cost of implementing such a project was also expressed as they felt cost could be a barrier to its success.

These comments are further discussed below.

Web 2.0 applications facilitate easy access to any academic library's services because these Web 2.0 applications are easy to use due to their desktop like interfaces (Rollett, *et al,* 2007). This ease of use reflects in the high adoption rate of these applications because people feel comfortable using them. The open nature and ease of use of the Web 2.0 applications make them very useful in the teaching and learning environment (Lippincott, 2010a). Various studies have shown that a number of universities have applied these Web 2.0 applications in their service delivery efforts (Marmood & Richardson, 2011; Hiranarayana & Rayu, 2010; Shrager, 2010; Ouyang & Chu, 2009).

As Rollett *et al.* (2007) have posited, the use of WAP for mobile devices has made it easier and cost effective for Web 2.0 applications to be accessed by mobile devices because users do not need additional software to enable them access these applications. This has therefore resolved such fears which respondents had expressed concerning cost of using these applications with regards to access and updates.

It could possibly be because of these reasons that some respondents indicated that implementing Web 2.0 tools at the UDS Library had become necessary.

Overall, these comments by these very few respondents appear to show their appreciation of what Web 2.0 based library services entail.

4.5 Conclusion

This chapter presented the data, analyzed and interpreted it. The data was collected through the use of a 23 item questionnaire administered to 155 respondents. A total of 119

questionnaires were retrieved and found to be suitable for analysis. The data was analyzed through the use of the SPSS package and was presented by use of text and bar and pie charts.

The analysis and interpretation of the data was done according to the sub-divisions used in the questionnaire. These sub-divisions were demographic details of the population, use of Web 2.0 applications and the use of mobile devices. Based on the analysis and interpretation, findings were drawn from the data presented. General comments by respondents were then discussed and a conclusion to the chapter was then drawn. The following chapter will discuss the conclusions to the study and provide recommendations.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

Academic libraries the world over are leveraging new technologies such as mobile technologies and Web 2.0 applications to enhance their service delivery efforts to their users. However, this phenomenon is yet to be fully embraced by academic libraries in sub Saharan Africa and other places in the developing world.

The purpose of this chapter 5 is therefore to expand on and draw conclusions to the research questions as stated in chapter 1. These conclusions are drawn based on the research findings as presented in chapter 4 and the literature reviewed in relation to this study as presented in chapter 2.

The chapter ends with a discussion of recommendations based on data collected and analyzed, taking cognizance of the reviewed literature.

5.2. Findings

This study sets out to investigate how mobile technologies could be used to implement Web 2.0 based service delivery to graduate students in the UDS library.

Arising out of this research question, the following sub-questions were formulated:

> What is Web 2.0 and how can Web 2.0 applications be used in an academic library for enhanced service delivery?

> What are the types of mobile technologies currently available?

What are the advantages and challenges in using mobile technologies in the academic library?

Which library services can be provided through the use of Web 2.0 applications making use of mobile technologies?

The subsequent paragraphs discuss the results of the empirical study as they pertain to the research sub problems within the context of the reviewed literature.

5.2.1. What is Web 2.0 and how can Web 2.0 applications be used in an academic library for enhanced service delivery?

The term Web 2.0 has been variously described by a number of Web 2.0 proponents as discussed in chapter two. The literature has also shown that there are different types of Web 2.0 applications. Some of the types of Web 2.0 applications as discussed in the literature review in chapter two include Blogs, Instant Messaging (IM), Real Simple Syndication (RSS) Feeds, Social Networking Sites (SNS), Podcast, Vodcast, Wikis, Photo Sharing and Microblogging. Graduate students of UDS affirmed that they used some of these applications through their mobile devices. SNS and IM were the only two applications which were used on a daily basis by a considerable number of students. The respondents also indicated that they were most proficient in the use of these two applications.

As indicated in chapter two, many academic libraries have adopted Web 2.0 applications to enhance their service delivery. The UDS Library has not yet adopted any of the Web 2.0 applications in its service delivery. However, almost all graduate students who participated in the study indicated that Web 2.0 applications would be useful in delivering library services and that implementing Web 2.0 applications to enhance service delivery at the UDS Library has become necessary.

5.2.2. What are the types of mobile technologies currently available?

There are a number of mobile technologies currently available but this study discussed only the most prolific ones. These include 2G technologies (GSM), 2.5G technologies (EDGE, GPRS), 3G technologies and 4G technologies (WiMAX). The literature study indicated that EDGE and WiMAX were the most appropriate for the implementation of mobile based service delivery in the Ghanaian environment due to their relatively low cost and high speed. It is these technologies that have enabled the delivery of internet services through mobile devices.

All the graduate students owned at least one or the other mobile device with Internet capabilities with all respondents owning a mobile phone. The ownership of an Internet enabled mobile device is essential for the delivery of Web 2.0 mobile based library services. This obviously creates an opportunity for the UDS Library to deliver some of its services through some of these mobile technologies. Although the UDS Library does not offer services through these mobile devices, students' expressed their desire to access the library's resources through their mobile devices. This showed that with the necessary infrastructure and technical expertise there exists a real possibility of delivering library services through mobile devices to graduate students at UDS.

5.2.3. What are the advantages and challenges in using mobile technologies in the academic library?

Academic libraries could benefit immensely from using mobile technologies to deliver library services to their users. Some of the advantages of using mobile technologies have been noted as being able to retain library users and enable libraries have access to their users through services they are familiar with. They enable wider penetration of service delivery and some of the mobile technologies make use of megabit rather than per second billing which has cut down on cost of being online.

The implementation of mobile technologies in libraries comes with some challenges which must be noted and managed to ensure success. Some of the challenges as noted in chapter two include slow connectivity nature of mobile devices, small screen, limited memory and the inability of some of the mobile devices to print documents, lack of knowledge and skill in ICT by the librarians who would implement the technologies as some of the problems that come with the use of mobile technologies. Even though these challenges are profound at the UDS Library, respondents indicated in chapter four that they would like to access their library's resources through their mobile devices.

5.2.4. Which library services can be provided through the use of mobile technologies?

Many academic libraries as discussed in chapter two are offering a broad variety of mobile services to their users in order to enhance their service delivery.

Although the UDS library does not offer any mobile library services, the majority of the respondents said that it would be useful if they could access their library's services through their mobile devices and expressed their desire to do so. The services they would like to have access to included: Reference services, circulation services, searching the OPAC, accessing library news, e-resources and subject guides.

There were however, a few respondents who indicated they did not wish to access their library through their mobile devices. Reasons given for this lack of desire were mostly attributed to cost. This confirms Lippincott's (2010b) finding that many students state cost as the main reason for not using the Internet capabilities of their mobile devices.

5.3. Recommendations

Arising out of the literature review, the findings of the study and the conclusions drawn, the following recommendations for the UDS library are made.

- Management of UDS library system should as a matter of urgency initiate some Web 2.0 based services. With this in mind, the UDS Management should also commit substantial amount of money to ensure the implementation and consequent sustainability of a project of this nature.
- The UDS library needs to fully automate its system in order to successfully implement a mobile based Web 2.0 library service. The Management of the University and the ICT department should as well seriously consider giving the library a bigger Internet bandwidth which can support such a service.
- The library should consider recruiting staff with the requisite technical expertise. Alternatively identified staff with potential to acquire this technical know-how could also be retrained to adequately manage the project.
- It is also essential that the UDS Library puts in place a continuous training package for its entire staff. The library should also offer training to students on how to effectively use these Web 2.0 applications through their mobile devices to access the library's information resources.

5.4. Recommendations for further study

The researcher would like to suggest that further studies be conducted on all the campuses of the University to ascertain if the results obtained in this study which show enthusiasm among the graduate students based in the Graduate School for mobile based Web 2.0 library services, is a general feeling among the entire student body.

The researcher would also recommend that a study be conducted in the future to investigate the impact of training users in the use of Web 2.0 applications in their research efforts.

5.5. Conclusion

In conclusion, Web 2.0 applications and mobile technologies have changed the way people access information. As a result, many academic libraries are now taking advantage of these technologies to deliver enhanced services to their users. The UDS Library however, has not as yet taken advantage of this situation even though respondents have indicated in the study that they own Internet enabled mobile devices and they would also like to access their library's services through these Web 2.0 applications using their mobile devices. The study has therefore showed that there is a great potential for implementing these technologies. Furthermore, this study could also serve as a foundation for other academic libraries in Ghana to conduct research into the possibility of using these technologies for enhanced service delivery in their libraries.

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Appendix 1

QUESTIONNAIRE

Dear Sir/Madam,

Thank you very much for participating in this research. This research is being conducted by Miriam Linda Akeriwe in fulfillment of a Masters in Information Technology Degree at the University of Pretoria, South Africa. This mini-dissertation is focused on finding out whether mobile devices can be used as a platform to implement Web 2.0 library services to graduate students in the University for Development Studies Library, Ghana.

This questionnaire is organized into three sections; Section A concerns necessary background information, Section B covers the use of Web 2.0 applications, and Section C is on the use of mobile devices. As part of University of Pretoria policy, all information that you provide will be treated with confidentiality and your identity will not be revealed when the study results are reported. In order to ensure your protection, the researcher has obtained ethical approval for this study from the University of Pretoria, EBIT faculty. The researcher is kindly requesting 10-15 minutes of your time to answer this questionnaire. Taking part in this study may benefit you directly since the aim is to find out if the University for Development Studies library can implement Web 2.0 based library services using mobile devices to graduate students of the University.

Thank you for your participation and contribution towards this mini-dissertation.

Instructions:

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

SECTION A

DEMOGRAPHIC INFORMATION

1. Age

   a. Below 30 [ ]

   b. 30-39 [ ]

   c. 40-50 [ ]

   d. Above 50 [ ]

2. Gender

   a. Male [ ]

   b. Female [ ]

3. Please specify the programme that you are currently registered for e.g. MA/MSc/PhD

   ……

SECTION B

USE OF WEB 2.0 APPLICATIONS

4. Do you use Web 2.0 applications?

a. Yes [ ]

b. No [ ]

5. If you answered **No** to the above question, please indicate why not:

……

……

6. Which of the following Web 2.0 applications do you use? Please select all options that are applicable and/or add those tools not mentioned.

a. Social networking (e.g.Facebook, MySpace) [ ]

b. Blogs [ ]

c. Microblogging (e.g. Twitter) [ ]

d. Photo sharing (e.g. Flickr) [ ]

e. Video sharing (e.g. YouTube) [ ]

f. Social Bookmarking (e.g. Delicious) [ ]

g. Wikis [ ]

i. RSS feeds [ ]

j. Instant Messaging [ ]

k. Other (please specify)

……

……

7. Please tick in the appropriate column to indicate how often you use the following Web 2.0 applications.

Web 2.0 tool	**Never**	**Daily**	**Weekly**	**Monthly**	**Ad hoc**
Social networking					
Microblogging					
Photo sharing					
Video sharing					
RSS feeds					
Social Bookmarking					
Instant Messaging					
Blogs					
Wikis					

8. In your opinion, can Web 2.0 applications be used to deliver library services? Please tick the applicable option.

   a. Yes [ ]

   b. No [ ]

   If you answered **Yes** to question 8, please go to question 10.

9. If you answered **No** to question 8, please explain why you think so?

   ……

   ……

10. Does your library use any of the above mentioned Web 2.0 applications to deliver library services? Please tick the applicable option.

    a. Yes [ ]

    b. No [ ]

    If you answered **No** to question 10, please skip question 11 and go to question 12.

11. Which of the following Web 2.0 applications do you think could be used to access services at your library? Please tick all that are applicable

    a. Social networking (e.g. Facebook, MySpace) [ ]

b. Blogs [ ]

c. Microblogging (e.g. Twitter) [ ]

d. Photo sharing (e.g. Flickr) [ ]

e. Video sharing (e.g. YouTube) [ ]

f. Social Bookmarking (e.g. Delicious) [ ]

g. Wikis [ ]

i. RSS feeds [ ]

j. Instant Messaging [ ]

12. In your opinion, please rate how useful you think the Web 2.0 applications listed below are in a University library? Please tick the applicable options.

Web 2.0 applications	**Extremely useful**	**More useful**	**Useful**	**Less useful**	**Not useful at all**
Social networking					
Microblogging					
Photo sharing					
Video sharing					

RSS feeds					
Social bookmarking					
Instant Messaging					
Blogs					
Wikis					

13. How would you rate your abilities in using the Web 2.0 applications? Please tick the applicable option.

Web 2.0 applications	**Excellent**	**Very good**	**Good**	**Not so good**	**Poor**
Social networking					
Microblogging					
Photo sharing					
Video sharing					
RSS feeds					

Social Bookmarking					
Instant Messaging					
Blogs					
Wikis					

SECTION C

USE OF MOBILE DEVICES

14. Do you own a mobile device? (Mobile phones, iPads, Galaxy Tabs, laptop, PDA, etc). Please tick the applicable option.

    a. Yes [ ]

    b. No [ ]

    If you answered **No** to question 14, please go to question 16.

15. If you answered **Yes** to question 14, what kind of mobile device do you own? Please select all options that are applicable and/or add those tools not mentioned.

a. Mobile phone [ ]

b. iPad [ ]

c. iPod touch [ ]

d. Galaxy tab [ ]

e. Laptop [ ]

f. PDA [ ]

g. eBook reader (Kindle) [ ]

h. Others, please specify

……

……

16. Can your mobile device access the Internet? Please tick in the appropriate box.

a. Yes [ ]

b. No [ ]

17. What do you use your mobile phone for? Please select all the applicable options by ticking in the boxes?

a. Make/receive calls [ ]

b. Text messaging [ ]

c. Surfing the net [ ]

d. Listening to the radio [ ]

e. Play games [ ]

f. Watch videos [ ]

g. Watch TV programs [ ]

h. Send /receive e-mails [ ]

i. Record video clips [ ]

j. View maps [ ]

k. Take photographs [ ]

g. Others, please specify

……

……

18. Do you use your mobile device to access any of the Web 2.0 applications previously mentioned? Please tick the applicable option.

a. Yes [ ]

b. No [ ]

19. If you answered **No** to question 18, please provide a reason for your answer:

.....

.....

20. In your opinion, do you think it would be useful to access your library services through your mobile device? Please tick the applicable option.

a. Yes [ ]

b. No [ ]

21. If you answered **Yes** to question 20, what kind of library services would you like to be able to access? Please tick as many options as applicable.

a. Reference services [ ]

b. Circulation services (e.g. find out availability, reservations & holding of books) [ ]

c. Searching the OPAC (Online Public Access Catalogue) [ ]

d. Library news [ ]

e. E- resources (e.g. Databases) [ ]

f. Subject guides [ ]

g. Others, please specify

……

……

22. If you answered **No** to question 20 , please motivate your answer

……

……

……

23. Any other comments?

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Thank you for your time!