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MOBILE DIGITAL LIBRARY ACCEPTANCE

A thesis submitted for the degree of Doctor of Philosophy

By

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أهدي هذه الرسالة إلى أحب الناس إلى قلبي:

إلى التي رآني قلبها قبل يديها

وحضنتني احشاؤها قبل يديها

أهدي محبتي وسلامي إليها

إلى أمي

سلام يامنبع الطيب يا عزوتي وفخري

يا قدوتي عسى قلبك من الهم صافي

علمتني يبا للعلم أسعى وبدرب الخير أجري

وفهمتني وشلون أبقى مع الناس وافي

إلى أبي

Abstract

Mobile digital library service could make students' lives easier and may help academic libraries to enhance their image by offering their services through smartphones, which are very popular among students nowadays. However, the literature lacks a comprehensive theoretical framework to understand factors affecting the adoption of such a service. This research focused on factors affecting the intention to use a mobile digital library within the context of the UAE and explored features and services that would encourage students to adopt such technology. The research design considered users' perspectives, comprised a number of phases and employed mixed methods. The first phase involved designing a preliminary prototype and framework based on the literature and the technology acceptance model (TAM). This prototype was used in the second (exploratory) phase as a stimulus material when students and librarians were interviewed in 10 focus groups. Based on their comments and views, factors that affect their intention were explored and hypotheses were generated. This exploratory phase allowed the development of a theoretical framework for mobile digital library adoption.

Focus group results, card sorting methodology and usability testing produced a final prototype that was sent to all students at Zayed University within UAE with an experiential online questionnaire through e-mail. This testing phase was conducted to test the hypotheses and confirm the importance of the same factors extracted in the second phase. The results obtained from the 211 respondents supported a number of paths in the proposed theoretical framework. First, *Perceived usefulness*, *Perceived ease of use*, *Mobile and web experience*, *Distinctiveness/prestige*, and *Trust* were found significantly affecting the *Behaviour intention* directly. Second, *Mobility*, *Library assistance*, *Interface design*, and *Social influence* were found to affect the intention to use indirectly through Perceived ease of use. Finally, the relationship between Perceived ease of use and Perceived usefulness was found significant. The results lead for producing a final framework for mobile digital library acceptance consisting of seven external factors falling in the three general categories: interface characteristics, personal characteristics and system characteristics. It consists of *Interface design*, *Social influence*, *Mobility*, *Library assistance*, *Distinctiveness/prestige*, *Mobile and web search experience* and *Perceived trust*. This research contributed in understanding factors affecting mobile digital library adoption within the developing world.

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Declaration

This work was produced by the author unless otherwise stated and duly acknowledged.

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Date: ……………………….

Publications

The following publications have published or submitted for publication as a direct result of this research:

Journal paper

- AL-Faresi, S., and Patel, N. (2012). 'The need for an adoption and acceptance framework for mobile digital library services', *Journal of Internet Technology and Secured Transactions (JITST)*, 1 (1/2), pp.42-51.

Paper in refereed conference proceedings

- AL-Faresi, S., and Patel, N. (2012). 'The design of an adoption and acceptance framework for mobile digital library services' *International Conference on Information Society (i-Society), IEEE*, London, June 2012, pp. 216-224.

Chapter 1: Introduction

1.1 Introduction

Although modern libraries provide many digital resources such as e-books, databases and online catalogues, their resources are not always the first search choice of students (Buzynski, 2007). This might be related to the outdated image that students hold about libraries, an image that does not fit with the needs of the new generation of students who prefer receiving information quickly and rely heavily on technology to access information (Prensky, 2001; Smith, Salaway and Caruso, 2009). Students increasingly rely on smartphones to access online services; these have the benefit that they are always connected, unlike desktops or laptops that usually require a person to be in certain place in order to have access (Choy, 2011). This suggests that students may be more willing to engage with library services if these are provided through mobile digital library applications; such applications could also help improve the image and role of libraries in the modern educational environment by providing a better match with the technologies that younger people are naturally adopting.

At present the number of libraries providing mobile services is few and concentrated in developed countries (Vila, Galvez and Campos, 2010; Wilson and McCarthy, 2010). A limited amount of research has addressed mobile digital libraries from a user perspective and it is also unclear whether existing findings from Western, developed contexts will apply in developing countries. This thesis explores the perceptions of users from the United Arab Emirates (UAE), a developing country with high investment in technological and educational infrastructure, towards the concept of mobile digital libraries and also explores the features and services that would encourage them to adopt such technology. The aim overall was to provide a theoretical framework to identify factors influencing *Behavioural intention* a mobile digital library within the UAE context.

This chapter begins by introducing and stating the reasons for researching intention to use mobile digital library in the UAE, then the aims and objectives of conducting this research

are presented, followed by a summary of the methodology used to fulfil those aims. The significance of the study and the outline of the entire thesis are subsequently stated.

1.2 Research background and motivation

1.2.1 Mobile use

New mobile devices such as smartphones have a number of features that make them popular amongst the younger generation. They provide the services that were already covered by small-screen traditional mobile phones, such as calling, SMS, e-mail and Global Positioning System (GPS), with numerous extra functionalities and innumerable potential applications. The new smartphones have bigger screens with keyboards (QWERTY keypads), touch screen, full and fast web browser and the ability to run third-party software (Bridges, Hannah and Griggs, 2010). Most importantly, smartphones guarantee full mobility and anytime, anywhere wireless connection (Malladi and Agrawal, 2002). As they become increasingly affordable and accessible they are extensively appreciated. Global smart phone penetration increased from 5% in 2009 to 22% by 2013, an increase of 1.3 billion smartphones in four years; over one in five people now own a smartphone (Heggestuen, 2013). However, this increase is mainly in the developed world and very limited research has addressed the developing world context (Ally, 2008).

Research studies that considered global mobile use found that the most appreciated mobile features are SMS and making calls (ALFailakawi, 2004; Belwal and Belwal, 2009; Harris Interactive Report, 2008; Kenedy et al., 2008; Manochehri and Alhinai, 2008). However, those studies focused on the limited features provided by traditional small screen mobile phones and not on smartphones.

Research on mobile use in a library context has also focused on small screen mobile features and PDAs, finding that SMS or text alert is the most appreciated feature, followed by catalogue search (Abdul Karim, Darus and Hussin, 2006; Mills, 2009). However, contrary to the ethos of mobile technology, mobile library services were restricted to the physical locations associated with traditional libraries (West, Hanfer and Faust, 2006).

Although some preliminary research identified the potential benefits of using smartphone features for library services (Choy, 2010; Ezell, 2009; Fox, 2010), only a limited number of libraries even in the developed world considered implementing such services. Additionally, the limited application of mobile library services has been based on the individual judgment of library service providers or allowing students to select from a range of predetermined services, rather than on the basis of empirical evidence. (Vila, Galvez and Campos, 2010; Wilson and McCarthy, 2010).

1.2.2 Intention to use mobile digital library

Much academic literature on the adoption of new technology is dominated by the technology acceptance model (TAM) developed by Davis (1989), and subsequent derivatives of this model. TAM assumes that *Perceived usefulness* and *Perceived ease of use* are the main factors influencing intention and behaviour in the use of a new information system (Choy, 2011). The little research that has specifically considered intention to use mobile digital libraries has also drawn on the TAM approach. Goh and Liew (2009) found support for the core TAM constructs in predicting *Behavioural intention* and SMS-based library catalogue. In addition they identified a role for *Self-efficacy* in predicting intention. Goh (2011) subsequently identified gender differences in role of *Self-efficacy* within their research model. However, both of these studies were limited as they only focused on SMS services rather than more interactive services which exploit the richer interactions enabled by modern smartphone developments. As with most published literature, the approach taken by Goh and Liew (2009) and Goh (2011) was a hypothesis-driven approach focussed on confirming previous findings/models for the specific application area of mobile libraries. It is possible that this new domain may give rise to new issues which have not been considered for desktop computer services, and so it can be argued that more exploratory work is needed.

Related literature has considered factors affecting the adoption of digital libraries, mobile services and mobile technology in education. Such research has highlighted a number of other potentially relevant constructs, as well as confirming the relevance of *Perceived usefulness* and *Perceived ease of use* (Davis, 1989), including *Terminology*, *Screen design*,

Navigation, *Relevance*, *System accessibility*, *Domain knowledge* (Thong, Hong and Tam, 2002), *English literacy*, *Library assistance* (Park et al., 2009), *Social influence* (Tan and Qi, 2009) and *Perceived trust* (Gao, Moe and Krogstie, 2010). However, it remains unclear which of these might be relevant for the specific application of mobile digital libraries. In addition, the focus of previous research has been primarily in the West and developed Asian countries (e.g. Singapore), and little work has considered other developing nation contexts. While Park et al. (2009) considered digital library acceptance in developing countries, the focus of their research was on usage of a large database of agricultural articles, distributed via CDs, representing a rather limited scope in terms of digital library implementation. In addition, the majority of their research sample was from either Sub-Saharan Africa or Latin America; fewer than 100 participants were categorised as being from Asia (and this sample was restricted to Indonesia and Nepal).

To summarize, the key shortcomings of existing work on adoption of digital libraries are: first that there is very little that is specific to this individual application area and it is unclear whether findings for related applications (e.g. mobile and digital libraries in general) will generalise to applications that deliver library services via mobile devices; second the limited work that has specifically considered mobile digital libraries is based on older technology which is not representative of what current smartphone technology can deliver; third the work in this area has tended to follow a hypothesis-driven approach, testing the validity of existing constructs identified in the literature and in particular constructs from TAM, an approach which does not provide for the discovery of new factors relevant to this new domain.

A more exploratory approach is therefore adopted in this thesis by conducting a qualitative focus group study (Barbour and Kitizinger, 1999). While the analysis of the results draws on existing constructs from the literature (through coding the data according to a number of a priori constructs) it also uses a more inductive approach to open up the possibility of discovering new factors applicable to this new application area. The analysis also looked for possible relationships between identified constructs with the aim of developing an initial framework to understand intention to use mobile digital libraries. As a second stage,

this thesis conducts a confirmatory research to test the hypotheses and framework derived from the focus groups.

The context of the research was an academic library in the UAE. The Middle East represents an interesting case for study. While part of the developing world, the Middle East market also has high penetration rates of mobile technology (exceeding 100%), especially among the countries which make up the Gulf Cooperation Council (GCC). The highest penetration rate is found in the UAE, with 210% (Buddecomm, 2010) so there is great potential for mobile technology solutions here. However, the majority of digital library research to date has focussed on Western or developed Asian contexts (i.e. countries in the Far East or South-East Asia). There is therefore a need to inductively explore the factors which are relevant within this alternative cultural setting as these may not be adequately captured by existing research.

1.3 Aims and objectives

The research motivation section has highlighted that study of the adoption of mobile digital libraries requires an effective theoretical framework. Based on that, the main aim of this study is to understand how students decide whether or not to use mobile digital library technology. The research is interested in identifying key factors affecting the demand for using mobile library services, as well as developing and testing a specialized framework for mobile digital libraries.

In line with this aim, the main research question that motivated this research is:

> *What factors affect users'* intention to use mobile *digital libraries in a developing world context?*

To meet the aim and provide answers for the above question, the following research objectives were devised:

1. Understand the current state of the art in the adoption of mobile digital libraries.
2. Design an initial mobile digital library prototype to use as stimulus for generating user views on desirable mobile library features to encourage adoption.

3. Derive an initial theoretical model/framework to explain mobile digital library adoption.
4. Refine the mobile digital library prototype to use as a probe in a quantitative study.
5. Empirically test framework on mobile digital library adoption
6. Draw theoretical and practical conclusions from the empirical results.

1.4 Introduction to methodology

Based on positivist assumption, several methods were used to achieve the objectives of this research. The first part involved reviewing existing research findings on the adoption of new technology and related areas to the adoption of mobile library services to establish a comprehensive understanding of the topic and design a preliminary prototype, in addition to a preliminary framework of factors affecting mobile digital library adoption. This framework and prototype formed the basis for structuring subsequent study.

The second part involved empirical research that relied on a mix of qualitative and quantitative data collection and analysis methods. It started with an exploratory phase consisting of focus groups and card sorting. Those methods helped to refine the preliminary framework and generate hypotheses and to refine the preliminary prototype to meet users' requirements. Then, for the sake of testing the generated hypotheses, an online survey was sent to students accompanied with the final prototype that was tested using usability test to reach its final form. The methodology and research design are discussed thoroughly in chapter 3.

1.5 Significance of study

The outcomes of this thesis contribute to the body of literature on intention to use mobile digital library technology in the developing world in general and in the GCC and UAE in particular. Mobile digital library may help enhance the image of libraries by upgrading the services they offer to satisfy users' needs on an anytime, anywhere basis. The literature lacks a coherent framework to explain *Behavioural intention*, thus designing a framework to predict users' intention will help academic libraries to develop mobile digital library

applications that match users' needs and consider factors affecting their intention, which is the focus of this thesis. More detailed information on the contribution to theory, practice and methodology is presented in chapter 7.

1.6 Thesis organization

The organization of the thesis is as follows:

- Chapter 1: Introduction

Introduces the background and motivation of mobile digital library that makes this research significant. It also provides a summary of the research methods used to meet the research aims and objectives. Finally, it illustrates the structure of the entire thesis.

- Chapter 2: Literature review

Introduces the theoretical basis of this research. It reviews theories and frameworks used to measure the intention of IS use in general. In addition, multidisciplinary literature related to intention to use mobile digital library is explored to identify the knowledge gap that this thesis aims to address. This chapter presents the preliminary framework for understanding *Behavioural intention* for a mobile digital library.

- Chapter 3: Methodology

Defines the overall philosophical basis of the thesis, elucidating the strategy and methods used to gather and analyse data. This chapter explains and justifies the methods used.

- Chapter 4: Exploratory phase

This chapter discusses the exploratory phase of the research. It consists of two phases: focus group and card sorting. The aims of the focus groups were twofold: first to refine the preliminary framework and generate new hypotheses, second to better understand participants' needs in relation to library services and therefore enable refinement of the

mobile digital library prototype. The organization of services within the prototype was further refined by card sorting method.

- Chapter 5: Testing phase

Reports a survey study to empirically test the research framework. First, it describes the design and testing process of a digital library prototype to be used as a stimulus during the survey. Then it describes the survey itself-describes the data collected and the statistical analysis to test the research hypotheses generated from the exploratory phase.

- Chapter 6: Discussion

Discusses the findings from both qualitative and quantitative phases of the research and compares them with literature theories, models and previous related findings.

- Chapter 7: Conclusion

Concludes the research by highlighting research contributions to theory, practice and methodology. It also provides information about the limitations of this research and any potential future work that can be conducted. Figure 1.1 summarises the thesis structure.
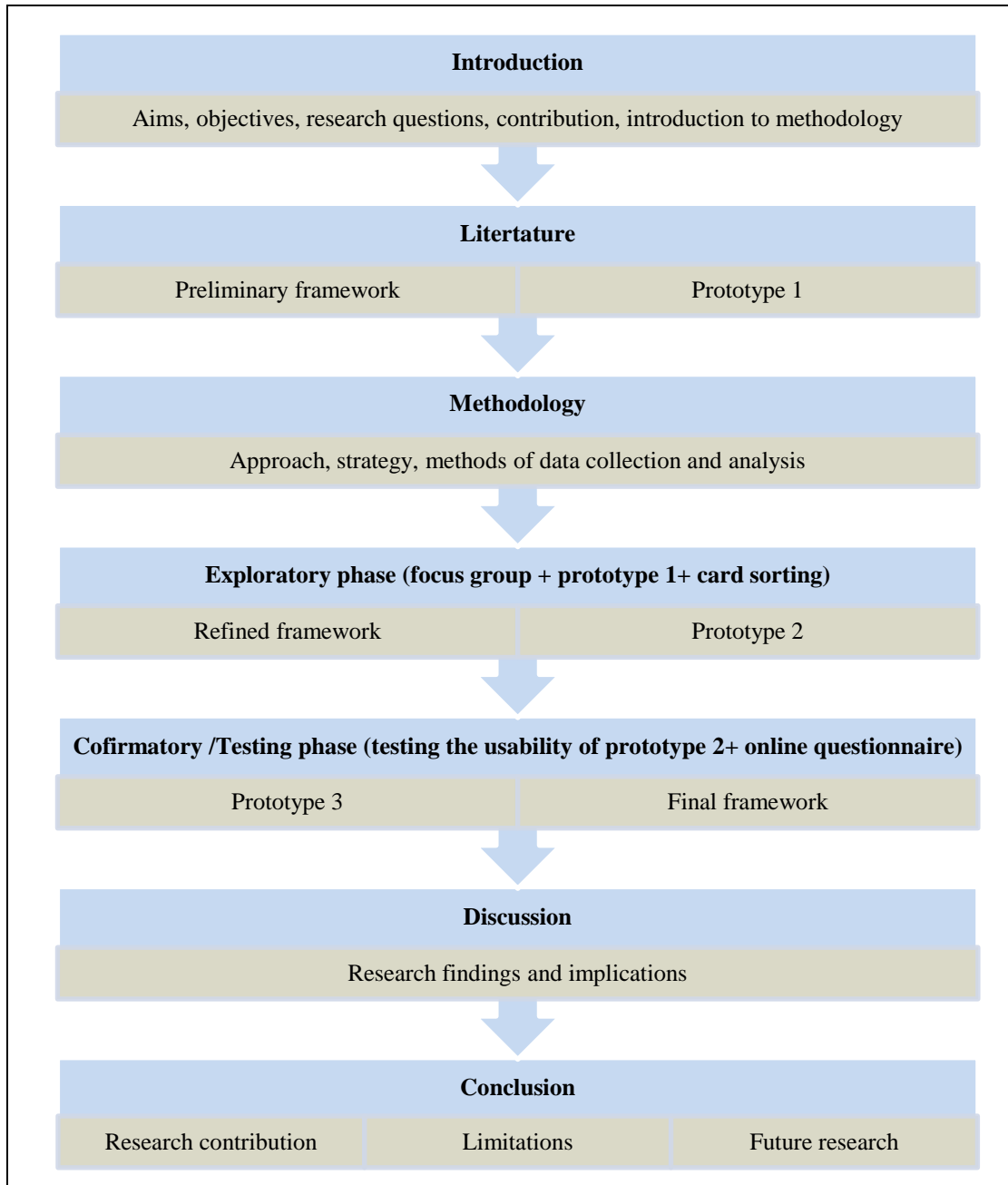
Figure 1.1: Thesis structure

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews literature related to mobile digital libraries, critically analysing the existing research on this area. It begins by defining smartphones in order to understand their nature and to construct an overview of what digital library services might be delivered through these tools. Defining and explaining the importance of providing mobile digital library is the focus of the following section. Further sections are provided to understand theories and models that focus on information technology adoption and acceptance. Some of the previous research on mobile use, mobile adoption and digital library adoption are also reviewed for the purpose of understanding limits to current knowledge, establishing the theoretical background for this research and placing the current research in relation to existing work.

2.2 Mobile devices/mobile wireless technologies

Modern mobile devices are essentially highly portable devices with a screen for viewing and interacting with multimedia content; high speed access to the internet and GPS functions; telecommunication functions such as voice, email and SMS; and the ability to run third-party software (Choy, 2010). Handheld computers or personal digital assistants (PDAs), mobile phones and new smartphones, audio players (such as iPods), video players and wearable devices are all forms of mobile devices that can be stand-alone or periodically synchronised products, occasionally connected to a network, or always connected (Tin, Sheikh and Elliott, 2008). Mobile devices that provide users with a connection to a network without limitations of time and location, and which fulfil mobility and computing criteria, can also be called mobile wireless technologies (Malladi and Agrawal, 2002). Mobile wireless technologies deliver transmissions of any form of data - text, voice or image - through radio waves or microwaves (rather than using wires) to mobile phones, conferring freedom of time and location on the end user (Dubendorf, 2003; Kim, Mims and Holmes, 2006).

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The latest versions of mobile devices or mobile wireless technologies are smartphones. Dhir (2004) states smartphones are a mixture and combination of wireless phone that has text and internet capabilities along with several functions of other mobile devices such as mobile phone, pager and PDA. According to Bridges, Hannah and Griggs (2010), a smartphone is a device that has a larger screen than a regular mobile phone; synchronises with a computer; may have a full typewriter style keyboard (QWERTY keypads); may have touch-screen capabilities; applications and software can be downloaded; full web browser to access any website; and often uses Wi-Fi, 3G and 4G networks for faster connectivity.

2.3 Smartphones' importance/popularity

In the continuing stream of advanced technologies released for popular consumption over recent decades, the most defining have been the internet, personal computers and mobile telephones. Since the popularisation of computers and mobile phones from the late 1990s onwards, they basically functioned independently until the late 2000s and the advent of smartphones; people used their mobile phones for call and SMS communication, and their computers for internet access and other applications. Research in the US by Allied Business Intelligence (ABI, 2008) to measure the mobile phone users nationwide found that 75% of adults and 90% of college students have mobile phones. Furthermore, American people between the ages of 18-29 stated that they would never replace the mobile phone over any other technology (Horrigan, 2008). By the end of 2012, the ITU World Communication reported that mobile phone penetration rate reached 91% worldwide, 84% in the developing world and 170% in the UAE, the focus of this research (ITU, 2013); mobile technologies "are here to stay and will become even more widely used" (Fox, 2010, p.9). Smartphones represent the latest sea change in this process, offering many of the traditional (and indeed advanced) capabilities of personal computers in a portable, hand-held device, combining the functions traditionally associated with either mobile phones or computers in one platform.

By looking at smartphones' popularity in general, it was found that many people all over the world, including in developing countries, are increasingly using mobile devices to

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communicate and access the internet and digital information because mobile computing devices nowadays are more affordable, more accessible and easier to use than desktop computers, and can connect to the internet from almost anywhere (Johnson et al., 2010). Governments in developing countries are investing in internet infrastructure to improve access from remote locations, and mobile technology is often the first choice for providers and users in regions where the legacy system (i.e. traditional telecommunications infrastructure) is underdeveloped. The mobile market today has nearly four billion subscribers, of whom over two-thirds live in developing countries (Ally, 2008; Johnson et al., 2010).

Smartphones received a fillip by the appearance of Web 2.0 and the upsurge in the use of social networks (Dempsey, 2009) The popularity of smartphones has increased dramatically because of third generation mobile technology (3G), which allows high-speed broadband access to data services, followed by fourth generation mobile technology (4G) which is 10 to 50 times faster (Gaylord, 2009).

Accessing the web through mobile devices has several benefits, including that mobile devices: allow the user to have constant connectivity to the internet, regardless of location; they cover the whole web, not only the websites designed for mobile browsing (in contrast with traditional internet-enabled mobiles); many smartphones today have GPS capabilities, enabling users to be aware of their location all the time, and to navigate (e.g. when driving); and mobile web interactive capabilities allow the user to participate and create their own content, such as sharing video or photos taken from their camera phones, in addition to social media functions such as making comments, writing blog posts, tagging resources and forming connections on social networks (Kroski, 2008).

2.4 Mobile digital library concept

Mobile digital library is a new, evolving concept and most researchers did not provide specific definitions for it. One notable exception is Needham and Ally (2008, p.iii), who defined mobile digital libraries as "libraries that deliver information and learning materials on mobile devices such as mobile phones, PDAs, palm top computers and smartphones to allow access to anyone from anywhere any time".

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However, a number of researchers emphasized the importance of providing digital library services through smartphones. Vila, Galvez and Campos (2010) mentioned that meeting users' needs and delivering library services through mobile devices will be a necessity rather than a privilege in the near future. Bridges, Hannah and Griggs (2010) added that mobile site versions are anticipated to be as common as the library's current website today. Thus, with the fast adoption and change of technology among general users, waiting for the technology to settle down in order to decide on the implementation of mobile services is not the answer for libraries (Lippincott, 2010b). Mobile device availability today is three times greater than that of personal computers (Kroski, 2008), which offers libraries an opportunity to engage with people anytime, anywhere and to expand the number of their users (Kroski, 2008; Needham and Ally, 2008). Digital libraries that choose to deliver their services through mobile devices will gain the advantage of increased access to their content and increased learning opportunities (Cao et al., 2008).

Despite the importance of providing mobile digital library service, adopting and accepting the service is not guaranteed unless it meets users' needs. A successful implementation of such service relies on understanding users' current trends and attitudes towards smartphones and investigating factors affecting their intention to use mobile digital libraries.

Thus, the starting point of mobile digital library services is to understand their appropriateness, which can be investigated by reviewing mobile users' patterns and purpose of use, and the extent of using various mobile features. The review will be conducted to explore the features and services that would encourage students to adopt such technology and to understand if there is any cultural or gender differences among users that would help in the design of mobile digital library.

The second step will be reviewing information system (IS) theories that explain the intention of using a system, followed by factors that are highly validated in related areas as a source to propose a framework for mobile digital library intention of use.

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2.5 Mobile use

2.5.1 Trends, attitudes and patterns

Mobile use trends and attitude towards mobile phones in general have been reviewed for the purpose of demonstrating the importance and the intensive use of mobile phones and smartphones among a wide range of population. In addition, this review will help in understanding users' pattern of use to locate similar or different smartphone features that might interfere with users' interest and affect their adoption of mobile digital library later on.

In the developed world, calling and texting were found as the most important features for small screen mobile phones; while web browsing, sending emails and social media were among the most appreciated features in smartphones (Baron and Ling, 2007; Ishii, 2004; Shiraishi et al., 2011; Wehmeier, 2012). Considering such features in the design of mobile digital library suggest possible uses related to features already familiar to and appreciated by users.

Baron and Ling (2007) distributed a questionnaire among 93 undergraduate students from two campuses to understand mobile phone use patterns in the US. They found that students are more likely to use their mobile phones to talk rather than texting, although they use both features to keep in touch, arrange meetings, share news, 'kill time', or seek advice. They also found that gender is a factor in the use of such services. Females call or send messages to share news more than males, and they also use it for 'presentation of self' purposes. They also tend to decorate their mobile phones and download ring tones more than males. Mobile digital library should consider such gender-specific behaviours relating to communication and news-sharing etc. One drawback from Baron and Ling's study is that it concentrated only on undergraduate students to explain users' attitudes in the US in general, who are mainly aged under-25, thus it excluded other age groups that form the US general and academic community. Additionally, Wehmeier (2012) found that smartphones (particularly those with the Android operating system) expanded users' patterns to include web browsing, Youtube and Facebook with no indication of gender differences (Wehmeier, 2012).

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Ishii (2004) investigated users' patterns of use in Japan focusing on differences between PC and mobile internet use patterns using a survey conducted nationwide in Japan in 2000 to 2003. The results indicated that 36.3% of the total population access the internet through their mobile phones, while 38.8% of the total population access the internet through PC. Ishii (2004) also found gender differences in frequency of their use, with females using mobile more than PC internet; conversely, male users used PC internet more. The main usage of mobile internet is e-mail, followed by web browsing, weather and music. They also found that mobile internet has a positive effect on sociability with friends, unlike PC internet, which is mainly used for professional (i.e. academic or business) purposes. Users in Japan keep in touch with their family and close friends who they habitually see face to face via mobile internet. However, Ishii's study considered the pattern of use of small-screen mobile phones and was focused on the Japanese population, which is unique in several ways with regard to technology use. For example, smartphone use in Japan reached 93% by 2010 (Shiraishi et al., 2011). This outpaces smartphone penetration in other developed countries, including the US, although Shiraishi et al. (2011) found that Japanese smartphone use is mainly for web browsing, albeit based on features used (and not on the purpose or frequency of use, which was the criterion of interest to Ishii, 2004), in common with US users (Wehmeier, 2012). Ishii (2004) recommended cross-cultural study in the future to explore cultural influence on telecommunication behaviour.

Verkasalo (2009) used automated software to study how mobile services are used in different contexts (home, office and when travelling). Based on a developed algorithm that has been used among 324 consumers in Finland and the UK, Verkasalo (2009) found that multimedia services are more often used while on the move (travelling), whereas legacy mobile experiences such as calls and texting are evenly distributed across all contexts. Again, this study was limited to small screen mobile phones.

Wilska (2003) looked deeper into the connection between consumption patterns and mobile use. Consumption patterns or styles refer to individual self-expression, individual identity formation and creativity (Wilska, 2003). She found that young people's relationship to the mobile phone is consistent with their general consumption styles and can be categorised according to three types of user: addictive-talking and sending messages

is very important to the user, and if the mobile phone is not in their hands they feel uncomfortable; the user perceives the mobile itself to be an important (trendy) gadget, which should therefore be new and have the latest technology; a basic mobile phone is good enough for the user, and they mostly care about the price of the mobile phone (thrifty). Among 637 Finnish young people aged 16-20, Wilska (2003) found that most users are thrifty, followed by trendy and then addictive. She also found that addictive style is more typical for girls, while trendy style is more typical for boys. On the other hand, thrifty style showed no gender differences. However, those styles were interconnected and users were part of more than one style, which makes it difficult to differentiate between them, therefore this undermined the value of the findings.

As for the GCC countries, studies have shown that smartphones are widespread and extremely appreciated, with similarities of use with developed countries. Users tend to focus on web browsing, sending emails and social media in their daily use. Booz and Co. (2012) reported on 3,000 digital users from nine countries in the Middle East and North Africa (the UAE, Egypt, Bahrain, Kuwait, Qatar, Jordan, Algeria and Lebanon) that 61% of users in GCC countries have access to smartphones, 70% of them use mobile internet from home and 65% use it on the move.

In Bahrain, Mohammad and Awadhi (2012) conducted a survey among individuals and organizations to investigate smartphone patterns of use. They found that 87% of Bahraini users access the internet through their smartphones, 81% of whom access it daily. They usually use their smartphones for web browsing, sending e-mails, entertainment, calling and chatting purposes. However, the sample size used in this research was not stated.

In Saudi Arabia, 60% of the entire population own a smartphone and 88% of them access the internet through their smartphones daily (Crum, 2012). Lobo and Calderwood (2011) focused on the general use of smartphones among Saudi females and found that out of the 70 users, 30% change their phones every year. They also found that game applications, camera, instant messaging, note taking, recording and alerts were among the most used features. However, the sample size was rather small to be generalized among all female users in Saudi Arabia. Alkhunaizan and Love (2013) focused on both genders in Saudi Arabia but only one feature of smartphones, the actual use of mobile social networks. By

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surveying 363 respondents, they found that age interacts with actual use, while gender and education had no effect on the actual use of mobile social networks.

General mobile use studies revealed rigorous use of smartphones and showed similar patterns between the developed countries and the developing world. They were interested mostly in features that allow them to communicate and browse for information. No major differences were found among the two genders in their general use of smartphones. Perhaps the most serious disadvantage of the reviewed literature is their over-reliance on quantitative approaches, which renders it difficult to understand the subjective needs of users. The next step would be investigating further if the patterns of use remain the same or change in the settings of higher education and libraries.

2.5.2 Mobile in higher education

Mobile use trends and patterns in higher education settings caught the attention of a number of researchers worldwide, as explored in this subsection. Their findings revealed no major differences for academic populations compared to the general populations of those countries, intensively using their mobile phones and being attracted to the same features as normal users. However, they were noted to be amenable to the concept of using their mobiles for educational purposes and felt that mobile phones would give them the freedom to learn from anywhere (Harris Interactive Report, 2008).

Hulme et al. (2011) conducted a study on 270 masters and doctoral students in the UK, Hong Kong, Portugal, Sweden and Australia to reveal that students are interested in SMS, accessing information on the web, reading e-books and e-news, listening to podcasts and music, scheduling, taking pictures of reference books, making notes and using social media. However, undergraduate students' patterns of use cannot be inferred from this study due to its focus on postgraduate students.

In Melbourne, Kennedy et al. (2008) surveyed first-year undergraduate students to report that the majority of students rely heavily on their phones to call and text people, with 80% texting daily. 60.6% students agreed that being able to download MP3s will assist their

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studies. 59.8% use their mobile phone as a personal organizer, 45.5% use it to access web-based information or services and 45.4% use it to send and receive emails.

A similar study in the US of teenagers aged between 13 and 19 (Harris Interactive report, 2008) discovered that only 28% of teens browse the web on their phone and the top four types of information they usually browsed were: email, social networking sites, weather and driving directions, while only 24% were looking for things for class. 57% of participants agreed with the statement "owning a mobile phone improved the quality of my life", and 18% agreed with the statement "the mobile had influenced my education positively". 66% supported the statement "mobile phones provide freedom to get an education from any location on earth".

Similarly, in the GCC countries making calls and sending messages seem to be the most appreciated functions among students. In Oman, 62% of students were making fewer than 10 calls per day and 68% of the students were sending more than 10 SMSs per day (Belwal and Belwal, 2009). In Kuwait, 77% of students send at least one SMS a day and 87% receive at least one message a day (AlFailakawi, 2004). Additionally, it was found that 98% of Kuwaiti students have mobile phones and more than half of them change their phones at least once every six months. 46% of university students' phone bills reach 11-30 KD (nearly £20.50-£60) monthly, and 59% of students' parents cover their phone services. Around 53% of students use their phones to check on their families, while 33% have their mobile phones in order to finish and check on other matters.

At Sohar University in Oman, students also like to watch videos, listen to music and exchange media through Bluetooth on their mobile phones. They also use their phones for camera, GPS and dictionary functions (Belwal and Belwal, 2009). Similar to Kuwaiti students (AlFailakawi, 2004), 62% of Omani students rely on their parents to pay their mobile phone bills (Belwal and Belwal, 2009).

Nor Shahriza, Ishaq and Mahmud (2010) further organized users' patterns into three categories that can be influenced by age, gender and occupation type. Mobile phones' physical attractors (i.e. brand name, price, model, colour, screen size etc.), the purpose of use (i.e. to contact family, socialized with friends, education etc.) and frequently used

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functions and features (i.e. SMS, alarm, calendar etc.) are the three appropriation patterns. They found that the former (physical appearance) is an important factor affecting users' judgments of purchase. They also found that users of the Malaysian university community use mobile phones for family contact, scheduling purposes, emergency contact and personal safety, socialization, collaboration with colleagues, knowledge seeking purposes and for business needs. In addition, they found that respondents frequently use SMS, voice call, music, alarm clock, address book, calendar and camera. As for the personal attributes (age, gender and occupation), all were found to significantly influence the three appropriation patterns. Young students are more attracted to purchase mobile phones due to their physical appearance than other older participants. Young students in general and female participants in particular are more likely to use mobile phones for information management and socialization purposes. As for the occupation type, students are more likely to use gadgets to facilitate their lives, which require more socialization and entertainment.

Reviewed studies in higher education context showed that students are interested in the camera, GPS, calendar, notes, videos, e-books, e-news, podcasts and music on top of the previously discussed features (web browsing, SMS, calling, social media and sending e-mail), meaning that students of higher education have more demands that should be considered when design a mobile digital library. Studies also showed that female users are more interested in socializing and information management than male users, which should also be taken into consideration when designing a mobile digital library.

All of these studies suffered from the fact that they relied heavily on quantitative approach and focused mostly on small screen (traditional) mobile phones. They also considered the most used mobile phone features and the purpose of use, and neglected the importance of factors that lead students to use such devices.

2.5.3 Mobile in digital libraries

The literature showed that students were interested in mobile digital library services and that both researchers and librarians were trying to meet users' needs. There have been some attempts to design mobile libraries in the past but their main limitation is that they

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only considered services that only can be delivered within context of traditional library infrastructure or through heavy devices and small screens (Aittola, Ryhanen and Ojala, 2003; Cao et al., 2006; Jones et al., 2000; West, Hanfer and Faust, 2006). The initiative of providing mobile digital library service started with laptops or PDAs in the early 2000s. Reports focussed on the process of technically developing a mobile library. Studies included some experiments and simulations to decide the best mobile platform (Cao et al., 2006; Jones et al., 2000; West, Hanfer and Faust, 2006). Cornell University Library launched its catalogue and maps online to be accessible via small laptops in order to allow access from shelves without having to go back to a fixed PC (Jones et al., 2000). They developed a prototype based on 50 users' responses to a survey asking about services needed, which was subsequently evaluated by 14 users. A fundamental contradiction that arises is due to the service providers offering students services to solicit their opinions, without consulting them about the services they actually require; thus it can asked whether students' responses to the survey are necessary using this approach as the researchers already decided that this mobile service is a tool to help students find books inside the library only.

The 'SmartLibrary' project, based on map guidance, was another example of an early mobile digital library. It was developed by University of Oulu in Finland to help library users locate materials on library shelves using wireless PDAs (Aittola, Ryhanen and Ojala, 2003). Based on 30 users' evaluation of this project, the system was successfully implemented in the library.

In 2004, Ball State University was one of the first universities to adjust their website to fit small mobile screens such as PDAs and Blackberrys (West, Hanfer and Faust, 2006). Athabasca University in Canada was also one of the first libraries to publish a study about their project of developing a mobile digital library (Cao et al., 2006). Their project has been designed to build a platform for a mobile library. As a result, the library website was recreated to ensure that it displays well on a variety of mobile devices. However, their study was about old mobile phones with small screens and PDAs, as it was prior to the spread of smartphones. In addition, similar to Jones et al. (2000), Cao et al. (2006) did not consider users' perspectives in the process of developing and implementing the website.

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The studies that considered users' perspectives during the development phase were those of Abdul Karim, Darus and Hussin (2006), Cummings, Merril and Borrelli (2010) and Mills (2009), however they studied library services that fit small mobile screens. Abdul Karim, Darus and Hussin (2006) investigated the influence of study discipline on users' patterns of use in a Malaysian public university. They gathered survey data from undergraduate students in two different disciplines, namely human sciences and information and communication technology, to explore the nature of mobile phone use among university students and investigate their perceptions of the use of these devices in library and information services. Between the two groups no significant differences were found in relation to the nature of mobile phone use or library use. Abdul Karim, Darus and Hussin (2006) found that all respondents owned a mobile phone and 94% of them used the library SMS service. The majority of respondents do not visit the library until it is needed for searching, returning and borrowing books, or studying for exams. The majority of respondents mentioned their willingness to use mobile services if offered. They also found that their highest usage of their phones was on games, followed by news, jokes, ticketing and religious (Islamic) services.

Cummings, Merril and Borrelli (2010) also carried out a survey in Washington State University in order to understand the nature of use of both undergraduate and postgraduate library users to determine whether there is a significant demand for using library service, especially the library catalogue, on small screen devices. 58.4% of the respondents who owned small screen devices indicated that they would use their phones to search the library catalogue if offered.

Mills (2009) considered a sample of 1530 people from Cambridge University and 776 from the Open University in the UK, covering undergraduate students, postgraduate students and academic staff to investigate their current use of text alerts and SMS reference services. He found out that SMS is one of the most popular mobile library services. 21% of respondents from Cambridge University were already using text alerts, compared to 35% of Open University respondents, while 27% of total respondents were using SMS reference service and 26% mentioned that they would try it as they were previously unaware of it. Mills (2009) also found that 55% of Cambridge and Open University total respondents

liked the idea of being able to access the library catalogue from their mobile phones, but very few respondents were supportive of having access to e-books, reading e-journals, watching videos, or listening to audio books. For that reason, the Open University and Cambridge University postponed the delivery of such services through a mobile site. The key problems with these studies are that their work relied heavily on quantitative analysis of a survey exploring user preferences regarding a fixed list of services and users' answers were limited to the capabilities of mobile phones with small screen.

In recent years, there has been an increasing amount of literature on library services that can be provided by smartphones (Choy, 2010; Ezell, 2009; Fox, 2010; Lippincott, 2008, 2010a), however they rely heavily on researchers' views. Lippincott (2008, 2010a) for example listed several potential services that can be provided through mobile devices and organized them into three categories: mobilizing content to include reference books, subject guides, e-books, podcasts and videos; mobilizing services and systems such as library hours, students' records and library catalogue; and mobilizing environment by providing relevant equipment e.g. iPods, electrical outlets and network connectivity. Choy (2010) also divided mobile services or applications into three areas: document access, transaction and services. The first area - document access - encourages librarians to look for the best readable format, such as PDF, to access information and persuade them to find publishers supporting mobile formats such as EBSCOhost and IEEE. The second area - transaction - engages all possible communication between libraries and users such as searching, renewing or holding a book, paying fines and sending reminders. The last area involves reference services, library guides and instructions that develop students' lifelong learning.

Researchers also pointed out the importance of providing multiple and diverse library services by mobile. For example, Ezell (2009) and Lippincott (2010a) were in favour of providing a paying service through mobile devices. Ezell (2009) for example stated that paying for services through mobile devices would have a major impact on libraries, hence it should be considered as the volume of payments made by mobile internet rapidly increased globally from $3 billion in 2007 to $10 billion in 2009 (Ezell, 2009). Lippincott (2010a) added that users will be able to pay by waving their devices directly in front of a

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terminal or automated device, making use of radio frequency identification technology (FRID). Walsh (2010) however thought that 'Text a librarian' is the easiest and cheapest service, requiring only an SMS portal subscription or working with the library management system (LMS). The SMS service can be used for sending overdue notifications, renewing items and answering students' questions.

Bridges, Hannah and Griggs (2010) and Mills (2009) on the other hand believed that providing a mobile library catalogue would be essential. The library can either work with their library management system (LMS) supplier to create a mobile version of their library catalogue, or submit their catalogue records to WorldCat to use the OCLC WorldCat mobile application (Mills, 2009). However, this means added expense incurred by the vendor version, or suffering from a lack of programming expertise. Innovative Interfaces, Inc (III) designed AirPac module for wireless mobile devices to allow library users to browse library catalogues, check due dates, request materials and view their records. The University of San Diego in California, the Hong Kong Polytechnic University and the University of Sydney in Australia are currently using AirPac (Bridges, Hannah and Griggs, 2010) but, the currently available versions lack customization (Bridges, Hannah and Griggs, 2010).

Other researchers were in favour of making use of new trends and technologies provided by the new smartphones, showing particular interest in quick response (QR) codes. The EDUCAUSE report (2009) defined QR codes as matrix or two-dimensional barcodes that a mobile phone camera interprets and directs users to text a message, ring a phone number, or link to URL sites about object or place. These codes can be generated by using freely available QR generators and displayed electronically or in printed format to be converted later using a QR reader that needs to be installed on a mobile device. Walsh (2009) explained that based on librarians' imagination, QR codes may have unlimited applications in a library setting: they can be placed on a photocopier to give further instructions on how to use it; linked to certain videos or podcasts; or even to certain quizzes. The most important thing is that these links can be updated without changing the code and also allow the library to run some kind of analysis to find out how many students went through these web pages. Vila, Calvez and Campos (2010) stated that QR codes will replace pen and

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paper use due to their speed efficiency; students will not have to remember a URL or a phone number and will not even have to print them. Still, in order to make QR effective, libraries should market and promote their use and explain how they work. Users should be aware of how to obtain a QR reader on their mobile. Robinson (2010) stated that users should be motivated to download a reader application on their mobile. According to him, Bath University failed to lead users to download such a service as they found that scanning the information from the library catalogue rather than writing the information on a piece of paper is not a good enough reason to drive them to download the QR reader.

Rector Gabriel Ferrate Library (BRGF) in Spain developed and implemented a mobile site for smartphones that supported many functions in relation to reference services: 'What is new' icon for library news; 'General information' that covers library hours, maps and telephone numbers; laptops availability; group study rooms; 'Ask a librarian', whether by SMS, e-mail, or chat; and a 'help' icon explaining mobile site services (Vila, Galvez and Campos, 2010). Again, these services were totally selected by librarians and researchers. In addition, users' *Behavioural intention* towards such a new system was not considered.

Wilson and McCarthy (2008) considered users' perspectives in their study on behalf of Rayerson Library in Canada to ascertain services needed by students. They found that the most wanted services by students were reference/circulation-related services such as booking group study rooms, checking library hours, checking borrowing records and laptop availability, while SMS can be treated as a complementary service (e.g. to notify users when a computer is available for example). After a year of providing mostly mobile reference services in Rector Gabriel Ferrate Library (BRGF) library, users widened their needs to include access to articles, e-books, checking out books and asking a librarian (Wilson and McCarthy, 2010). Wilson and McCarthy relied heavily on quantitative analysis of a survey to a fixed list of services; users were simply asked about their preferred services, and answered based on their experience with their library website and services pre-determined by the researchers. This quantitative approach limits users' replies and prevents the research from covering any new services that might appear based on qualitative interaction with users.

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A number of studies suggested approaches and phases to design mobile digital library based on their judgments rather than real cases. For example, Wasti (2006) listed some possibilities in order to come up with a mobile-friendly version of a library website. The first possibility was designing a totally new website from scratch, tailored to mobile phones, but this method can be very costly. The second possibility was creating a mobile-friendly version of each page of the website and directing the user to that version whenever a mobile device makes the request. Again, this method requires regular maintenance of multiple pages for different mobile devices. In addition, the pages have to be updated whenever a new version of a mobile with new capabilities emerges. Creating template-based dynamic pages will help changing the profile of the device rather than changing the dynamic page. The most popular approach is the use of an intermediary proxy, such as Skweezer, Mobile Google, or IYHY. Whenever a user makes a request to a web page, the request can be routed through an intermediary service that identifies the requesting device, gets the page from the web server on behalf of the device and reformats the page to make it suitable for that device. The success of such services depends on the intermediary service capabilities. Users do not need to make any special adjustments or install special software on their devices.

Kroski (2008) also mentioned some tips that can facilitate designing a mobile site. She explained that a simple interface with no unnecessary images, along with a search option on the top, will spare students from excessive scrolling. Content should be organized in one column and arranged based on importance from the top to the bottom. In relation to Kroski (2008), a smart strategy for developing mobile sites must be moving from simple to complex applications with the emphasis on continuous testing and considering users' feedback. It must be kept in mind that mobile users are looking for valuable information in small screens and do not require the details normally available in a website such as the library mission. The library should also consider the privileges that cannot be covered in a normal website the way mobile devices do: services such as location-based services and push alerts and users who cannot be reached otherwise.

Bridges, Hannah and Griggs (2010) added that the first step can begin by writing a proposal. Successful proposals that cover information about mobile users and new mobile

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devices and explain the importance of following new technologies, will help libraries gain administration, faculty and staff support. Additionally, proposals should include a plan of promoting and assessment of the new system in order to determine its usefulness.

Lippincott (2010b) stated that mobile site implementation requires precise and detailed planning ahead. The library should understand its population and be aware of the current state of mobile use within such a population. Knowing a library user's age or major will help in determining the best suitable service for them. Also, the library should have certain goals behind implementing such services, such as enhancing access to the library reference service, instructional programmes, raising the library profile and promoting library services generally. Measuring the success of mobile site implementation can be achieved through an assessment built upon the success of achieving the pre-set goals. Finally, the library should always keep planning ahead as new technologies are changing rapidly (Lippincott, 2010b).

Mobile digital library studies revealed that students' patterns of use were restricted to SMS, maps and catalogues that small screen devices can offer for library services. However, other studies stated that library services can be expanded with the use of smartphones. Based on that, it is expected that smartphones will be used by student population for library purposes, especially among the GCC countries due to the smartphone adoption and behaviour mentioned previously.

Although the previous section about mobile use patterns in general among students in higher education and in libraries was not directly relevant to the research question of this study, it helped to understand the daily life usage patterns. Understanding the usage patterns services is essential as it might have negative effects on the future of mobile service industry (Barsi, 2002).

Still, factors that affected their *Behavioural intention* or reject services need to be explored to assure a successful adoption of mobile digital libraries. The following section investigates theories developed in the IS field to explain users' *Behavioural intention* towards a system or a program that can be the foundation to develop a theoretical framework to understand factors affecting intention to use mobile digital libraries.

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2.6 Understanding the adoption and acceptance models

Understanding the factors that influence an individual's use of information technology has been a target of information system research since the mid-1970s (Compeau and Higgins, 1995). Several models have been developed to identify those factors, including the technology acceptance model (TAM) (Davis, 1989), theory of planned behaviour (TPB) (Ajzen, 1991), theory of diffusion of innovation (DOI) (Rogers, 1995, 1983) and unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003). By reviewing these theories, a suitable theory would be selected as the basis for developing an initial framework to understand intention to use mobile digital libraries.

2.6.1 Theory of reasoned action (TRA)

The theory of reasoned action (TRA) was one of the social psychological theories to explain the user acceptance behaviour in general (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). *Behavioural intention*, which leads to actual behaviour, is determined by attitudes toward that behaviour and *Subjective norms*. *Attitude* is a person's general feeling toward the behaviour (Ajzen and Fishbein, 1980). It is determined by a persons' positive or negative belief that performing certain behaviour will lead to certain outcome (Chang, 1998). As for *Subjective norm*, it is a person's perception of other peoples' opinion toward the same behaviour (Ajzen and Fishbein, 1980). These factors are important in the motivation of whether an individual performs the behaviour (figure 2.1).

TRA has been applied successfully in a number of situations (Sheppard, Hartwick and Warshaw, 1988). Since TRA is very general to include any *Behavioural intention* (Ajzen and Fishbein, 1980), Davis, Bagozzi and Warshaw (1989) believed that TRA is suitable for the Information Systems field and for explaining *Behavioural intention* computers. However, TRA concentrated on voluntarily *Behavioural intention* only and excluded other behaviours that are not voluntarily. Since an individual cannot have total control over their behaviour, *Behavioural intention* may not always lead to actual behaviour (Sheppard, Hartwick and Warshaw, 1988). Based on that, this theory has not been considered in this study.

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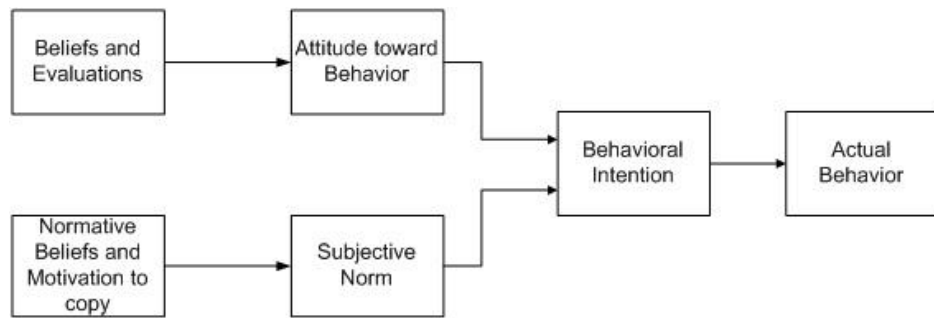
Figure 2.1: Theory of reasoned action (TRA)

(Fishbein and Ajzen, 1975)

2.6.2 Theory of planned behaviour (TPB)

For the sake of dealing with TRA limitations, Ajzen (1991) extended it to cover non-voluntarily behaviour and produce in the theory of planned behaviour (TPB). *Perceived behavioural control* (PBC) or individual perceptions of the ease or difficulty of performing behaviour was added to the original TRA theory. Thus the individual performance is determined by *Attitude*, *Subjective norm* and his/her perceptions of the availability of resources and opportunities. PBC influences behaviour directly and indirectly through the *Behavioural intention* (Ajzen, 1991) (figure 2.2).
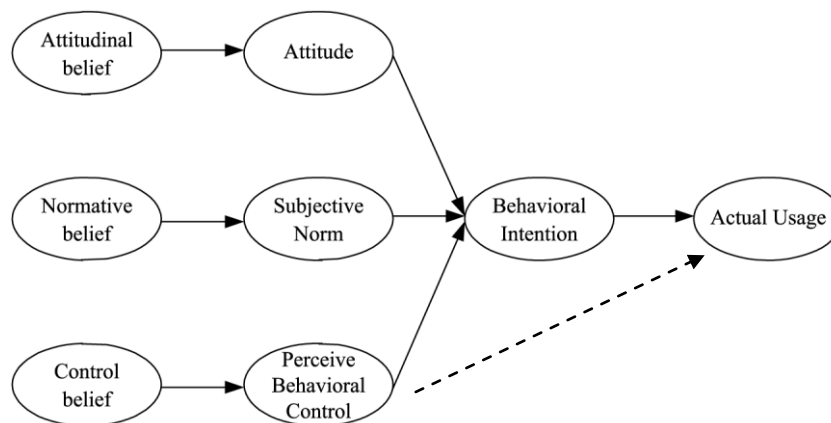
Figure 2.2: Theory of planned behaviour (TPB)

(Ajzen, 1991)

Just like TRA, TPB was designed for general *Behavioural intention* and not specifically for IT (Wang, Lin and Laurn, 2006). It was successfully used to predict the intention in a

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number of studies (Madden, Ellen and Ajzen, 1992; Mathieson, 1991). In the context of IT, PBC has been found to correlate well with attitudes towards technology, having a major influence on *Behavioural intention* that technology (Compeau and Higgins, 1995). However, TPB neglects a number of factors that might affect the *Behavioural intention* such as habit and self-identity (Eagly and Chaiken, 1993).

2.6.3 Technology acceptance model (TAM)

The technology acceptance model (TAM) is another extension of the TRA (Fishbein and Ajzen, 1975), which is the most widespread and accepted in the IS field. It was developed specifically to explain computer usage behaviour (Davis, Bagozzi and Warshaw, 1989) and gradually became the main model for information technology acceptance (Zhang, Huang and Chen, 2010). TAM has been reviewed as a dominant model for determining system usage and a valuable tool for system planning (Taylor and Todd, 1995b).

The aim of TAM is to locate external factors affecting the internal beliefs, attitudes and intention (Davis, Bagozzi and Warshaw, 1989). TAM model excludes *Subjective norms* from the original TRA and assumes that *Perceived usefulness* and *Perceived ease of use* are the main factors influencing use intention and behaviour to use a new information system (Davis, 1989). *Perceived ease of use* refers to the extent to which a person believes that using a system will be free of effort, while *Perceived usefulness* means the degree to which a person believes that using a system will enhance his/her job performance (Davis, 1989) (figure 2.3).
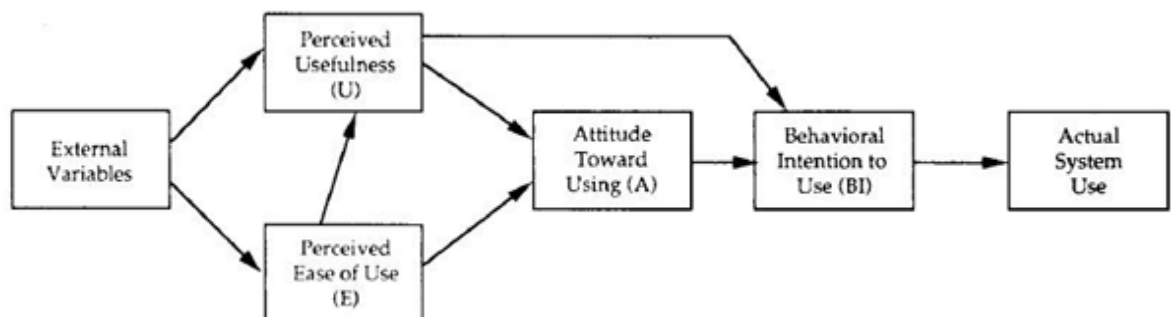
Figure 2.3: Technology acceptance model (TAM)

(Davis, 1989)

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Although the original TAM maintained attitudes towards use and believed that it affects *Behavioural intention* (Davis, 1989), the final TAM conceptualization excludes the *Attitude* construct for better explanation of intention (Davis, Bagozzi and Warshaw, 1989), as other studies confirmed that the *Attitude* construct weakly influenced the adoption intention (Adams, Nelson and Todd, 1992; Taylor and Todd, 1995b). *Perceived usefulness* is proposed to have a direct impact on adoption intention, because users will be more willing to use a system if it offers valuable functions. On the other hand, *Perceived ease of use* will influence both adoption intention and *Perceived usefulness*. The easier it is for a user to interact with a system, the more likely he/she will find it useful and intend to use it (Thong, Hong and Tam, 2002).

Despite its popularity, TAM has some limitations. *Perceived ease of use* and *Perceived usefulness* may not fully explain people's intention to adopt information services (Gao, Moe and Krogstie, 2010). TAM excludes social factors, gender, age and other important inputs that influence user adoption (Zhang, Huang and Chen, 2010). However, TAM overcomes these limitations by allowing the addition of external factors. TAM suggests that the use of external factors based on unique IS adoption contexts can have a significant impact on users' adoption through the main two determinants (Davis, 1989) and therefore facilitating theory development (Park, 2010). Researchers had found that TAM is easier to use and better explains the *Behavioural intention* and IS than TPB (Chau and Hu, 2001, 2002). Even when TPB is combined with TAM to form decomposed TPB, the difference is negligible (Chua and Hu, 2001, 2002); Taylor and Todd (1995a) found that it explained 60% of the variance in *Behavioural intention* and TAM explained 52%, indicating a small increase.

2.6.4 Technology acceptance model 2

For the purpose of enhancing the original TAM that overlooked social factors, Venkatesh and Davis (2000) extended TAM to originate TAM2. TAM2 excluded the *Attitude* factor and involved *Social influence* and cognitive instrumental processes as two set of external factors affecting *Perceived usefulness*. They explained that several studies revealed that the

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Perceived usefulness is a much stronger predictor of usage intention than *Perceived ease of use*.

Social influence in TAM2 includes *Subjective norm*, voluntariness and image; while cognitive instrumental process consists of job relevance, output quality, result demonstrability and *Perceived ease of use* (Venkatesh and Davis, 2000) (figure 2.4).
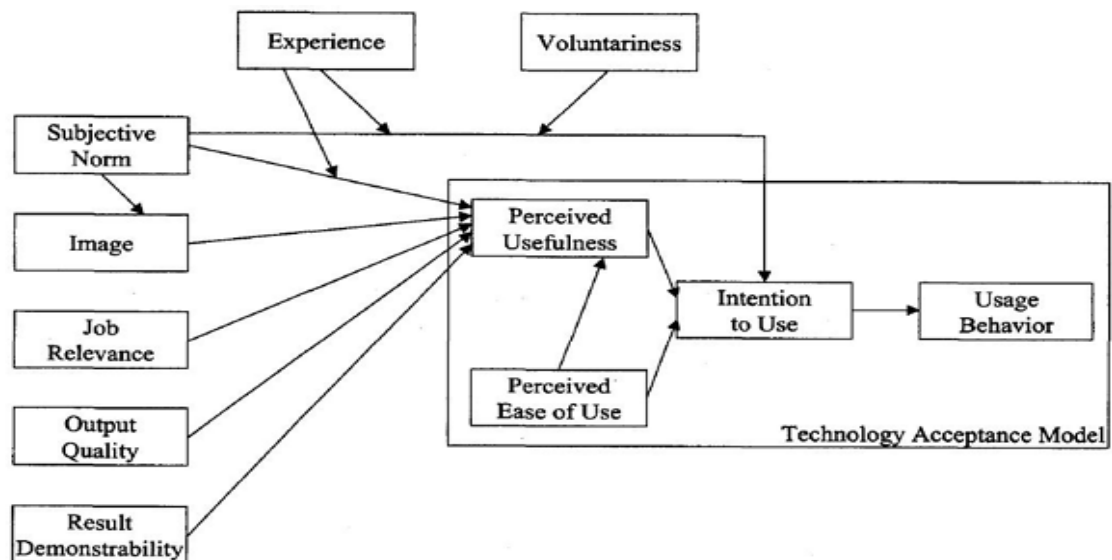
Figure 2.4: Technology acceptance model 2 (TAM2)

(Venkatesh and Davis, 2000)

TAM2 has been found to be more powerful in explaining the variance in individuals' intention than the original TAM: TAM explained 40-50-%, while TAM2 explained 60% in *Perceived usefulness* only, and 52% in *Behavioural intention* (Venkatesh and Davis, 2000) which is not a major difference from the original TAM. However, unlike TAM, limited research has used TAM2 (Wu et al., 2011).

2.6.5 Technology acceptance model 3

Venkatesh and Bella (2008) further extended TAM2 to form TAM3. TAM3 maintained all factors affecting the *Perceived usefulness* in TAM2 and added anchoring and adjustment factors from Venkatesh's (2002) work as determinants of *Perceived ease of use*. Anchor factors consist of *Computer self-efficacy*, *Perceptions of external control*, *Computer*

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anxiety and *Computer playfulness*. *Perceived enjoyment* and *Objective usability* comprise the adjustment factors.

TAM3 does not hypothesize any cross-over effects; factors that affect *Perceived ease of use* are proposed not to affect *Perceived usefulness* (Venkatesh and Bella, 2008). In addition to TAM2, TAM3 proposed that experience moderates the relationship between: *Perceived ease of use* and *Perceived usefulness*; *Computer anxiety* and *Perceived ease of use*; and *Perceived ease of use* and *Behavioural intention* (Venkatesh and Bella, 2008) (see figure 2.5). They suggested that high experience will increase the influence of *Perceived ease of use* on usefulness. They also suggested that increasing experience will diminish the influences of *Computer anxiety* on *Perceived ease of use*. Users will have better perceptions of their capability of use declining the effect of *Computer anxiety* on *Perceived ease of use*. Finally, they expected that high experience that comes with time will reduce the effect of *Perceived ease of use* on *Behavioural intention*. Users will find *Perceived ease of use* less important with experience. However, limited research has used TAM2 and TAM3 (Huang and Kao, 2012; Wu et al., 2011).

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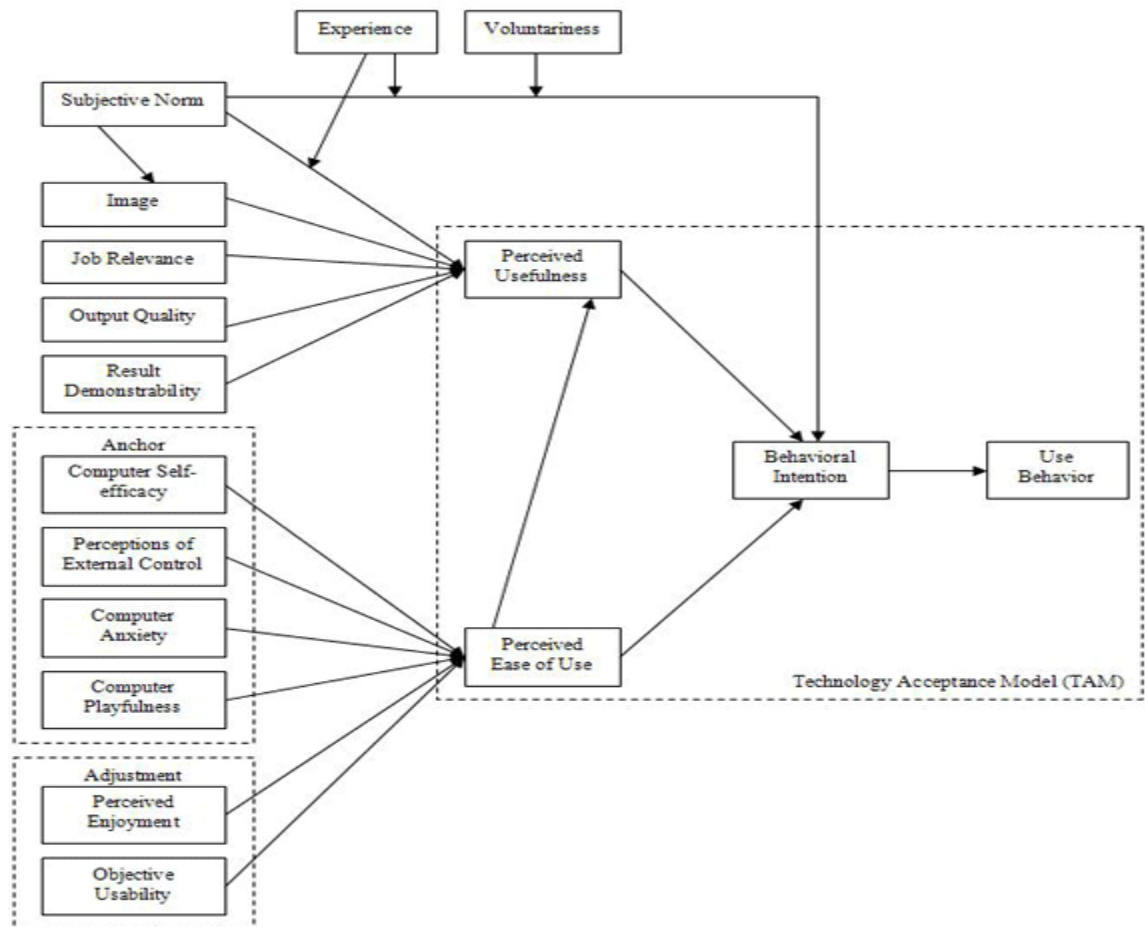
Figure 2.5: Technology acceptance model 3 (TAM3)

Venkatesh and Bella (2008)

2.6.6 Unified theory of acceptance and use of technology (UTAUT)

The unified theory of acceptance and use of technology (UTAUT) has also been developed to explain the acceptance and usage of information technology (Venkatesh et al., 2003). It has been formulated based on reviewing eight models: Theory of reasoned action (TRA) (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975), Technology acceptance model (TAM) (Davis, 1989), the motivational model (MM) (Davis, Bagozzi, and Warshaw, 1992), Theory of planned behaviour (TPB) (Ajzen, 1991), a model combining TAM and TPB (C-TAM-TPB) (Taylor and Todd, 1995a), the model of PC utilization (MPCU) (Thompson, Higgins and Howell, 1991), Theory of diffusion of innovation (DOI) (Rogers,

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1983; 1995) and social cognitive theory (SCT) (Compeau and Higgins, 1995). UTAUT explains 70% of the variance in intention.

UTAUT consists of four direct determinants of user acceptance and usage behaviour: *Performance expectancy*, *Effort expectance*, *Social influence* and *Facilitating conditions* (Venkatesh et al., 2003). *Performance expectancy* is an individuals' belief that using a system will help in achieving gain in job performance. This factor is equal to *Perceived usefulness* in TAM. *Effort expectancy* (equal to *Perceived ease of use* in TAM) is the degree of ease associated with the use of the system. *Social influence* defined as the degree to which an individual listens to the opinion of people important to him/her about whether he/she should use the system or not. Venkatesh et al. (2003) also defined *Facilitating conditions* as the degree to which an individual believes that organizational and technical infrastructure is available to support the use of the system.

UTAUT explained that *Performance expectancy* is moderated by age and gender; while *Effort expectancy* moderated by age, gender and experience. The effect of *Social influence* is moderated by age, gender, experience and voluntariness. Finally, *Facilitating conditions* is moderated by age and experience only (figure 2.6).
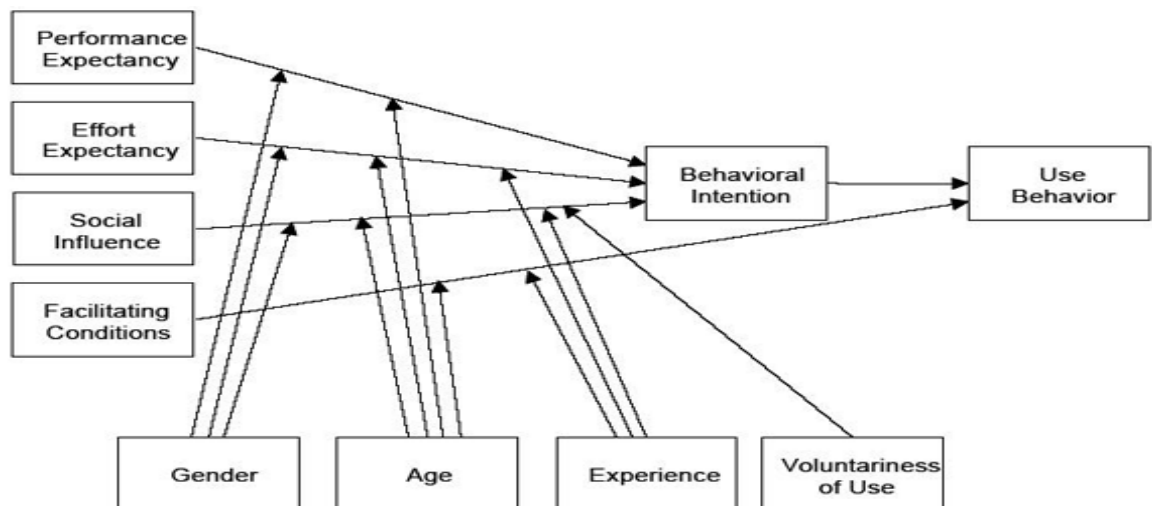
Figure 2.6: Unified theory of acceptance and use of technology (UTAUT)

(Venkatesh et al., 2003)

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Bagozzi (2007) criticised UTAUT due to its constituency of a large number of almost overwhelming relations, stating that "we are left with a model with 41independent variables for predicting intentions and at least eight independent variables for predicting behaviour. I say "at least" because there are plausible direct effects not tested by Venkatesh et al., 2003" (Bagozzi, 2007, p.245). In addition, he thinks that important independent variables were excluded because of the generic predictors included; consequently, research is unlikely to discover new factors because they will subsumable under the existing predictors. Raaij, Jeroen and Schepers (2008) also clarified that UTAUT is less parsimonious than TAM. The high R2 is only achieved when moderating the key relationships with up to four variables (gender, age, experience and voluntariness) in order to yield more significant coefficients.

2.6.7 Theory of diffusion of innovation (DOI)

Rogers (1983) believed that the diffusion of an innovation goes through a certain process by which an innovation is communicated through certain channels over time among the members of social system. The innovation decision of each member of the social system goes through five steps: knowledge, in which the person becomes aware of the availability of a certain innovation and constructs an idea about how it functions; persuasion, where a person forms a favourable or unfavourable attitude towards the innovation; decision to adopt or reject the innovation, based on a person's engagement in certain activities related to the same innovation; implementation, actually putting an innovation into use; and confirmation, whereby a person evaluates his/her decision based on the results of the innovation. The person might change his/her decision if receiving conflicting messages about the innovation.

Each individual innovation decision is shaped by personal characteristics. Rogers (1983, 1995) identified five characteristics of innovation that affect the rate of diffusion innovation among individuals: relative advantage, compatibility, complexity, observability and trialability. Although Moore and Benbasat (2001) mentioned that DOI has been used widely, they claimed that very few researchers achieved the required validity and

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reliability. Another limitation of this theory is that it considers only individuals, and not organizational and environmental factors (Lee and Cheung, 2004).

2.6.8 Comparison of the adoption and acceptance models

Choosing the best theory or model that fulfils the aim of this study was decided based on comparing and contrasting the utility of the previous discussed models for this research context. TRA, TPB and TAM seem to be the best models that suit the purpose of this research as they have been highly validated in a number of areas (Shepppard, Hartwick and Warshaw, 1989; Zhang, Huang and Chen, 2010). TRA and TPB are general theories that are suitable to explain *Behavioural intention* for IS (Davis, Bagozzi and Warshaw, 1989), whereas TAM was developed specifically to explain *Behavioural intention* for IT, giving it the advantage over the previous theories.

TRA and TPB, as explained previously, had some limitations that excluded them from this research. Their explanation of *Behavioural intention* depends only on people's beliefs about the behaviour and the opinions of others about it. They focus on personal factors and exclude system and interface factors that are of concern in this research, and which might affect the adoption of mobile digital libraries. TRA also hypothesises that the actual behaviour or the adoption is only influenced by voluntarily behaviours. It excludes individuals who may not have total control of their behaviours (i.e. lack of confidence) or those who are spontaneous, impulsive, habitual or mindless (Bentler and Speckart, 1979; Langer, 1989). TPB theory tried to overcome this limitation by adding a perceived behavioural control to the original TRA, but excluded important factors that might affect the intention such as habit and self-identity (Eagly and Chaiken, 1993). Based on that, TRA and TPB were not considered in this research.

TAM was found to be easier to use and to better explain the *Behavioural intention* for IS compared to TPB (Chau and Hu, 2001, 2002), making it a suitable option to explain *Behavioural intention* toward mobile digital library service. The TAM assumes that *Perceived usefulness* and *Perceived ease of use* are the main factors influencing intention and behaviour in the use of a new information system (Davis, 1989). In that sense, if library users believe that using a mobile library service is free of effort and will enhance

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their work, they will tend to use that service. Just like the TRA and TPB, TAM has limitations; it excludes social factors, age, gender and other important dimensions. However, unlike the previous theories, TAM specifies room for modifications and allows the addition of external factors based on the context, allowing for theory development. Within this rationale, an extended TAM called the mobile digital library acceptance framework can be developed by selecting factors covering personal, system and interface factors from related areas.

Although TAM2 and TAM3 were developed to overcome the limitations of TAM, they were not considered in this research for a number of reasons. Firstly, only a limited number of studies have implemented TAM2 and TAM3 (Huang and Kao, 2012; Wu et al., 2011), so it is hard to check the validity of these models in the context of mobile digital library. TAM2 focuses mainly on the antecedents of *Perceived usefulness* and overlooks factors affecting *Perceived ease of use* (Wu et al., 2011), which might be an important factor in the context of mobile digital library adoption. TAM2 based on Huang and Kao (2012) is still insufficient for explaining factors influencing the acceptance of modern IT products. It ignores the organizational and personal perspectives (Wilkins, 2009). In other words, TAM2 did not really overcome the limitations of the original TAM.

TAM3 was also excluded from this research. It considers the adoption from managerial views (Venkatesh and Bela, 2008), which is not the focus of this research. TAM3 focuses on how managers take decisions about interventions that lead to acceptance of IT while this research seeks to understand the adoption from users' perspectives. TAM 3 explained 53% of the variance in *Behavioural intention* (Venkatesh and Bella, 2008) which is not much greater than the original TAM that explains 52% of the variance. Based on that, this research is in favour of using the original TAM.

UTAUT was also found to be unsuitable for this research. It consists of overwhelming factors and relations that does not allow for discovering any new factors (Bagozzi, 2007). This does not match with the aim of this research that seeks to explore and understand factors affecting *Behavioural intention* to use mobile digital library.

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DOI limitations also excluded it from this research. DOI has been used widely but the reliability and validity of a number of studies which used that theory have been questioned (Moore and Benbasat, 2001). Similar to TRA and TPB, DOI considers only individual factors and overlooks the importance of organizational and environmental factors (Lee and Cheung, 2004) or the interface and system factors that this research intend to explore.

In conclusion TAM appears to be the most promising for the area of mobile digital library adoption. The next sections will review existing work attempting to apply TAM and other intention theories specifically to digital libraries, mobile services, mobile services in higher education and mobile in digital libraries.

2.7 Previous research about intention to use digital libraries

Since both mobile digital libraries and library websites provide almost similar services, studies focusing on digital library acceptance were a potential source for finding relevant factors affecting the adoption of mobile digital library services. Among the large number of studies that have been published in the digital library context, only few focused on the three general categories that affect *Behavioural intention*: interface characteristics, system or organizational characteristics and personal characteristics that affect *Behavioural intention* either directly or through *Perceived ease of use* and *Perceived usefulness*. In addition, studies that maintained such categories were conducted mostly in Asian countries like Malaysia, Hong Kong and Korea. However, the components of these categories are not agreed upon. For example Thong, Hong and Tam (2002) declared that interface characteristics include *Terminology*, *Screen design* and *Navigation*, while other researchers mentioned that screen design is part of system characteristics (Nov and Ye, 2008) or system components (Vaidyanthan, Sabbaghi and Bargellini, 2005). This might be related to the general definition that Kling and Elliott (1994) provided about usability components: interface and organizational dimensions. They explained that the interface dimensions are centred on an individual's effective adaptation to a user interface, while the organizational dimensions are concerned with how computer systems can be effectively integrated into work practices of specific organizations.

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Thong, Hong and Tam (2002) were among the first researchers to investigate the influence of these components. They added nine variables to the TAM framework and organised them into three categories: interface characteristics, organizational context and individual difference. These categories proved to have an impact on adoption intention through *Perceived usefulness* and *Perceived ease of use* of the digital library, specifically the Open University of Hong Kong. Interface characteristics (*Terminology*, *Screen design* and *Navigation*) were all found significantly to affect *Behavioural intention* through *Perceived ease of use*. Organizational context such as relevance was found to significantly affect the intention through both *Perceived ease of use* and usefulness; *System accessibility* was significantly affecting the intention through *Perceived ease of use* of use only; while system visibility was affecting the intention through *Perceived usefulness* only. The entire components of individual differences (*Computer self-efficacy*, *Computer experience* and *Domain knowledge*) were significantly affecting *Behavioural intention* through *Perceived ease of use*. However, Thong, Hong and Tam (2002) considered the needs of distance learners only and neglected the needs of students who use the library resources on a more regular/conventional basis.

A number of subsequent studies adapted Thong, Hong and Tam's model (2002), either completely or with some minor changes such as renaming certain concepts or excluding others, or adapting parts of the model, such as interface characteristics or TAM determinants. The same interface characteristics of Thong, Hong and Tam (2002) have been adapted to investigate their impact on post-graduate students' (Lee et al., 2005) and undergraduate students' *Behavioural intention* to use digital libraries in Malaysia (Ramayah, 2006b). Consistent with Thong, Hong and Tam (2002), Lee et al. (2005) found that terminology had a significant effect on perceived ease of using digital library. Conversely, screen design and navigation did not have much impact on *Perceived ease of use* for digital libraries. They explained that most users are familiar with the use of computers, so navigation is not a problem for them. In addition, students are more interested in searching rather than the attractiveness of the screen. Conversely, Ramayah (2006b) completely supported the findings of Thong, Hong and Tam (2002). However, all of these studies fail to consider the differing categories of *Behavioural intention*, concentrating only on the interface characteristics. In addition, these studies focused only

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on undergraduate students and neglected the perceptions of other student levels. Ramayah (2006a) replicated the same study again but this time among both undergraduate and post-graduate students to include all the categories of Thong, Hong and Tam (2002); however, he considered only *Perceived ease of use*, to which all factors were found to be significantly related except for *Domain knowledge* under individual differences category and *Computer self-efficacy* and computer experience, which were insignificant.

Jeong (2011) also modified Thong, Hong and Tam's (2002) model to study the acceptance of digital libraries among elementary students in Korea. Jeong (2011) chose to rename *System accessibility* as 'system quality' and exclude 'system visibility' from the organizational context ('system characteristics'). He also excluded the 'computer experience' factor from the individual differences category. The results of his study were grouped into four major findings.

First, *Domain knowledge* was found a strong predictor of *Perceived ease of use*; while *Self-efficacy* was found not a significant construct. Second interface characteristics influence the *Perceived ease of use* directly and *Perceived usefulness* indirectly, consistent with the results of Thong, Hong and Tam (2002). Third, system or organizational characteristics (in terms of relevance and system quality) directly influence the *Perceived usefulness* of the system. Fourth, *System quality* positively influences both *Perceived ease of use* and usefulness. Finally, the total influence of *Perceived ease of use* can be chosen as a primary determinant of *Behavioural intention*. However, Jeong makes no attempt to differentiate between different levels of education; students in higher academic levels might have different needs and perceptions than students in elementary school.

For the sake of examining factors that influence users' intention to use digital libraries in developing countries, Park et al. (2009) gathered data from 16 institutions in Africa, Asia and Central/South America. They included computer experience, *Domain knowledge* and added *English literacy* and interest in publishing as individual differences but excluded *Computer self-efficacy*. In addition, they included *Visibility*, *Accessibility*, *Relevance* and they added *Library assistance* to measure system characteristics. However, they excluded interface characteristics. Park et al. (2009) found that *English literacy* had a direct effect on *Perceived ease of use* and *Perceived usefulness*, in addition to an indirect effect on

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Behavioural intention. Interest in publishing factor also had a direct effect on *Perceived usefulness*. *Library assistance* was also found to be a significant factor on both *Perceived ease of use* and *Perceived usefulness*. The rest of the findings were consistent with Thong, Hong and Tam (2000) except for *Visibility*, which did not have any significant effect on *Perceived usefulness*. Park et al. (2009) explained that this might be related to the fact that only 2.1% of participants in that study had never used the system. Park et al. (2009) however limited their research only to the use of a large database of agricultural articles, distributed via CDs. In addition, their research sample was from Sub-Saharan Africa, Latin America, Indonesia and Nepal; albeit this covers a wide area of the developing world, it does not provide a comprehensive picture.

Similar to Park et al. (2009), Vaidyanthan, Sabbaghi and Bargellini (2005) and Nov and Ye (2008) focused on individual and system characteristics yet with different components. Among both faculty and students at Indiana University, Vaidyanthan, Sabbaghi and Bargellini (2005) examined one component of individual differences: search functions (or *Computer self-efficacy*). In addition they investigated the influence of *Terminology*, design and display that were part of interface characteristics in other studies (Lee et al., 2005; Thong, Hong and Tam, 2000) along with *Relevance* and the *Reliability* as system components. They found that search functions and design and display have a strong positive impact on both *Perceived ease of use* and *Perceived usefulness*. They also found that *Reliability* has a strong positive impact on *Perceived usefulness*. *Terminology* however, did not have a significant effect on either *Perceived ease of use* or *Perceived usefulness*. Similarly, *Relevance* did not have a significant impact on *Perceived usefulness*, contradicting the findings of Thong, Hong and Tam (2002). They explained that users employ different criteria in making their own evaluations of relevance. Individual or personal differences to Nov and Ye (2008) consist of *Computer anxiety*, *Computer self-efficacy* and resistance to change (RTC). On the other hand, system characteristics involve screen design and relevance. They found that all factors are significant and RTC is a determinant of users' PEOU of digital library system. However, their research does not take into account *Perceived usefulness*, the other determinant of *Behavioural intention*. Furthermore, they focused on individual and system components that might influence the acceptance only of new freshman. In 2009 they extended their model to include both

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Perceived ease of use and *Perceived usefulness* along with two new constructs, *Terminology* under system characteristics and *Result demonstrability* from TAM2 as both dependent and independent constructs (Nov and Ye, 2009). RTC was found to be an indirect determinant of *Effort expectancy* (EE, *Perceived ease of use*) via *Computer anxiety*. RTC was found to be a determinant of *Result demonstrability* and an antecedent of *Performance expectancy* (PE, or *Perceived usefulness*). All system characteristics were found significantly influencing the intention through EE. *Computer self-efficacy* was also found to be a determinant of *Result demonstrability* though it did not have a significant effect on EP. They justified that users may believe the system is easy to use, yet not associated with confidence in their ability to use it properly.

Some researchers chose to select few factors from the three categories discussed earlier (interface, personal and system characteristics) with no attempt to relate them to a specific category. To investigate the acceptance and highlight problems confronting female postgraduate students in Pakistan, Arif and Kanwal (2009) developed a framework based on TAM and other factors such as *Relevance*, *Navigation*, *Authenticity* and *Accessibility*. They mentioned that all factors showed an effect on the acceptance of digital library except for authenticity of material. They mentioned that the digital library is easily accessible, the files are quick to download and the materials available are relevant, but the limited access to full articles makes students visit other library websites. A better study would compare both genders from different levels, rather than focusing on female postgraduate students only.

Kim (2010) conducted three studies devoted to finding factors affecting *Behavioural intention* to use digital library resources in four universities or institutions in the US. According to him, these factors can be influenced by majors or disciplines (2010c), by gender (2010a), or by different educational levels (2010b). Kim (2010c) generally investigated what sources are mostly used by users from two disciplines and why they use library resources. He considered users' usefulness, *Computer self-efficacy*, mandatory use, the role of librarians, attitude of users and *Behavioural intention* to discover users' preferred sources of information and the reasons of choosing the source. In addition, this study investigated whether users' library website usage differs across institutions. Data was

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collected from Business, Arts and Science undergraduate students, postgraduate students and faculty in four universities. Kim (2010c) found that Business College students use commercial websites much more than users in Arts and Sciences to locate information; the latter were found to use more printed material. He also found that *Perceived usefulness* is significantly influencing all users' *Behavioural intention* library resources, with greater value to Art and Sciences users. *Computer self-efficacy* was also significant, but respondents from Business College had a higher value for this. Users of Arts and Sciences are much more appreciative of librarians' services and feel much more pressure to use library resources than business users. While all users express positive attitudes, this was much higher among users in Arts and Sciences than Business users. All users have very high *Behavioural intention* to use library resources, but this is notably higher for Arts and Sciences students than for Business users. Kim (2010a) investigated the influence of *Computer self-efficacy* and *Subjective norm* as external variables to TAM moderated by gender. Male users found library resources to be easier and they were less likely to be influenced by *Subjective norms*. Male users are more self-confident. *Perceived usefulness* is a strongly influenced by *Perceived ease of use* and *Subjective norms* for female group. Female users have lower levels of *Computer self-efficacy* and higher levels of *Computer anxiety*. They are not likely to form *Behavioural intention* to use library resources unless they are easy to use. *Perceived ease of use* is a stronger predictor for females than males. Kim (2010b) categorized users based on their academic roles and then analysed them as subgroups in order to observe different adoption patterns across-groups. He exchanged *Computer self-efficacy* with assistance this time. The model's degree of applicability is substantially different across the three groups. SN increases *Behavioural intention* to use the system, but master's students perceived the strongest pressure to use the library resources, followed by undergraduate students, and faculty/doctoral students felt the least pressure. In his study however, assistance to use the system influenced *Perceived ease of use* but with no differences between groups. In fact, he found that *Perceived ease of use* is important for all users to evaluate *Perceived usefulness*. *Perceived ease of use* also has a positive impact on *Behavioural intention* with no differences between groups. However, *Perceived usefulness* has been found to be a key determinant of *Behavioural intention*, with faculty/doctoral students showing the strongest relationship. Finally, the study showed

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a strong relation between *Behavioural intention* and actual usage of library resources, but this was weakest for undergraduate students, and insignificant among faculty/doctoral students. He explained that this is usually significant only if affected by a compulsory environment, which is not the case for faculty/doctoral students. A more comprehensive study would include further disciplines and more external factors rather than concentrating on two each time.

Miller and Khera (2010) also examined TAM but across two universities in developing countries (Kenya and Peru) to find factors contributing to the adoption of digital library. They found that particular predictors of *Perceived usefulness* (*Relevance*, *Trust*) and *Perceived ease of use* (ease of access) were consistent across cultures, while other constructs (*Social norm*, *Domain knowledge*, *Visibility* and *Self-efficacy*) showed power only in one setting. However, *Computer literacy*, level of infrastructure, *librarian assistance* and *English literacy* did not significantly influence *Perceived ease of use* in either setting. They explained that future research is needed to address whether these differences result from cultural, institutional, or sample-specific differences.

A limited number of studies have been developed to investigate *Behavioural intention* to use digital library by using UTAUT model. Tibenderana and Ogao (2008) and Tibenderana et al. (2010) conducted a study for the sake of investigating the level of end-users acceptance of electronic library services in one of the developing countries. They replaced "*Effort expectancy*" and "*Voluntariness of use*" with "*Relevance*" and "*Awareness*" because the researchers thought that these constructs are inappropriate for this context and the latter constructs are significant in the library setting, digital environment and IS environment. The study demonstrated the importance and validity of UTAUT model in the context of developing countries such as Uganda, with some modifications.

Abdulrahman, Jamaludin, Mahmud (2011) only investigated four factors from UTAUT in Malaysia because of their strong support from previous studies and their applicability and suitability in the context of digital libraries. *Information quality*, *Performance expectancy*, *Effort expectancy* and *Service quality* were among factors investigated. The findings indicated that *Performance expectancy*, *Effort expectancy* and *Information quality* were all significant predictors positively related to *Behavioural intention* to use digital library,

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while service quality was significant but negatively related to *Behavioural intention*. *Information quality* and *Service quality* was added to the UTAUT and has been found important for the intention. Factor interactions (between gender and *Performance expectancy*; gender and *Effort expectancy*; age and PE) were found to be insignificant to explain any additional variations on intention. The interaction between experience and *Effort expectancy* was significant and positively related to intention.

Very few studies investigated users' *Behavioural intention* to use particular library services. Tao (2008) extended the TAM to examine the role of two aspects of e-resource characteristics, namely *Information quality* and *System quality*, in predicting public health students' *Behavioural intention* e-resources for completing a research paper assignment. Neither *Information quality* nor *System quality* were found to have a direct significant impact on BI. *Perceived usefulness* and *Perceived ease of use* fully mediated the impact that *Information quality* and *System quality* had on *Behavioural intention*. One major criticism of this study is the focus on public health students only, and its restriction to one academic institution in the US; the research model should be tested for reliability and validity with different user groups in different settings.

Kim (2006) conducted a study to determine factors affecting user acceptance of web-based subscription databases. He found that *Job relevance* and *Result demonstrability* have a significant effect on *Perceived usefulness*, while *Output quality* did not. A *Subjective norm* was found to have a significant influence on *Perceived usefulness*. *User training* was found to have no significant impact on either *Perceived usefulness* or *Perceived ease of use*. The strongest influence was noted for *Terminology* clarity. *Accessibility* has positive significant influence on *Perceived ease of use*. No significant effect from *Subjective norms* on intention was found. The author believes that this was because the use of the databases is voluntarily. The study however does not consider those who do not use web-based subscription databases. Lin et al. (2010) on the other hand examined how users perceive the influence of recommendations: word of mouth (WOM), advertising and expert recommendations on *Behavioural intention* e-books for academic purposes. This study was also conducted to measure the level of the perception of *Perceived trust* and *Perceived risk* when users receive e-book recommendations from peers, advertisers and experts. WOM

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played a more important role than other recommendations in determining *Behavioural intention* e-books in academic digital library. In addition, enhancing the *Perceived trust* and reducing risk towards the use of e-books can mediate the relationship between recommendation sources and the *Behavioural intention*s to use e-books. However, it is hard to generalize the findings since it targeted a specific user group in Taiwan.

Korobili, Tilikidou and Delistavrou (2006) examined both the use of library printed and electronic resources, including internet use among teachers in Greece. The study showed that a great number of participants were in favour of websites, e-mail and e-journals. Males were found to be more frequent users of e-sources. Faculty within the school of Business and Economics were heavier users of all sources. They also found that the use of e-sources is positively influenced by the *Perceived usefulness* of sources, the convenience of access to the sources and their academic productivity. *Computer anxiety* was found to be the strongest negative influential factor upon the use of e-resources, with the greatest reported to females and the lowest to Faculty with PhD and less years of experience. The other main barrier to use was time needed to explore information sources.

Although a number of factors were found to significantly affect users' intention to use digital libraries, still this area is far from covering important factors related to mobile services. For that reason further mobile service studies will be investigated.

2.8 Previous research about intention to use mobile services

Literature about intention to use mobile services seems to falls into a number of aspects: intention to use mobile phones and mobile features; mobile services; wireless mobile services; mobile commerce and mobile payment; and mobile marketing.

Very few articles considered exploring intention to use mobile phones and their features. Kuo and Yen (2009) for example used TAM, PIIT and *Perceived cost* to understand consumers' *Behavioural intention* to use 3G mobile features. Their sample consisted of undergraduate and postgraduate students in Taiwan. They found that PIIT had a positive influence on *Perceived ease of use* but had no significant effect on *Perceived usefulness*. *Perceived cost* had a negative significant effect on *Attitude* and *Behavioural intention*.

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Nevertheless, *Perceived usefulness* had no significant effect on *Behavioural intention*. They explained that respondents were new adopters and they were not using their phones for work. However, their study focused on students and neglected other users and other age groups. In addition, they admitted that *Personal innovativeness* and *Perceived cost* cannot be the only external factors that determine *Perceived ease of use* and *Perceived usefulness*. In Taiwan again, Chen, Chen and Yen (2011) focused on both software and the hardware acceptance of smartphones in a delivery service company. They also focused on the less educated people. 215 surveys were distributed to drivers after training them to use the smartphone features. *Self-efficacy* was divided into *Individual self-efficacy* and *Assisted self-efficacy* that rely on external assistance or resources. They found that *Assisted self-efficacy* had a significant impact on both *Perceived ease of use* and *Perceived usefulness*. *Individual self-efficacy* had a significant impact on only *Perceived ease of use*. They also found that *Perceived ease of use* had more influence than *Perceived usefulness* on *Behavioural intention*. However, their study investigated the acceptance of only one particular hardware - the smartphone that has been given to drivers was the same. Also *self-efficacy* cannot be the only factor that determines users' *Behavioural intention*.

The second aspect of the literature focused on mobile services. Wang, Lin and Luarn (2006) developed a framework to identify factors that affect consumer intention to use mobile services in general. The sample consisted of 258 respondents who were attending an e-commerce symposium held in Taiwan. Their study focused on: *Self-efficacy*, *Perceived financial resources*, *Perceived credibility*, *Perceived ease of use* and *Perceived usefulness* to find that all factors significantly affecting intention to use mobile services. Wang, Lin and Luarn's work would be more interesting if it randomize their sample to include other nationalities and cover different geographic area. Their sample selection was somewhat biased as these participants already show interest in new technology by attending this event.

Kim, Choi and Han (2009) also proposed a theoretical framework based on TAM but to understand both users' intention and their continuous usage of mobile data services in Korea. They anticipated that *Perceived enjoyment*, *Perceived fee* (cost) moderated by prior experience would affect the intention and continues use of mobile data services.

Inexperienced and experienced students from middle school, high school and universities were the sample of their study. Among inexperienced users they found that *Perceived usefulness* and *Perceived enjoyment* positively affect the intention; while *Perceived fee* negatively influence their intention. The same factors were significantly influencing the continued usage of experienced users. *Perceived ease of use* had no significant effect on the intention, *Perceived usefulness*, or even *Perceived enjoyment* among inexperienced users. The effect of *Perceived ease of use* on the continued usage was also insignificant. However, it does have a significant indirect effect on the continued usage through *Perceived usefulness* and *Perceived enjoyment* and a significant negative direct effect on *Perceived usefulness* and *Perceived enjoyment*. *Perceived fee* had a negative direct and indirect effect on *Behavioural intention* through *Perceived usefulness* and *Perceived enjoyment*, but only a negative indirect effect on continued usage through *Perceived usefulness* and *Perceived enjoyment*. Their study however, considered only students and neglected the view of other user groups.

A number of articles chose to label the general services and investigate the intention of mobile cross-services' use. Nysveen, Pedersen, Thorbjrnses (2005a) investigated factors affecting consumers' intention to use mobile phones for the purpose of communication (SMS, contact), payment and entertainment (gaming). They found that *Perceived enjoyment*, *Perceived usefulness*, *Perceived expressiveness* and *Normative pressure* significantly affected *Behavioural intention* these services. They also believed that these services moderate the effect of the external factors. However, their study offers no explanation about this relation. It is not obvious which factors affect the intention to use which service.

Hong, Tam and Kim (2006) also investigated factors that might affect potential users' decision but for the purpose of communicating, searching for information, or entertaining. In Hong Kong, they found that *Perceived ease of use*, *Perceived usefulness*, *Perceived enjoyment*, *Perceived cost* and the need for uniqueness significantly affected users' intention to adopt mobile services. However, they found differences in their effect on the different services and found that age and gender interact with users' intention. For example, they found that *Perceived usefulness* was a significant factor among men but not

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among women. They explained that men would use mobile services to be functional while women would use it to express uniqueness. They also found that people in their 20s and 30s have a greater desire to express the need for uniqueness, but in the entertainment services people over 41 require more uniqueness than the younger people. Similar to Nysveen, Pedersen, Thorbjrnses (2005a), Hong, Tam and Kim (2006) neglected to specify the factors that affect each group and each service and relied heavily on quantitative approach. On the other hand, Chang (2009) interviewed 50 consumers in Australia and Taiwan for the sake of understanding the adoption of mobile phones for entertainment, e-mail, personal information management and commerce purposes. He found that *Perceived ease of use* and *Perceived usefulness* are important factors affecting consumers' intention to use mobile phones. *Perceived enjoyment* and *Perceived risk* are also considered facilitators to mobile phone use. He also found those consumers' choices of phone type and service subscription; their individual differences such as age, gender and occupation; along with consumer ownership of other devices such as PDAs and mp3 player are considered moderators of mobile phone use. Still, their study failed to locate factors that influence each service separately.

Nysveen, Pedersen, Thorbjrnses (2005b) were interested to know factors affecting the acceptance of one particular mobile service. They reinvestigated the same factors that they used in their previous study (Nysveen, Pedersen, Thorbjrnses, 2005a) moderated by gender to explain intention to use mobile chat services. The results showed that *Social norms* and *Enjoyment* are important determinants of *Behavioural intention* among female users, while *Usefulness* and *Expressiveness* were important factors affecting *Behavioural intention* among male users. However, their results were limited to young adopters. Similarly, Zhang, Huang and Chen (2010) were interested in one mobile service, searching for information, in China. 195 undergraduate and postgraduate students from two MBA classes were the sample of their study. By using UTAUT framework and experience factor, the study showed that *Performance expectancy* of the mobile search is the strongest factor. It has a positive significant impact on *Behavioural intention*. *Experience* also had a significant impact on *Performance expectancy*. *Social influence* had a significant positive impact, while *Perceived cost* had a negative significant impact on *Behavioural intention*. The main criticism of this study is the sample. They investigated only one discipline and

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only two classes. Their paper might be more interesting if they considered different disciplines. Kargin, Basolgu and Daim (2009) also built a framework devoted to identify factors affecting the adoption of a particular mobile service. The framework was tested on students and employees using a location-based directory, Pocket Info & Enjoy Mobile Service, which allows them to have phone numbers, address information, distance information and taxi fee to a certain place. The framework consists of the following factors: *Image*, *Personalization*, *Content*, *Mobility*, *Enjoyment*, *Innovativeness* and *External influence*. They found that *Perceived ease of use* does not have a strong influence on the *Perceived usefulness* or the *Attitude* to use mobile services. Their findings indicate that *Perceived usefulness* and *External influence* are the determinants of *Attitude*. They found that *Mobility* has a strong influence on *Usefulness*. *Content* has a positive influence on usefulness. *Innovativeness* has a direct influence on ease of use. *External influences* have a positive influence on attitudes towards mobile services. *Image* is an important determinant in service usage as it positively and significantly influences the perception of usefulness. *Personalization* and *Enjoyment* factors have a significant and positive influence on usefulness. Researchers however, admitted that their work relied heavily on quantitative method. So they suggested conducting focus group studies and generating prototypes to be tested with mobile users as future research.

More factors were considered by Phan and Daim (2011) in their study among university graduate students. They examined *Service quality*, *Simplicity*, *Innovativeness, Visual factor*, *Speed*, *Time efficiency*, *Enjoyment*, *Cost*, *Mobility*, *Content*, *Habits*, *Technology*, *Social factors*, *Usefulness* and *Ease of use*. Based on hierarchical analysis and cluster analysis, they found that *Ease of use*; U*sefulness*, *Technology* and *Habits* have impacts to the *Attitude* toward using. *Social factors*, *Visual factors* and *Innovativeness* however, were not significantly affecting the *Attitude*. *Service quality*, *Simplicity* and *Speed* show the highest effect followed by *Cost*, *Enjoyment*, *Mobility*, *Content* and *Time efficiency*. A serious weakness of their study is the small sample size that does not match with the big list of investigated factors. Only 15 postgraduate students were part of their survey. In addition, the definitions of factors used were not mentioned.

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Roine (2011) adapted a model tested in higher education (Gao, Krogsite and Gransaether, 2008) for the purpose of evaluating and testing usability of a prototype tourism tool among students, the Mobile Tourism Recommender (a user-centric mobile app for the Norwegian University of Science and Technology). His findings were consistent with Gao, Krogsite and Gransaether's (2008) findings. He found that 82% of students would use the system only if is reliable and trustworthy (*Perceived trust*). *Context* was also found to be an important factor. 91.5% of the users would use the application on vacation. While 91.5% of respondents considered themselves capable of using the system, 82.9% did not consider being the first to use the system is important. Most users agreed that the application is useful and easy to use. One major criticism of Roine's work is that he conducted the study on students only; non-academic users might have other points of view.

Kargin and Basoglu (2007) is one of the limited studies that used qualitative method to investigate factors affecting the adoption of mobile services especially for informative and location based services. 12 high school students, undergraduate students and postgraduate students were interviewed and their comments were categorised to create a mobile service adoption taxonomy. It consists of service aspects (*Content*, *Mobility*, *Enjoyment* and *Cost*) and social aspects (*Social influence*s and user characteristics). The interviews revealed that *Perceived usefulness* and *Ease of use* are the most important factors in service aspects. The service aspect was found to be more significant than the social aspect, and *Content* and *Mobility* were the most needed factors. For social aspects, *Social influence*s are more important than personal characteristics. However, their study had some limitations. Their aim was to locate factors affecting the adoption of location based systems to find for example certain restaurant or parking areas however, they concentrated only on students. Other older age groups would be the most appropriate sample since they drive and might need for such information. One more thing, it was not clear whether the researchers used a deductive or inductive approach for the analysis.

The third section of literature looked into wireless mobile services. Lu, Yao and Yu (2005) for example, investigated *Social influence*s and *Personal innovativeness to information technology* (PIIT) influences on users' intention to adopt wireless internet services via mobile technology. Collecting data from MBA students in a university in Texas revealed

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that both *Social influence*s and PIIT had a significant impact on *Perceived ease of use* and *Perceived usefulness* and both had no significant impact on *Behavioural intention* directly. This study focused on students only and only on academic students from one discipline. Other age groups were not part of this study. In addition, they focused on only two individual factors and they did not consider system factors. Similarly Lu et al. (2008) and Tan and Qi (2009) investigated factors affecting the adoption of wireless mobile data services in China. Lu et al. (2008) investigated wireless mobile data services functionality (i.e. personalization, immediacy and localization), *Interface design*, PIIT, *Social influence*s, *Mobile trust* and *Facilitating conditions* such as time and money. Based on 1432 survey responses, they found that mobile functionality had a significant impact on both *Perceived ease of use* and *Perceived usefulness*. *Social influence* had a negative impact on *Behavioural intention*. *Facilitating conditions* had a significant influence on *Perceived usefulness* but not on *Perceived ease of use*. Mobile *Perceived trust* had significant influence on *Perceived ease of use*, usefulness and *Behavioural intention*. PIIT has a significant effect on *Perceived ease of use* and *Behavioural intention*. Tan and Qi (2009) combined both the TAM model and Hawkin's consumer behaviour model to produce the following factors: *perceived economy* (PE), *Personal curiosity* (PC), *Social influence* (PSI, SSI) and *Personal innovativeness to information technology* (PIIT). The findings of that research summarized into these points: *Perceived usefulness* and *Perceived ease of use* has a significant effect on *Attitude* towards mobile service use. *Perceived ease of use* has a significant effect on *Perceived usefulness*. *Perceived economy* has no effect on *Behavioural intention*. *Perceived economy* has no effect on use. *Personal innovativeness to information technology* has a significant effect on *Perceived usefulness*. *Personal innovativeness to information technology* has no effect on *Perceived ease of use*. *Perceived curiosity* has a significant effect on *Behavioural intention*. *Perceived curiosity* has a significant effect on the use. Superior *Social influence* has a significant effect on *Perceived usefulness*. Peer *Social influence* has a significant effect on *Behavioural intention*. And finally peer *Social influence* has a significant effect on the use. However, most participants in Lu et al.'s and Tan and Qi's studies were students. Wireless mobile services can be used by other group users as well.

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Several attempts have been made to investigate factors affecting intention to use mobile commerce and mobile payment. Wu and Wang (2004) for instance, integrated a factor from innovation diffusion theory, compatibility, along with perceived risk and cost into TAM to investigate user acceptance of mobile commerce. 310 customers from two banks and investment companies in Taiwan formed the sample of the study. They found that *Behavioural intention* to use mobile commerce had a significant effect on the actual use. *Perceived ease of use* did not have a significant effect on users' intention but it had a significant direct effect on *Perceived usefulness* and indirect effect on the intention and actual use through *Perceived usefulness*. *Perceived usefulness* significantly and directly affect the intention and indirectly affects the actual use. *Compatibility* positively and directly influences both *Perceived usefulness* and *Behavioural intention*. *Compatibility* also influences *Behavioural intention* and actual use indirectly through *Perceived usefulness*. Cost had a significant negative effect on *Behavioural intention*. *Perceived risk* had a significant but positive effect on *Behavioural intention* directly and indirect effect on the actual use. They explained that consumers might have a comprehensive understanding of mobile commerce that made them avoid the potential risk. The key problem with their research is focusing on only a few system characteristics and ignoring interface and individual differences.

To understand mobile commerce acceptance and usage in China, Min, Shaobo and Gang (2008) modified UTAUT model to include user satisfaction, unique characteristics of mobile commerce and Chinese culture. They also think the framework should include trust, privacy protection and cost to be tested in the future. They suggested conducting multiple methods such as cross-sectional, longitudinal case studies and focus group approaches to understand users' acceptance of mobile commerce in different stages. In the case of mobile payment service, Schierz, Schilke and Wirtz (2010) developed a framework devoted to understand why consumers have not adopted such services. They collected data from 1447 users in Germany. They considered TAM and *Perceived compatibility*, *Subjective norms*, individual *Mobility* and *Perceived security*. *Perceived ease of use* predicts *Perceived usefulness* of mobile payment. *Perceived compatibility* is found to predict *Perceived usefulness* and *Behavioural intention*. *Mobility* has significant relationship with the intention and *Perceived usefulness* of mobile payment. *Subjective norms*, *Perceived*

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security, *Perceived compatibility*, *Individual mobility*, *Ease of use* and *Perceived usefulness* were all significantly affecting the attitude toward using mobile payment services. Their research however, did not consider the influence of interface characteristics.

Kim, Mirusmonov and Lee's (2010) study also considered individual and system characteristics influence on intention to use mobile payment in Korea. They investigated PIIT and mobile knowledge as part of individual characteristics; and looked into *Mobility*, *Reachability*, *Compatibility* and *Convenience* as system characteristics. They also considered the effect of these factors on early and late adopters. Their study revealed differences between the two user groups. Mobile payment system characteristics showed no significant effect on the *Perceived usefulness* among early adopters. They explained that early adopters cannot expect much of the useful features from the new technology. *Mobility* and *Reachability* were found to significantly affect *Behavioural intention* through *Perceived ease of use*. On the other hand, *Reachability* was found to have a significant influence on both *Perceived ease of use* and usefulness among late adopters. In addition, late adopters perceive mobile payment to be useful if mobile payment is reachable and convenient. Moreover, innovative late adopters perceive mobile payment to be easier to use than non-innovative late adopters. However, there may be other individual and systems characteristics variables that can affect intention to use mobile payment.

Mobile payment also found an interest in Tunisia to understand factors causing resistance to use "MobiFlouss", a service that allows the user to pay their water and electricity bills through their mobile phones (Chemingui and Lallouna, 2013). Among 300 non-users, they found that *Compatibility*, *Resistance to technology*, *Trailability* and *Perceived enjoyment* significantly affected the intention. They also found that *System quality* affected *Trust*; while *Perceived trust* was not affecting *Behavioural intention* such service. Chemingui and Lallouna's study however, suffers from a number of limitations. First, the study was conducted only in the capital city which does not really represent the entire population. Second, the study was conducted among non-users of "MobiFloss" service only which cannot symbolize the entire mobile payment services. Finally, the main theory that this study was built on was not clearly mentioned.

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Rouibah's (2007) study is one of the limited studies that investigated *Behavioural intention* of mobile payment in one of the GCC countries. Rouibah (2007) investigated *Behavioural intention* to use Mnet, a new mobile payment technology recently introduced in Kuwait. TAM along with *Social norm*, *Enjoyment*, *Trust* and *Privacy* has been investigated among students registered in management information system class. He found that individual characteristics like gender and experience are two important factors which determine the acceptance of mobile payment. *Perceived enjoyment* and *Perceived usefulness* were important factors among inexperienced and experienced male users, while *Enjoyment* was essential for female students. *Perceived trust* affects *Behavioural intention* regardless of experience, yet it affects the intention of female students only. This study however, concentrates only on students from one department. They overlooked other user groups that might make more use of mobile payment.

Mobile marketing and advertising was also among literature published in mobile services field. Based on TRA, Bauer et al. (2005) investigated factors that influence the acceptance of mobile marketing. They focused on *Social norms* and consumers' personality factors such as, *Innovativeness*, existing *knowledge*, *Information seeking behaviour* and *Attitude* toward advertising. They also focused on innovation factors such as *Perceived utility* and *Perceived risk*. The study proved the validity of TRA for research in the area of mobile marketing. The role of consumer personality factors was confirmed. *Innovativeness* influences knowledge positively; *Information seeking behaviour* and *Knowledge* affects the *Attitude* toward advertising positively. However, the study shows that *Social influence* had a slight direct influence on the *Behavioural intention* but had a strong indirect influence through personal attitude. Their study also showed that *Perceived utility* positively influenced the attitude toward marketing; information seeking behaviour positively influenced perceived utility. However, *Perceived risk* was found to negatively influence the attitude toward marketing. Their study investigated the framework among old students with 30 years average. Considering younger students and using multi-group analysis based on age and gender would enrich the study.

Another example was a study by Westerlund et al. (2009). By extending TRA, they investigated the influence of content and *Perceived trust* as main determinants on

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consumers' acceptance of mobile advertisements. Via collecting data from 103 users in Finland and the Netherlands they found that both *Perceived trust* and content are important determinant factors of the consumers' *Behavioural intention*. However, their study did not consider possible differences like age and gender.

Clearly all previous reviewed studies relied heavily on quantitative approach. They focused mainly on individual and system characteristics and ignored interface characteristics. In addition, they concentrated on students while considering other users groups would be more convincing since mobile services covers the whole society. They suggested a number of relationships that predict usage of mobile systems but unclear whether these will apply to mobile libraries specifically.

2.9 Previous research about intention to use mobile services in higher education

Since digital libraries and the higher education sector share the same users' population, investigating intention to use mobile services in higher education might be a suitable source to locate factors affecting intention to use mobile digital libraries.

Studies about mobile service adoption in higher education are very limited and considered a small number of factors to explain *Behavioural intention*. Most of these studies focused on the intention in general before designing or referring to specific applications or systems. In Thailand, Phuangthong and Malisawan (2005) conducted a preliminary study to examine individual factors affecting *Behavioural intention* to use 3G mobile phones for learning purposes. Surveying 385 respondents revealed that in addition to TAM constructs, *Perceived enjoyment* significantly affected *Behavioural intention* through *Attitude*. Ju, Sriprapaipong and Minh (2007) also considered Thai students to investigate the influence of *Self-efficacy* on intention to use mobile learning. Their results supported TAM and indicated that *Self-efficacy* had a strong influence on *Perceived ease of use*.

Among undergraduate and postgraduate students in Taiwan, Huang, Lin and Chuang (2007) found that both *Perceived enjoyment* and *Perceived mobility* had significant impact on intention to use mobile learning. Whereas in China, Liu, Li and Carlsson (2010) found

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that near-term and long-term usefulness and PIIT influence the adoption intention directly of undergraduate students. They also found that *Perceived long-term usefulness* significantly affects the *Perceived near-term usefulness*. In addition, they found that PIIT influenced both *Perceived ease of use* and long-term *Perceived usefulness*.

In New Zeeland, Callum (2009) examined the influence of computer experience, *Computer self-efficacy*, *Motivation*, *Student dependence* and *Attitude* to determine students' adoption of mobile learning among 30 postgraduate students in a computing course. He found that age and gender interact with students' *Behavioural intention*. Younger students tend to have higher *Computer self-efficacy* and tend to have more positive attitude towards mobile learning. *Computer experience* was significantly related to gender. Male respondents seem to have more mobile experience than females, and those with greater experience of computer use also exhibited greater mobile experience. However, *Attitude*, *Motivation* and *Students' dependence* had no influence on the adoption intention of mobile learning. He explained that users had no experience with using mobile devices to learn; therefore they do not realize the importance of that opportunity. One drawback of this study is the small scale of sample used. Callum's paper would have been more convincing if they considered other disciplines and other age groups, especially as the findings showed that age affects users' adoption. The main weakness of literature reviewed so far is the failure to address other importance categories of factors such as system characteristics and interface characteristics.

Individual differences and system characteristics were considered by numerous studies (Liaw, Hatala and Huang, 2010; Park, Nam and Cha, 2012; Wang, Wu and Wang, 2009; Ye, Li and Geng, 2010), yet interface characteristics were not part of their studies. Based on TAM, Park, Nam and Cha (2012) studied the influence of *Self-efficacy*, *Relevance*, *System accessibility* and *Subjective norms* on intention to use mobile learning in Korea. They found that all factors significantly affected *Behavioural intention*, however, *Attitude* was the most important factor followed by relevance and *Subjective norms*.

Based on TAM again, Ye, Li and Geng (2010) investigated the influence of service quality, mobile devices, mobile resources, visual attractions and interest of learning on

intention to use mobile learning. Among undergraduate and postgraduate students, they found that all factors significantly affected their *Behavioural intention*.

On the other hand, Wang, Wu and Wang (2009) investigated factors influencing intention to use mobile learning based on minor changes on UTAUT. Surveying respondents from five organizations in Taiwan revealed that *Performance expectancy*, *Social influence*, *Perceived playfulness* and *Self-management* had significant impacts on *Behavioural intention*. They found that age moderated the effect of *Effort expectancy* and *Social influence*; and moderated the effects of *Social influence* and *Self-management*.

Al-Aish and Love (2013) also investigated factors affecting intention to use mobile learning in UK based on a modified UTAUT. Derived from 174 responses from second year students in the school of information systems, computing and mathematical science in Brunel University, they were able to find a significant relationship between *Performance expectancy*, *Effort expectancy*, influence of lectures, *Personal innovativeness*, *Quality of service* and the *Behavioural intention*. They also found that prior experience moderated the effect of the entire constructs. Like most of the reviewed studies, this work suffered from the fact that students were answering concerning their intention to use a service that is not yet developed; this might lead to biased responses lead by users' thoughts and not experiences about mobile learning. Also, Al-Aish and Love's study concentrated only on second year students, which might affect the results.

Generally, all studies reviewed so far focused on the intention in general before designing or referring to specific application or system except Liaw, Hatala and Huang (2010), Gao, Krogsite and Gransaether (2008), Gao, Moe and Krogsite (2010), and Kuadey (2010) who considered evaluating a certain system based on users' acceptance. To evaluate a mobile knowledge management system based on users' acceptance, Liaw, Hatala and Huang (2010) surveyed 152 students who were already using the system based on activity theory. They found that system satisfaction, system activities, learners' autonomy and system functions were all significantly affecting the acceptance of the system. Gao, Krogsite and Gransaether (2008) proposed an extended model of TAM based on certain relevant factors, such as: *Context*, *Trust* and *Personal initiatives and characteristics* (including age, gender, background, knowledge and skills, culture and preference) tested in a case study called the

FindMyFriends system. This is a system that allowed students to locate each other inside a particular building. From a survey of 207 users, they found that context like location, information history and people conditions had a direct effect on both *Perceived usefulness* and *Perceived ease of use* and an indirect effect on *Behavioural intention*. *Trust*, *Personal innovative and characteristics* factors including age, gender, background, knowledge and skills, culture and preference had a direct effect on intention to use mobile applications.

Gao, Moe and Krogsite (2010) used the mobile services acceptance model in a new case study called mobile student information systems (MSIS) for university students. This system allows users to locate each other, view lecture schedules and view news and notifications. From a survey of 25 students, they found consistent results with the previous FindMyFriends case from Gao, Krogsite and Gransaether (2008) except for *Perceived usefulness*, which was found to have a negative impact on *Behavioural intention*. The findings of Gao, Moe and Krogsite' might be more convincing if the sample size was bigger or covered a wider range of disciplines. They concentrated only on engineering students.

Kuadey (2010), under Krogsite's supervision, adapted the same model for the purpose of evaluating and testing usability of MCLS the extended version of MSIS, a prototype for e-learning in the Norwegian University of Science and Technology; a user-centric mobile app to enable a user to send and receive messages, search for other users and receive notification about lecture notes and assignments. His findings revealed the importance of the same factors investigated by Gao, Moe and Krogsite (2010). He found that *Perceived trust* is an important factor. A majority of students would use the system only if the system protects their privacy. *Context* was also found to be an important factor. Most of the users agreed that they would use the system if they are out of home or office or if they don't have access to desktop computer. *Personal innovative and characteristics* however, was not as important as the rest of the factors. 43% of respondents disagreed with the statement that they would be the first to use the system. Conversely, Gao, Moe and Krogsite (2010) found that 79% of the users found the system useful. One major criticism of Kuadey (2010) is that he neglected to mention the size of the sample that tested the application.

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A number of studies also proposed conceptual frameworks for future testing. Based on investigating and reviewing others papers on mobile learning, e-leaning and mobile services, Liu, Han and Li (2010) built a framework in order to anticipate factors affecting intention to use mobile learning. They arranged factors that might influence the intention into three categories related to the role of mobile learning user (comprising technology user, consumer and learner) to be tested in the future. Zhao and Zhu (2010) also proposed factors that might influence intention to use mobile learning and suggested few guidelines for mobile designers to consider. They think that e-learning experience, age, option leader (i.e. boss), mobile devices using confidences should be considered in testing the intention in future work. Similarly Liu (2008) proposed a conceptual model however, based on UTAUT and five additional factors to explain the adoption of mobile payment. He considered *Self-efficacy*, *Mobility*, *Attainment value*, *Perceived enjoyment* and *Self-management* as external factors affecting *Behavioural intention* and excluded all moderated factors that were available in UTAUT for the purpose of future research.

Just like the previous sections, studies about mobile services in higher education relied on quantitative data. The literature reviewed focused on personal and system characteristics and neglected the interface characteristics influence. Studies reviewed suggested a number of relationships that predict usage of mobile systems, yet it is not clear whether these will apply to mobile digital libraries.

2.10 Previous research about intention to use mobile digital libraries

Only two articles have been located specifically in the area of mobile digital library. These articles focused on *Behavioural intention* to use SMS-based library catalogue. The user in this service will send an SMS with a keyword, to receive materials availability from the library. Based on TAM, Goh and Liew (2009) investigated the influence of *Self-efficacy* on *Behavioural intention*. The sample of 103 undergraduate students supported TAM constructs. In addition, the researchers found that *Self-efficacy* has positive effect on *Behavioural intention* through *Perceived ease of use* and a negative effect through *Perceived usefulness*. Additionally, Goh (2011) considered gender differences on students' *Behavioural intention* towards an SMS-based library catalogue. He found that *Perceived*

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usefulness significantly affected *Behavioural intention*. He also found that *Perceived ease of use* and *Self-efficacy* had no direct significant impact on *Behavioural intention*. Among male users, *Self-efficacy* had a positive significant impact on the intention through *Perceived ease of use* and significant negative impact through *Perceived usefulness*. However, in the case of female users, *Self-efficacy* had a positive significant impact on the *Perceived ease of use*. He explained that male users might find SMS very straightforward so they do not appreciate its usefulness. However, both studies considered only SMS services provided by small screen mobile phones. They also concentrated on only one factor, which cannot be the only factor for determining users' intention. In addition, the studies were quantitatively focused, aiming to confirm previous models, and not to provide new insights into the mobile digital library area, which can discovered through qualitative approaches.

Since most of the studies draw on the TAM, all constructs mentioned in previous areas in relation to TAM have been grouped into one table (see Appendix A). Any external constructs that were hypothesized to affect the intention directly or through *Perceived usefulness* or *Perceived ease of use* in the literature were mentioned. The table provides details about the hypothesized relations; the area where those relations have been tested; the findings of those relations and more information about the author, the year and the title of the study.

2.11 Gap in mobile digital library studies

The review of relevant literature in this chapter highlighted some of the gaps in the field of mobile digital library adoption from users' perspectives that this thesis aims to address.

Previous attempts concentrated on the technical process of designing mobile digital libraries and neglected users' perspectives. Those attempts concentrated on delivering services inside the library only or delivering limited library services such as SMS through small screen mobile devices. However, the new smartphones are increasingly popular among college students and have a number of new features that help the academic libraries to deliver much more than just SMS service. Users are no more bound to library walls, the new smartphones will allow them to gain speedy access to relevant information from

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anywhere anytime. Consequently, this thesis considers an updated version of mobile digital library called 'smart digital library', which delivers library services through new smartphones.

Recently published studies pointed out the popularity of smartphones and the importance of delivering library services on such devices. They even laid out a number of guidelines and phases for designing mobile digital libraries. However, they were based on experience and opinion rather than empirical evidence. Thus there is a vital need to conduct empirical research about this area.

Mobile digital library or smart digital library is a new area that lacks a coherent theoretical framework to explain the adoption and acceptance of such innovation. Papers reviewed about the adoption from related areas such as mobile service, mobile service in higher education and digital library showed an overwhelming reliance on TAM. However, it seems that there is no agreement about external factors affecting users' intention. Some considered either interface characteristics, system characteristics, or individual characteristics; others mixed two or all. Ultimately, the components of these characteristics were not agreed upon. This thesis will address all three external characteristics that are believed to affect the adoption and intention.

Papers reviewed about the adoption from related areas also showed a great reliance on quantitative approach. This restricts the possibility to uncover new factors that might affect the adoption of this novel technology. There is a need therefore for applying a mixed method approach to explore and explain factors affecting intention to use mobile digital library. Previous research has primarily been conducted either in developed countries or Far East Asia. Very limited research has been conducted in developing countries and very little in GCC countries. So there is a need to cover GCC area and understand factors affecting their use of mobile digital library.

Most studies that investigated *Behavioural intention* or the adoption and acceptance of digital libraries have been conducted after implementation. It has been used to evaluate users' acceptance of such service and not to anticipate what may interfere with their adoption. On the other hand, studies about intention to use mobile services, especially in

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higher education, have been mainly conducted before designing or referring to a specific system (see Table 2.1). This thesis adopts a midpoint between these two aspects; it considers investigating the adoption before implementation while referring to a developed prototype. Conducting adoption and acceptance research before implementation saves money and effort. Thus, rather than designing a complete version of mobile digital library first and then evaluate its use, this thesis investigates users intention to use mobile digital library before implementation based on their exposure to a mobile digital library prototype.

Table 2.1: Adoption and acceptance phases

Pre-implementation	Mobile services in higher education Liu, Li and Carlsson (2010); Callum (2009); Park, Nam and Cha (2012); Ju, Sriprapainpog and Minh (2007); Huang, Lin and Chuang (2007); Phuangthong and Malisawan (2005); Ye, Li and Geng (2010); Wang, Wu and Wang (2009); Al-Aish and Love (2013)
Implementation	_
Post-implementation	Digital libraries Thong, Hong, Tam(2002); Vaidyanthan, Sabbaghi and Bargellini (2005); Ramayah (2006a); Park et al. (2009); Jeong (2011); Kim (2010a); Kim (2010b); Nov and Ye (2008); Nov and Ye (2009); Miller and Khera (2010); Lee et al. (2005) Mobile services in higher education Liaw, Hatala and Huang (2010)

2.12 Initial framework for mobile digital library acceptance

As mentioned earlier, the literature lacks a theoretical framework dedicated to mobile digital library acceptance. Such a framework would not only help libraries understand users' needs and what may interfere with their acceptance of such technology, but would also help in the process of developing a mobile digital library application and the selection of services.

Based on the preliminary knowledge maintained from a literature review focused on developed countries or East and South-East Asia, a proposed framework for mobile digital library acceptance in the UAE can be proposed. Since it is hard to assume that the findings of those research match the context of developing countries and the GCC countries in particular, this research presents a preliminary framework that works as a foundation for an exploratory phase. Figure 2.7 represents an initial set of predictions based on the literature review.
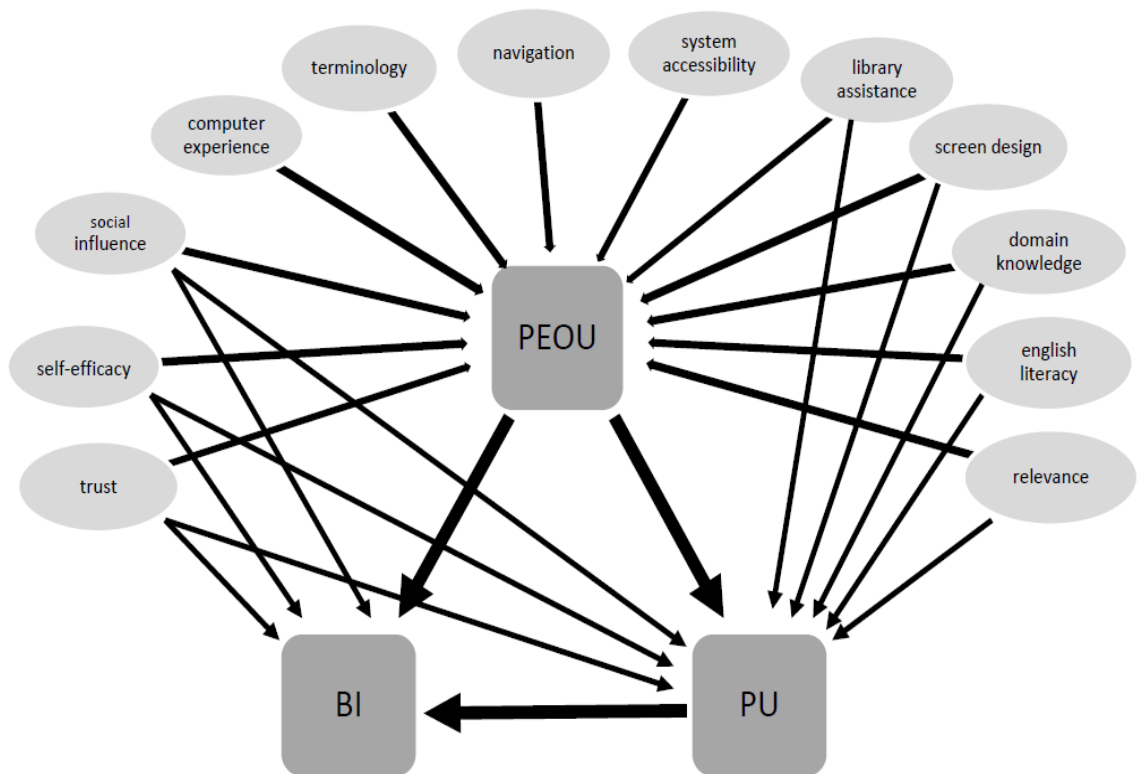
Figure 2.7: The proposed theoretical framework

As clear from the literature review (and summary provided in Appendix A), a substantial number of external constructs have been found significantly affect *Behavioural intention* either directly or through *Perceived usefulness* and *Perceived ease of use*; it is hard to focus on all of them. Based on that, only constructs that showed influence on *Behavioural intention* in digital library system and proved their affect again in related areas such as intention to use mobile services and mobile services in higher education have been used to design a preliminary theoretical framework. Additionally, factors that were limited to digital libraries and believed to have an impact on the mobile digital library but have not been included in the rest of related areas will be included.

Based on this analysis of post literature, a preliminary framework to understand intention to use mobile digital library service is proposed based on integrating 12 external factors organized into three categories: interface characteristics, personal characteristics and system characteristics. However, as this framework has been developed only through

reference to published literature in related but not identical domains, further work is needed to confirm their impact on mobile digital library services' adoption and acceptance. The following table summarizes constructs reviewed in the literature from different area and the selected constructs in this thesis.

Table 2.2: External constructs related to TAM

MS	MSH	MS+MSH
Perceived risk/security	Motivation	Enjoyment
Perceived cost	Service quality	PIIT and characteristics
Perceived expressiveness		Context
Functionality		Mobility
Personalization		
Facilitating condition		
Personal curiosity		
Reliability		
Convenience		
Compatibility		
Image		
Content		
DL	**DL***	**DL+MS+MSH***
System visibility	Screen design	System accessibility
Interest in publishing	Terminology	Relevance
Reliability	Navigation	Social influence
Computer anxiety	Library assistance	Trust
Resistance to change	Computer experience	Self-efficacy
Result demonstrability	Domain knowledge	
Mandatory use	English literacy	
Information quality		
System quality		
Output quality		
Mobile service (MS); Mobile service in higher education (MSH); Digital library (DL); Used factors *		

Appendix A also shows a number of significant relationships, however no studies were directly comparable to mobile library context. Only well established relationships for the selected earlier constructs will be reported. TAM's two determinants *Perceived ease of use* and *Perceived usefulness* in most studies were significantly affecting the intention. *Perceived ease of use* was also found to significantly affect *Perceived usefulness* in a number of studies. *Terminology*, *Screen design* and *Navigation* were found to significantly affect *Perceived ease of use*. *Screen design* was also found to significantly affect *Perceived usefulness*. *Domain knowledge* was found to significantly affect both *Perceived ease of use* and *Perceived usefulness*. *Computer experience* was found to significantly affect *Perceived ease of use*. *Self-efficacy* was found to affect the intention directly and through *Perceived*

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ease of use and *Perceived usefulness*. *Relevance* was also found to affect the intention directly and through both *Perceived usefulness* and *Perceived ease of use*. *System accessibility* was found to significantly affect *Perceived ease of use*. *Library assistance* was found to significantly affect both *Perceived ease of use* and *Perceived usefulness*. *English literacy* was also found affecting both *Perceived ease of use* and *Perceived usefulness*. *Social influence* was found to affect the intention directly and through *Perceived usefulness* and *Perceived ease of use*. *Trust* also was found to significantly affect the intention directly and through *Perceived usefulness* and *Perceived ease of use*.

The following section will provide details about TAM main constructs and will explain each of the variables that might influence intention to use mobile digital library, selected based on their demonstrated impact in similar adoption domains.

2.12.1 TAM main constructs

- *Perceived usefulness*

Perceived usefulness (Davis, 1989) or *Performance expectancy* (Venkatesh et al., 2003) means the degree to which a person believes that using a system will enhance his/her job performance. In the context of library service, Abdul Rahman, Jamaludin and Mahmud (2011, p.118) defined *Perceived usefulness* as "the degree to which digital library users believe that using the information resources in the digital library will provide them with the advantages in their study or/and research". In that sense it is predicted that if library users believe that using mobile library service will enhance their work, they will tend to use that service.

- *Perceived ease of use*

Perceived ease of use (Davis, 1989) or *Effort expectancy* (Venkatesh et al., 2003) refers to the extent to which a person believes that using a system will be easy and free of effort. Abdul Rahman, Jamaludin and Mahmud (2011, p.118) defined *Perceived ease of use* as "the degree of ease associated with the use of digital library". Based on that, it is predicted that if library users believe that mobile digital library is easy to use and requires no effort, they will tend to use it.

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- *Attitude*

Attitude is a person's general positive or negative feeling toward the behaviour (Ajzen and Fishbein, 1980). So if an individual develop a positive attitude toward a system, he/she will intend to use it (Brown and Massey, 2002; Castaneda, Munoz-Leiva and Luque, 2007).

But as mentioned earlier, *Attitude* will be excluded from the study, since there is evidence that it weakened the results (Davis, Bagozzi and Warshaw, 1989; Adams, Nelson and Todd, 1992; Taylor and Todd, 1995b) and removing it from TAM will give better explanation of intention (Davis, 1989).

- *Behavioural intention*

Behavioural intention is a measure of the strength of one's intention to perform a specific behaviour (Fishbein and Ajzen, 1975, p.288). *Behavioural intention* understanding will help in predicting action by knowing whether users are motivated and have the intention to use a system regularly in the future. (Ajzen and Fishbein, 1980).

2.12.2 Interface characteristics

It is the medium between the system and the user (Thong, Hang and Tam, 2002). Interface characteristics and user-centric system features such as menus, icons and control tool bars enhance usability of any system (Davis et al., 1989; Cho et al., 2009). As a well-designed interface contributes in reducing users' efforts to locate certain object on the screen, provides smooth navigation among screens and makes the system looks more easy to use (Fox et al., 1993). Based on that, it is expected that interface characteristics will enhance the usability of mobile digital library application and will interfere with their acceptance of such system.

- *Screen design*

Screen design refers to the way information is presented on the screen (Lindgaard, 1994). A screen that is well organized and carefully designed assists users to scan the screen and locate relevant information more easily (Thong, Hong and Tam, 2002). Links, graphics,

content layout, colour schemes, icons, buttons, font sizes and line spacing are important features to be considered in relation to screen design (Bernard, 1990; Graham, Hannigan and Curran, 2005) with the highest effect on users interaction with the system goes to graphical user interfaces (Hu, Ma and Chau, 1999). Therefore, screen clarity and organization are expected to affect the acceptance of mobile digital library services.

- *Terminology*

Terminology is a set of words, sentences, abbreviations or expressions used in a particular subject and reflected in a system (Ramayah, 2006). A clear understanding of terminology decreases users' search efforts, facilitates efficient searching and formulates easier digital library images (Thong, Hong and Tam, 2002). The gap between the vocabulary of users and the professional terms and jargons of digital library providers (Jeong, 2011) must be addressed, or if necessary accompanied by clear explanations, as it might affect search results (Ramayah, 2006). Accordingly, clear terminology is predicted to affect the adoption and acceptance of a mobile digital library service.

- *Navigation*

Navigation is the ease with which users can move around the system, understand menu options and recognize where they are and where they are going in a sequence of screens (Lindgaard, 1994). By providing navigation aids or increasing the amount of unique landmarks, users can be prevented from getting lost in information-intensive systems and be guaranteed a sufficient search (Lindgaard, 1994). As a result of that, it is predicted that navigation clarity helps users find relative information on mobile digital library systems and prevents them from getting lost in it.

2.12.3 System characteristics

System characteristics focus on the interaction between the system and organizational context or the library (Thong, Hong and Tam, 2002). Those factors are the technical support that facilitates access to the needed information (Wilkinson et al., 2004). They affect both user beliefs and the acceptance of technology in a variety of context (Davis, 1989; Selim, 2003). So in order to help the library succeed in delivering mobile library

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service, the design of the application is expected to cover system characteristic factors. The design should be accessible and provide relevant up-to-date and correct information.

- *System accessibility*

System accessibility or system quality as Jeong (2011) call it means easily locating specific computer systems, data and information (Kling and Elliott, 1994). Accessibility has been found to be one of the most important determinants of the frequency of information source usage (Culnan, 1983; O'Reilly, 1982). Specifically, it has been found that poor accessibility can negatively affect the use of electronic resources provided by digital libraries (Graham, 1995; Harter and Kim, 1996; Zhang and Estabrook, 1998). If a digital library is difficult to access, either because of lack of computers or necessary software, users will tend to perceive it as difficult to use (Thong, Hong and Tam, 2002). Thus, this research suggests that a mobile library system should be accessible whenever it is needed, otherwise people will not use it.

- *Relevance*

Authenticity (Arif and Kanawal, 2009) or *Relevance* refers to the degree to which the system matches the tasks carried out in the current environment (Lindgaard, 1994). *Relevance* in a library context mainly focuses on successfully delivering users' requests and matching their needs with the content in a digital library system (Vaidyanathan, Sabbaghi and Bargellini, 2005). In other words, *Relevance* in digital library system is equivalent to content factor. Users' search efforts tend to be more productive and effective when they find relevant information in the digital library (Thong, Hong and Tam, 2002). Relevant to them means locating useful documents (Yao, 1995). In view of that, the existence of resources relevant to users' needs is predicted to affect the acceptance of mobile digital library system.

- *Library assistance*

The availability of technical support may enhance the rate of computer system acceptance (Park et al., 2009). Studies show that the ability to use a system among older adults and new users, who are less skilled in the use of the system or are developing searching skills,

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can increase through assistance (Lam and Lee, 2006). Librarians' assistance or role of librarians (Kim, 2010c) is an important element in the digital age as it promotes a system's ease of use (Marler, Liang and Dulebhon, 2006; Park et al., 2009; Schillewaert et al., 2005), influence and facilitate the usage of library resources and library system (Bowers et al., 2009; Jacoby and O'Brian, 2005; Rutledge and Maehler, 2003). Similar to previous studies, technical support may enhance the acceptance of mobile digital library services. Library users who are less skilled in using mobile services need mobile technical support.

2.12.4 Personal or individual characteristics

Personal characteristics describe the relationship between individual differences and information system (Thong, Hong and Tam, 2002) in this case mobile digital library application. Evaluating the usefulness of any information system evolved from evaluating the system itself toward evaluating its usefulness from user's perspective (Barry and Squires, 1995). Just like any technological innovation, the success of mobile application depends as much on individual differences as on the technology itself (Nelson, 1990). As a matter of fact, Individual differences are the most significant determinants of Information system success (Harrison and Rainer, 1992; Thong, Hong and Tam, 2002) and digital library system success (Borgman, 1989; Chen et al., 2000). It decides user performance on information retrieval systems (Borgman, 1987; Chen, Czerwinski and Macredic, 2000). Therefore, this study believes that individual or personal characteristics may interfere with the acceptance and the success of mobile digital library application. The acceptance of mobile digital library may vary from individual to individual, depending on the characteristics of the individual.

- *Social influence* (*Subjective norm*)

Pressures from social networks to make or not to make a certain behavioural decision, formats *Social influence* (Lu, Yao and Yu, 2005). *Social influence*s equal to *Subjective norm* in TRA and referred to others' opinions, superior influences and peer influences (Venkatesh and Davis, 2000; Taylor and Todd, 1995b). Whenever an innovation creates uncertainty about its expected consequences for potential adopters, individuals feels uncomfortable and therefore tend to interact with social networks to consult on their

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adoption decisions (Burkhardt and Brass, 1990). *Social influence*s can be divided into two variables: external influence (Hung et al., 2003) or superior *Social influence* that enhances *Perceived ease of use* (Tan and Qi, 2009); and peer *Social influence* that encourages consumer use without considering its usefulness or ease (Tan and Qi, 2009). Research shows that the use of mobile search is heavily influenced by family and friends (Kargin, Basoglu and Daim, 2009). People may feel they should use a mobile search often after watching other people, even if they are not positive toward the behaviour or its consequences (Venkatesh and Davis, 2000). Following prior research, this study generally predicts that: the social network will have a major impact on the decision of mobile service use. Library users may feel they should use a mobile digital library service after they see their peers, friends and teachers are using it.

- *Trust*

Trust or perceived credibility (Wang, Lin and Luarn, 2006) can be defined as a user's belief or faith in the degree to which a specific mobile application can be regarded to have no security and privacy threats. In mobile applications there are two kinds of trust: *Perceived trust* in technology and *Perceived trust* in vendor. Trust in technology is dependent upon people's knowledge and experience of the technology. Trust in vendor primarily depends on people's perceptions of the vendor or service providers (Gao, Krogstie and Gransaether, 2008). Trust is hard to gain but easy to lose (Gao, Moe and Krogstie, 2010). Thus, *Perceived trust* is expected to affect mobile digital library acceptance.

- *Mobile self-efficacy*

Bandura (1986) defines *Self-efficacy* as people's judgments of their capabilities to organize and execute courses of action required to attain designed types of performance. It is concerned not with the skills one has but with the judgments of what one can do with whatever skills one possesses. Callum (2009) chose to rename *Self-efficacy* as 'student independence' or 'self-directed'. From a library prospective, Miller and Khera (2010) attached *Computer self-efficacy* to the degree of self-ability to conduct a search on a library database or digital library. Individuals with higher levels of *Computer self-efficacy* show

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stronger capabilities and confidence when using a computer and in turn, require less support and assistance than those with less self-efficacy (Kim, 2010c). Prior research has found a positive relationship between *Computer-self-efficacy* and general computer usage (Igbaria and Iivari, 1995), computer literacy and usage of information retrieval systems (Davies, 1997; Jacobson and Fusani, 1992; Mark and Jacobson, 1995) and a relation between self-efficacy and registration in computer courses at universities (Hill et al., 1987). Therefore, this study expects that people with a high level of self-efficacy will be able to use and search on a mobile digital library system.

- *Computer experience*

Computer experience can affect successful interaction with personal computers, the worldwide web and information retrieval systems in libraries (Igbaria, Guimaraes and Davis, 1995). Prior experience with the internet also had a significant impact on the user's perception of digital libraries' usability or *Perceived ease of use* (Koohang and Ondracek, 2005). Furthermore, Dishaw and Strong (1999) found out that experience in mobile search influence positively the *Perceived ease of use* and *Perceived usefulness* and leads to acceptance of mobile search. In view of these findings, this research suggests that: years of smartphone experience might also affect the interaction with mobile digital library services.

- *Domain knowledge*

Domain knowledge is defined as the person's knowledge of a particular discipline, domain, or area that is relevant to the search (Miller and Khera, 2010). Users' knowledge in the subject might interfere in their search performance (Thong, Hang and Tam, 2002) and help them identify relevant information, learn search principles and use technical terminologies in their searches (Meadow, Wang and Yuan, 1995; Linde and Bregstorm, 1998; Marchionini et al., 1993). Existing knowledge not only determines users' ability to understand the features and usage of an innovation (Bauer et al., 2005), but also leads them into perceiving an innovation or a product similar to it to be less complex (Sheth, 1968). As a result, this research proposes that people who have solid knowledge in a particular

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discipline might understand the mobile digital library features. In addition, they might conduct better searches on a mobile digital library system.

- *English literacy*

To read and understand information found on digital library systems, it is necessary to be literate about the language used in that system (Park et al., 2009). The more an individual understands articles written in English, the easier the person will find articles to use (Park et al., 2009). Similar to previous research, *English literacy* might affect the use of the mobile digital library system. The language used in the mobile digital library system is English too. The more a person is English literate, the more the person might use a mobile digital library service.

2.13 Summary

This chapter has been conducted for the purpose of introducing the concept of mobile digital library and reviewing related studies to the area conducted in developed and developing countries (given that the study context, the UAE, has features of both, e.g. high smartphone penetration alongside legacy pedagogical systems in education). The literature review allowed for locating the gap in the area of mobile digital library and helped in proposing a preliminary framework to understand intention to use mobile digital libraries in the UAE context. This preliminary framework has been designed based on TAM, the most used model in IS field and based on external constructs that were highly validated across all relevant areas: intention to use digital libraries, mobile services and mobile services in higher education. The preliminary framework will be refined in an exploratory phase and validated in a testing phase later on.

The next chapter will provide details about strategies and methods used to fulfil the aim of this research; why they have been selected; and what tools helped to conduct such methods.

Chapter 3: Methodology

3.1 Introduction

This chapter aims to illustrate and justify the research approach. It starts by defining the philosophical paradigms upon which this study is based, followed by the research design and reasons for selecting a survey strategy that combines both qualitative and quantitative method. The process of qualitative and quantitative data collection and analysis is then explained, followed by the sampling techniques and consideration of research quality.

3.2 Selection of appropriate research approach

IS as a discipline engages itself within the general evolution of human communication and involves a very wide range of disciplines (Mingers and Stowell, 1997). The field of IS study has currently extended to include communication and collaboration between people and organizations, inter-organizational systems, electronic commerce and the internet (Mayers and Avison, 2002). In other words, IS utilizes many diverse research fields and disciplines, which in turn leads to diversity in approaches.

Galliers (1992) argues that there is no universal approach in the field of IS, yet there are optimum approaches for certain locations and circumstances. Research approach (Galliers, 1992), paradigms (Oates, 2006), or philosophical assumptions (Chua, 1986) were used interchangeably to refer to researchers' view about the world and how to investigate it. Galliers (1992, p. 147) defined the approach as "the way of going about one's research", while Oates (2006 p.13) stated that a paradigm is "a pattern or model or shared way of thinking". The type of research questions raised, the methods and techniques used to solve those questions are all determined by the views researchers hold about the world and the ways that help studying it.

Chua (1986), Livari et al. (1998), Mingers and Brocklesby (1997) and Orlikowski and Baroudi (1991) illustrated that IS approaches or paradigms include three broad philosophical assumptions: positivist, interpretive and critical. They divided them based upon their assumptions and beliefs towards the world and their work to include:

- **Ontology: Beliefs about existent physical and social reality**

  Beliefs that organize the world into a quantifiable external reality that exists independent of human perception, or a socially/cognitively constructed phenomenon dependent on human understanding. The ontology conditions the way in which researchers view themselves and the humans they study when investigating the way people interact in organizations, groups and society.

- **Epistemology: Beliefs about knowledge**

  Beliefs that lead in to developing and evaluating valid knowledge criteria are based on epistemological assumptions and beliefs about methodological assumptions that help selecting research methods and techniques appropriate for gathering evidence. Quantitative methods are associated with the belief that the world exists and can be quantified by numerical data, thus quantitative research typically seeks to test hypotheses by experimentation to produce replicable findings. Qualitative methods are concerned with the meanings humans attach to their experiences, thus they seek in-depth qualitative data and can often begin by gathering data that is later used to generate theories (inductive approach).

- **Ethics or axiology: Beliefs about relationship between knowledge and the empirical world/ what is valued or considered true**

  Beliefs concerning the role of theory in the world of practice and researchers' intentions in their work.

Table 3.1 demonstrates how those beliefs differ among the three philosophical assumptions.

Positivist research ontologically assumes that the world exists independently of humans and that human action is intentional and rational. It has the view that the world consists of physical and social communities that can be studied, captured and measured, usually with numerical (quantitative) data (Dube and Pare, 2003; Orlikowski and Baroudi, 1991). Epistemologically, positivist research is based on theories and hypotheses and fixed relationships within phenomena, to be confirmed or refuted by empirical testing. This approach believes that there will be one model or explanation for any aspect of the world. It looks for generalizations and universal laws to understand the single existent truth (Dube

and Pare, 2003; Oates, 2006). Positivist studies generally attempt to test a theory or hypothesis to increase the understanding of phenomena objectively, by measurable properties, independently of the researcher and instrument (Mayers and Avison, 2002). Positivist research in IS involves formal propositions, quantifiable measures of variables, hypothesis testing and the drawing of inferences about a phenomenon from a representative sample to a stated population (Orlikowski and Baroudi, 1991). The positivist approach usually involves laboratory experiments, field experiments, surveys, case studies, theorem proof, forecasting and future research, simulation and role playing (Galliers, 1992). Examples of positivist approach in qualitative research include the studies of Yins (1994) and Benbasat, Goldstein and Mead (1987) conducted in the IS context in general, as no studies in relation to mobile digital libraries or digital libraries was found. Theoretically, the researcher in this approach is a neutral and objective observer of the world who does not intervene in the phenomena or impose his/her feelings and personal values to it (Oates, 2006; Dube and Pare, 2003).

Table 3.1: IS paradigms

Paradigm beliefs	positivist	Interpretive	Critical
physical and social reality /Ontology (what is assumed to exist)	• Objective world exists independently of humans • Human nature can be unproblematically apprehended, characterized, and measured • Human action is intentional and rational, or at least boundedly rationale • Social relations are generally stable, and conflicts are dysfunctional to the social system (group, organization, or society)	• Subjective world is produced and reinforced by humans through their interaction • Social reality can only be interpreted by humans rather than discovered • Meanings are negotiated, so interpretation of reality may shift over time	• Social reality is historically constituted • Belief in human potentiality • Social reality produced and reproduced by humans • Social relations are constantly undergoing change • Beliefs in totality (things can never be treated as isolated elements)
Methodology & Epistemology (the nature of valid knowledge)	• Search for universal laws or principles from lower-level hypothesis • Done for the sake of explanation, prediction, and control. • Surveys, experiments, and case studies are the primary data collection techniques.	• Explain and interpret the way meanings are created and sustained in particular setting • Field studies is one of the appropriate data collection technique and case studies	• Knowledge is grounded in social and historical practices • Phenomenon can only be understood historically • Aim to interpret, understand a phenomenon, along with critique certain conditions. • Tend to be longitudinal and ethnographic studies
Relationship between theory and practice /Ethics or axiology (what is valued and considered right)	Researchers can objectively evaluate or predict action or processes, but they cannot get involved in moral judgments or subjective opinion.	• The researcher can never assume a value-neutral stance • Researchers prior assumptions, beliefs, values, and interests always intervene to shape their investigation • Complement positivism or replace it.	• Initiating change in the social relations and helping to eliminate the bases of alienation and domination. • Initiate a process of self-reflection among human actors • Some require transformation of self and social reality.

(Chua, 1986; Livari et al., 1998; Mingers and Brocklesby, 1997; Orlikowski and Baroudi, 1991)

Qualitative methods such as interpretive approach on the other hand are generally subjective, and generally attempt to understand phenomena through the meanings that people assign to them (Orlikowski and Baroudi, 1991). Ontologically, interpretive research assumes that access to reality is only through social structures such as language, consciousness and shared meanings (Mayers and Avison, 2002). The interpretive method in IS "aims at producing an understanding of the context of the information system,

influences and influenced by the context" (Walsham, 1993, pp. 4-5). Thus the social world cannot be characterized or measured in an objective or universal way. Epistemologically, interpretive research believes that studying people in their natural settings is essential to understand the world around them, but these findings are particular to the research context and cannot usually be generalized (Orlikowski and Baroudi, 1991). For that, it concentrates on qualitative data like words, metaphors and images that people use in their verbal communication. It also assumes different groups or cultures perceive the world differently and there is no single truth. So more than one explanation can be offered to explain a phenomenon with an indication of which one seems to be the strongest, if there is more evidence for it (Oates, 2006). The interpretive approach usually involves future research and role playing, argumentative research, action research and interpretive research (Galliers, 1992). Theoretically, researchers in this approach are not neutral. Their own assumptions, beliefs, values and actions interfere with the research process and affect the situation.

Ontologically, the critical approach assumes that social reality is historically formed and that it is produced and reproduced by people. However, the critical approach does not accept the status quo and goes further than empirically understanding phenomena in an objective way; rather it aims to empower people by challenging and removing barriers. The critical approach is dedicated to freeing people from the power relations, conflicts and contradictions in the society and help to eliminate the cases of alienation and domination (Mayers and Avison, 2002; Oates, 2006). Epistemologically, the critical approach is against any research projects that aims to improve or in increase managerial efficiency and control. Researchers in this approach think that people and society can shape the technology rather than adapting to the technology (Oates, 2006). The researchers' role in this approach is to influence the situation and interfere with the outcomes of the research. In addition their role is interchangeable with the participants during research (Galliers, 1992). Critical research tends to be longitudinal, historical and ethnographic with no theory to prove or disprove (Orlikowski and Baroudi, 1991). Theoretically, the role of the researcher is to criticize the social relations and practices to initiate changes and help illuminate the bases of alienation and domination. In that sense, the researcher goes beyond

studying and theorizing, to actively effect change in the phenomena being studied (Orlikowski and Baroudi, 1991).

Positivist research is a dominant approach in the Information systems field (Orlikowski and Baroudi, 1991). The existent literature tends to accept and follow this approach as it is replicable and can be empirically tested (Orlikowski and Baroudi, 1991). Researchers generally considered positivist approach as more rigorous, scientific, generalizable and reliable than other approaches (Chen and Hirscheim, 2004; Tornatzky and Klein, 1982).

Ontologically, this thesis has a view consistent with the world objective view of positivist approach. This research is constructed to find which factors affect the mobile digital library adoption and acceptance of academic students. It has the view that the social communities can be studied and explained. This thesis is also consistent with the epistemological beliefs of the positivist approach. It relies on theories and hypotheses to explain the adoption and acceptance of mobile digital library. In addition, it believes that the adoption can be explained by one model. Based on that, positivist approach will be the most suitable choice for this thesis.

3.3 Research design

- Research site

As mentioned in the previous chapters, mobile use in the developing world, especially in the GCC, is increasing rapidly but has been subject to less research than in the developed countries. This thesis focuses on the UAE, which has the highest penetration rate among the GCC countries (ITU, 2013). The research was conducted at Zayed University in the UAE. Zayed University is an English-medium public university established in 1998 by the federal government of the UAE (ZU Self-Study Report, 2013). It offers both undergraduate and postgraduate programs to prepare students for personal and academic success.

Zayed University was chosen because it is open to the idea of technology enhancements, having a fixed basic allocation of AED 210 million per annum for education, and an extra 6 million just for technology refreshment prior to 2011 (ZU Self-Study Report, 2008). By

the end of 2011 the total budget was increased to AED 406 million (ZU Self-Study Report, 2013). In addition, Zayed University already offers examples of mobile learning. It is a laptop university that aspires to integrate technology into its teaching and learning environments and to graduate students who are effective users of technology (ZU Self-Study Report, 2008). Zayed University is committed to integrate technology into all aspects of its operation to produce technologically literate students (ZU Self-Study Report, 2013).

- Research strategy

Oates (2006) mentioned that a strategy is the overall approach to answer research questions. Those strategies can be quantitative, qualitative, or a combination of both (Creswell, 2009). Both quantitative and qualitative strategies have strength and weaknesses (Gorman and Clayton, 2005), and the selection depends on the research context (Gorman and Clayton, 2005) and the current knowledge of a topic (Benbasat, Goldstein and Mead, 1987).

The structure of this thesis relies on a survey strategy that can be both qualitative and quantitative (Oates, 2006). Surveys can take the form of questionnaire, interview, observations and documents (Oates, 2006), and can be conducted for exploration and explanation purposes (Babbie, 1990). A survey's objective might be for making explanatory declaration about the population, being concerned with why the observed distribution exists. On the other hand, exploratory survey works as a search device at the beginning of a particular study in order to make sure that certain components of the situation were not missed. This thesis started inductively with a qualitative survey strategy for the sake of exploring and generating hypotheses (Johnson and Onwuegbuzie, 2004), followed by deductive approach for the sake of explaining, testing and confirming hypotheses generated in the exploratory phase (Johnson and Onwuegbuzie, 2004). This process of conducting research is referred to as a sequential exploratory strategy (Creswell, 2009). For further explanation of qualitative and quantitative research characteristics see table 3.2. Figure 3.1 provides a visual presentation of the general sequential exploratory strategy of this thesis and the sequence of collecting and analysing data that will be explained in details in the following sections.

Glaser and Strauss (1967) pointed out that the exploratory studies are usually conducted before setting the final study questions or specific methodological procedures. The goal of this type of study is to discover theory in its natural context. Yin (2012) added that exploratory work may be used when the researcher is uncertain about some major aspects such as the hypotheses, data collection methods, the questions to be asked, or the data analytic method. Once the exploratory phase has been completed the study will be ready with refined conceptual framework and a complete research design. Kraemer (1981) and Dutton (1981) showed an example of conducting exploratory studies in IS field for the sake of improving the success of future implementation efforts.

Table 3.2: Qualitative and quantitative modes

	Qualitative	Quantitative
Assumptions	-Social constructions of reality -Primacy of participant matter -Complexity of variables -Difficulty in measuring variables	-Objective reality of social facts -Primacy of method -Possible to identify variables -Possible to measure variables
Purpose	-Contextualization -Interpretation -Understanding participants' perspectives	-Generalization -Prediction -Casual explanation
Approach	-Theory generation -Emergence and portrayal -Researcher as instrument -Naturalistic -Inductive -Pattern seeking -Looking for pluralism and complexity -Descriptive	-Hypothesis based -Manipulation and control -Uses formal instruments -Experimentation -Deductive -Component analysis -Seeking norms and consensus -Reducing data to numerical indices
Researcher role	-Personal involvement and partiality -Empathic understanding	-Detachment and impartiality -Objective portrayal

(Gorman and Clayton, 2005)

Mobile digital library acceptance is a new topic about which little is known. Hypotheses and concepts adopted from related literature might not be comparable in a mobile digital library context. This thesis means to conduct the research in a new context (the GCC) where the original theories were not developed. Adopting such theories in this situation might not be applicable. Thus in order to discover services and factors that affect the adoption and acceptance of mobile digital library, generate hypotheses and to refine the developed theoretical framework based on the new context, an exploratory study was conducted. Focus group study and card sorting were the data collection methods selected to

fulfil the aim of the exploratory phase. The rationale of selecting these methods will be discussed in detail in data generation section.

Babbie (1990) illustrated that explanatory or testing phases are usually conducted to understand the population from a sample and predict how they will perform in the future. The analysis of that phase also aims to generalize a proposition about human behaviour. The generalization of those findings can be assured by replication of the findings among different samples and subgroups.
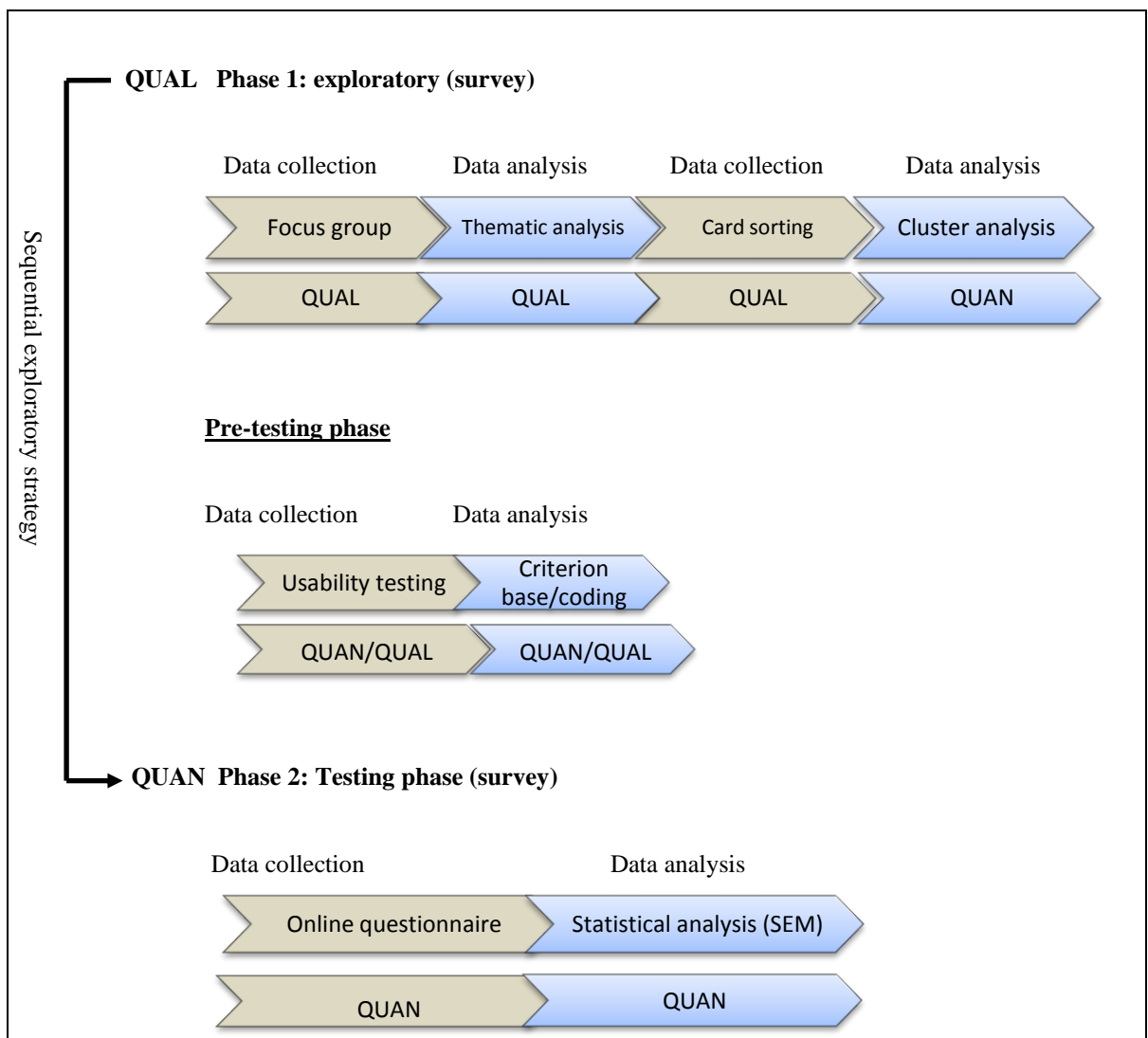
Figure 3.1: Data generation and analysis methods

Based on that, the framework and hypotheses generated in the exploratory phase were tested to validate the refined framework and predict factors affecting users' intention to use mobile digital library in the future. An online questionnaire was the most suitable method to accomplish the aim of the testing phase. The reason for selecting this method is also discussed in the data generation section.

3.4 Data generation methods (mixed methods)

Data generation method is the means by which an empirical data or evidence is produced (Oates, 2006). Data can be qualitative or numeric quantitative data. Using more than one data generation method enables us to look at the phenomenon of interest in different ways and then improve the quality of research (Oates, 2006). Data generated in this thesis is based on both qualitative and quantitative methods. In addition, data collection and analysis involved three phases: exploratory phase, pre-testing phase and testing phase (figure 3.1).

3.4.1 Phase 1: exploratory phase

The first phase, as discussed earlier, focuses on exploring and generating hypotheses. This thesis chose to start with a focus group study, for the sake of exploring factors affecting intention to use mobile digital library in the UAE; refining the proposed theoretical framework based on literature review and generate hypotheses; and finally to explore library services that meet users' needs.

Although designing a mobile digital library application is not the main focus of this study, it is believed that users cannot give their opinions from abstract. Related literature, as mentioned in chapter 2, either focused on the adoption before implementing without referring to a specific system, or studied the acceptance after implementing. To cover this knowledge gap, a prototype for mobile digital library service was developed based on the literature and was introduced to participants in the focus group as a stimulus material. This prototype was amended and tested based on users' preferences in a number of steps including focus group and card sorting. So the purpose of card sorting, the second part of the exploratory phase, was to understand the way participants prefer to organize services

on the mobile digital library system and amend the prototype developed so that it was suitable to use in the quantitative phase.

3.4.1.1 Group interviews (focus group)

Focus group interviews or discussions are a flexible, qualitative research technique that engages a small number of people into an informal discussion around a particular topic for the sake of collecting data about their feelings and opinion (Basch, 1987; Barbour and Kitizinger, 1999; Wilkinson, 2004).

Focus groups are the most appropriate method for exploring people's experiences, attitudes, opinions, wishes and concerns about a certain topic (Barbour and Kitizinger, 1999). The sense of belonging to a group and the less threatening environment can increase the participants' sense of cohesiveness (Peters, 1993) and help them feel safe to share their information, ideas, opinions and thoughts (Vaughn, Schumm and Sinagub, 1996).

Focus groups provide access to forms of data that are not obtained easily with individual interviews or participant observation (Morgen, 1997). Focus group is an economical, fast and efficient method to obtain data from multiple participants (Kruger and Casey, 2000). It has been found that conducting two focus groups provides almost the same ideas gained by conducting 10 individual interviews (Fern, 1982). This indicates that working with two focus groups would be more efficient than individual interviews. Working with focus groups would also provide instant evidence about similarities and differences in the participants' opinions and experiences unlike individual interviews. Focus groups are also suitable for observing participants' interaction on a topic (Morgan, 1997).

Although observation is more naturalistic, focus groups allow the researcher to observe a large amount of interaction on a topic in a limited time (Morgan, 1997). The data will be directly targeted to the researcher's interests. Furthermore, attitude formation and decision making are naturally unobservable and some kinds of behaviours are too private for meaningful observation (Morgan, 1997).

Stewart, Shamdasani and Rook (2007, p.42) summarized the advantages and disadvantages of focus group method (see table 3.3).

Table 3.3: Advantages and disadvantages of focus group method

Advantages	Limitations
Focus groups usually assembled quickly and allow researcher to gather data from group of people with less cost and time than individual interviews. Focus groups allow the researcher to ask for further clarifications and notice nonverbal responses such as gestures, smiles and frowns, which may carry information that supports or even contradicts the verbal responses. The researcher may get deeper level of meaning and make important connections through the open format of a focus group. Focus groups allow respondents to build on the responses of other group members to produce data or ideas that might not have been discovered by individual interviews. It helps researchers identify how and why individuals embrace or reject particular ideas, communications, or product. Focus groups are very flexible. They can discuss different topics with different people each time and in different locations. The results of a focus group are user-friendly and easy to understand.	The small number of participants limits generalization to a larger population. The results obtained in focus group may be biased by a very dominant or opinionated member. The open-ended nature of responses obtained in focus groups often makes summarization and interpretation of results difficult. The moderator may bias results by knowingly or unknowingly providing cues about what type of responses and answers are desirable or seeking to achieve group consensus on a particular topic.

(Stewart, Shamdasani and Rook, 2007, p. 42)

Stewart, Shamdasani and Rook (2007) and Krueger and Casey (2000) listed several situations where the use of focus group is favoured. The highlighted sections are the reasons for conducting focus group method in this thesis:

1. To gain general background information about a particular topic.
2. To generate research hypotheses that can be used for further research and tested using more quantitative approaches.
3. To discover factors that influence opinions, behaviour, or motivation.
4. To stimulate new ideas and creative concepts from the group.
5. To detect potential problems with a new program, service, or product.
6. To generate impressions about products, programs, services, institutions, or other objects of interest.
7. To learn how respondents talk about the phenomenon of interest, just before designing questionnaires, survey instruments, or other research tools that might be employed in more quantitative research.
8. Interpreting previously obtained quantitative results.
9. To understand differences in perspectives between groups or categories of people. Often, people in power see a situation or issue differently from those who are not. Professional people (medical, educational, scientific, technical, business, legal) often lose touch with the very people they are trying to serve. And top management often sees issues differently than frontline providers do. These differences can cause major problems, particularly when they are not recognized and understood.

10. To pilot test ideas, materials, plans, or policies.
11. To provide insight into complicated topics like conditional opinions or complex behaviour or motivation.

In regard to points two, three, six and nine, this research will apply focus group method to collect data. Focus group discussion will be assembled to explore new ideas and generate impressions about mobile library service and to realize which services are necessary to library users. Conducting focus group discussions will help in discovering factors that influence their behaviour and generate hypotheses for further testing. In addition, focus group will allow the researcher to understand different perspectives that postgraduate students, undergraduate students, or staff may have about mobile digital library.

3.4.1.2 Card sorting

In order to design a successful Information System, the language used in that program should be recognizable and easy to understand by expected users (Dickstein and Mills, 2000). Card sorting is a tool that helps understanding how people think about categories and concepts in order to design Information Systems from the users' perspective (Spencer, 2009). It moves away from librarians' and researchers' points of view into users' point of view (Hennig, 2001). In other words card sorting is a method that allows users to determine the information architecture of the system in a way that is logical to them (Guo and Yan, 2011).

The process starts with cards containing words or phrases for the user to arrange in predetermined categories, or leave the choice for the user to determine such categories (Turnbow et al., 2005). Card sorting in this research will help in organizing information on the mobile digital library prototype by finding similarities in how library users group information in a way that makes sense to them.

Zimmerman and Akerelrea (2002) focused on the strengths of card sorting and listed them as follows:

- Card sorting enhances the overall structure of a website, the navigation and searching and makes content understandable and easier to use.

- It focuses on the target population's views of the topic and how they organize information.

- Can be done relatively quickly.

- Can be done at nominal costs, depending on the location of the target populations, accessibility and availability.

- Can be flexible in either qualitative or quantitative methods used for data analyses.

- Can be used for other usability assessments beyond software and websites.

3.4.2 Pre-testing phase

Once the content of the mobile digital library prototype was organized based on users' preferences, the mobile library system was tested for usability and ease of use. Although this is not one of the main broad phases (exploratory and testing) that this thesis relied on, it was an important phase that preceded the testing phase. The final prototype (mobile digital library application) which was used as a probe in the quantitative testing phase emerged after the usability testing.

3.4.2.1 Usability testing

The usability of a computer system "is measured by how easily and how effectively it can be used by specific set of users, given particular kinds of support, to carry out a fixed set of tasks, in a defined set of environment" (Chapanis, 1991, pp.362-363). A number of researchers agreed that usability involves successful learning and using a system effectively and efficiently by specific users in certain context for the sake of accomplishing certain task (Clairmont, Dickstein and Mills 1999; Dumas and Redish, 1993; Guillemette, 1995). In that sense, usability in general involves users, a number of tasks, tools and the environment around users.

Usability tests provide the designer with information about how the user interface matches the natural human way of thinking (Kaikkonen et al., 2005). They show how easily users can navigate the system and whether they understand what they are seeing (Chisman, Dilller and Walbridge, 1999). By assigning a number of tasks to the user to do, the researcher will be able to observe the way users interact with the interface; and locate any

problems in the terminology, the colour, the location of navigation links on the system (McMullen, 2001). Without users' input, librarians may be tempted to design from their own perspective and with the jargon of the field (McMullen, 2001).

Evaluating usability involves a number of dimensions: learnability (Both, 1989; Brinck, Gergle and Wood, 2002; Nielson, 2000), efficiency (Both, 1989; Brinck, Gergle and Wood, 2002; Nielson, 2000), memorability (Brinck, Gergle and Wood, 2002; Nielson, 2000), errors (Brinck, Gergle and Wood, 2002; Nielson, 2000), satisfaction (Nielson, 2000), effectiveness (Both, 1989), attitude (Both, 1989), functional correctness (Brinck, Gergle and Wood, 2002) and subjectively pleasing (Brinck, Gergle and Wood, 2002).

However, The International Organization for Standardization (ISO 9241-11, 1998) defined usability as "the extent to which a product can be used by specific goals with effectiveness, efficiency and satisfaction in a specific context of use". ISO further defined the following dimensions of usability:

- Effectiveness: refers to the accuracy and completeness with which users achieve specific goals or complete certain tasks.
- Efficiency: refers to the resources expended in relation to the accuracy and completeness with which users achieve goals.
- Satisfaction: refers to the comfort of the work system to its users and other people affected by its use.

Evaluating the usability can be performed through the use of formal usability testing, focus groups, questionnaires, card sorting, think-aloud, cognitive walkthrough, heuristic evaluation, field study, paper prototyping and many other techniques (Blandford et al. 2004; Campbell, 2001; Kantner and Rosenbaum, 1997; Keith et al., 2003; Lingard, 1994; Popp, 2001; Rosson and Carroll, 2002; Snyder, 2003).

Lingaard (1994) mentioned that usability may involve gathering data during task performance or at other time; in the field or in the laboratory; and may collect data through observation, inspection, or retrospectively. Based on that he listed some of the usability methods in the following table:

Table 3.4: Usability methods

When	Where	How
During task performance	Laboratory	Experiments Quasi-experiments Confirmation studies Contextual inquiries Protocol analysis Question- asking protocols
Any other time	Laboratory	Heuristic evaluation Cognitive walkthroughs Source documentation Repertory grids
Any other time	Field	Knowledge elicitation methods Interviews Surveys Multi-dimensional Scaling/card Sorting Content analysis

(Lingaard, 1994)

3.4.2.2 Protocol analysis

Protocol analysis or thinking aloud is a method that is used to evaluate the functionality, usability, strengths and weaknesses of the site from user perspective (Ericsson, 2002). It requires users to think aloud and verbalize their thoughts, ideas, facts, plans, beliefs, expectations, or doubts while completing a specific task (Lingaard, 1994). Their immediate feedback will eliminate the need to rely on long-term memory to explain their behaviour, hence providing a more accurate explanation (Ericsson, 2002). In addition, it will help identifying any potential problems in the design or the organization of the website (Turnbow et al., 2005).

In this thesis, thinking aloud protocol will be used because it produces both qualitative and quantitative data (McMullen, 2001). The qualitative data will be obtained through observation and users' comments; while quantitative data will be gathered through criterion count of the steps that they have taken to reach the correct answer and through a short questionnaire that measure their overall impression about the application at the end.

3.4.3 Phase 2: testing phase (online questionnaire)

The final phase is conducted for the sake of validating framework refined in the exploratory phase and testing hypotheses generated. Using an experiential online

questionnaire will allow for collecting data from a large sample and propose final framework to understand intention to use mobile digital library within the UAE context.

Oates (2006, p.219) explained that a questionnaire is "a pre-defined set of questions, assembled in pre-determined order". These questions can be open or closed to leave respondents to decide what to answer in a blank space or choose from a range of answers. However, in this thesis, closed questions have been applied. It can be quickly analysed (Oates, 2006), and the researcher already decided on the possible answers, yet wants to find which answer is selected (Gillham, 2000).

The main difference between the paper-based questionnaire and the online (electronic-questionnaire) is the use of computers and internet (Rubin and Babbie, 2012). As the delivery and collection of online questionnaire can take the form of web-based questionnaire or e-mail questionnaire (Jansen, Corley and Jansen, 2007).

Increasingly online questionnaire became a popular method because of its speed and low cost of distribution among respondents (Rubin and Babbie, 2012). Sue and Ritter (2012) explained the advantages and disadvantages of conducting an online (e-mail) questionnaire as follows:

Table 3.5: Advantages and disadvantages of online questionnaire

Advantages	Disadvantages
Can be low cost Most software vendors provide free version of their services that limits the number of respondents. Low-cost monthly amount of money paid to increase the number of responses. Fast Can be distributed to hundreds or thousands of people and receive their responses quickly Efficient It allows the researcher to create the questionnaire, write invitations, upload a distribution list, send reminders and provide the researcher with online link to be uploaded where it is needed Sensitive questions effective The researcher is not present and the participants are freely and honestly answer questions because of the anonymity factor Direct data entry The survey software does not require technical	Coverage bias The online population does not reflect the general population. The researcher must have access to e-mail list for the studied population. Too many digital surveys, causing overload Potential respondents who receive a lot of online and e-mail surveys are ignoring invitations.

Advantages	Disadvantages
expertise with all instructions, tutorials and staff support provided by the vendor	
Wide geographical research	
Cover a wide geographic area to include a broad sample of respondents	

(Sue and Ritter, 2012)

Sue and Ritter (2012) and Evans and Mathur (2005) also suggested situations where online questionnaire is favoured as follows:

- When the sample size is large and widely distributed geographically.

- When the researcher can afford to keep an online questionnaire for an extended period of time to achieve a sufficiently high response rate.

- Respondents have access to the appropriate technology such as internet access.

- The researcher has access to the appropriate list of respondents' e-mails.

- The questionnaire contains sensitive information and requires more anonymity.

- When multimedia artefacts, such as photos and videos, are desired to be attached with the questionnaire

- When longitudinal comparisons are a goal.

Based on the advantages of online questionnaire proposed by Sue and Ritter (2012), this method will be used. In addition, the sample approached in this thesis (University students) already have access to internet, have e-mail addresses and it is large in size. Furthermore, the questionnaire contains multimedia artefacts such as videos and app link that cannot be delivered to students in any other suitable way.

3.5 Data analysis methods (mixed method)

Data that have been generated through the previously discussed methods need to be analysed. Just like data generation, data analysis relies on both the qualitative and quantitative method. For analysing the qualitative data and generating codes and themes, thematic analysis has been used. On the other hand, mathematical and statistical approaches have been used to analyse the quantitative data.

3.5.1 Focus group analysis (thematic analysis)

Most researchers use only the actual text (what each participant stated during the focus group) in their analysis (Onwuegebuzie et al., 2009). Transcript- based analysis represents the most rigorous and time-intensive mode of analysing data. This mode includes the transcription of videotapes/or audiotapes that usually ends up with more than 50 pages and then can be analysed (Krueger, 1994). Another mode for analysing data is tape-based analysis, wherein researcher listens to the tape and then creates an abridged transcript. That is usually shorter than the full transcript in transcript- based analysis (Onwuegebuzie et al., 2009). In this thesis, the actual text has been used to assure the rigorous analysis of the data.

For analysing focus group data Onwuegebuzie et al. (2009) suggested several qualitative techniques to include, classical content analysis, keywords-in-context, discourse analysis and constant comparison analysis. Classical content analysis involves grouping chunks of data and coding them to be counted. Keywords-in-context examines how words are used in context with other words. It represents an analysis of the culture of the use of the word (Fielding and Lee, 1998). Discourse analysis involves selecting unique segments or components of language use and then analysing them to examine how versions of elements such as the society, community, institutions, experiences and events emerge in discourse (Phillips and Jorgensen, 2002).

Constant comparison analysis involves creating themes. Three major stages characterize the constant comparison analysis (Strauss and Corbin, 1998). During the first stage (open coding), the data are chunked into smaller units. The researcher attaches a descriptor, or code to each unit. Then during the second stage (axial coding), these codes are grouped into categories. Finally, in the final stage (selective coding), the researcher develops one or more themes that express the content of each of the groups (Strauss and Corbin, 1998). Constant comparison analysis is particularly useful when a study includes multiple focus groups, enabling the use of the multiple groups to assess whether the themes that emerge from one group also emerged from other groups. This assists in identifying the data and/or theoretical saturation point (Onwuegebuzie et al., 2009). Constant comparison analysis or

thematic analysis is used in this thesis to analyse the qualitative data obtained from focus groups. Thematic analysis can be used with any form of qualitative data (Boyatzis, 1998)

Thematic analysis refers to "the process of analysing data according to commonalities, relationships and differences across data set" (Gibson and Brown, 2009, p.127). Boyatzis (1998, p.161) narrowed that definition to define a theme as: "a pattern found in the information that at the minimum describes and organizes the possible observations or at the maximum interprets aspects of the phenomenon". Vaughn, Schum and Sinagub (1996) listed five steps for focus group thematic analysis:

1. **Identifying big ideas:** After the involvement with focus group data and the careful rereading of that data usually the analyst will come up with big ideas or premature themes.

2. **Unitizing the data:** The smallest amount of information that can be interpretable by itself called unit. The size of that unit can vary from a phrase, sentence to a paragraph.

3. **Categorizing the unit:** Units that have been identified sorted into relevant categories or themes.

4. **Negotiating categories:** In case of availability of two analysts better to set down together and negotiate these categories

5. **Identifying themes and use of theory:** Refine themes or big ideas emerged in the first stage. Theory then can be used after the conducted analysis to assist interpreting the categories and findings. On the other hand, Yin (1996) mentioned that theory can be used upfront before the analysis to guide the way of selecting categories. So basically the process of thematic analysis or themes originates from two approaches: deductive and inductive (Bernard and Ryan, 2010).

Following Vaughn, Schum and Sinagub's (1996) analysis list, this research started with identifying big ideas, coding units of information, followed by categorizing these units into categories and subcategories and finally refined these categories. Theory or in this case framework has been used both upfront to determine the categories and after categorizing to assist interpreting the categories and generate themes.

3.5.2 Card sorting analysis (cluster analysis)

To analyse data obtained from card sorting and to understand how participants prefer to organize contents on the mobile library application, cluster analysis has been used. Lewis and Hepburn (2010) mentioned that there are three possible ways for analysing card sorting data: visual analysis, spread sheet template, or cluster analysis. Visual analysis was not suitable to analyse a large number of cards as it involves laying cards on a table or taping them on a board (Maurer and Warfel, 2004). The second possibility involves entering data into a ready developed spread sheet template, such as that developed by Lamantia, which fits up to 180 cards and 30 categories (Duncan and Holliday, 2008). This method relies on standardizing categories based on the researcher's interpretation; Maurer and Warfel (2004) were supportive of that method. The other possibility is cluster analysis, whereby data is converted into matrices and distances and run through a statistical program (Lewis and Hepburn, 2010). Cluster analysis offers a visual representation, of the highly correlated groups of categories to help in interpreting the logical user defined groups. This process also helps in structuring the content and navigation of the website in a way that is meaningful and supports user goals (Olmstead-Hawala, 2006). Cluster analysis is a quantitative method that can be calculated comprehensively to get distance matrix. The distance matrix is processed and draws a tree diagram that is easy to analyse and understand (Aldenderfer and Blashfield, 1984).

Spencer (2009) emphasised the importance of conducting both spread sheet analysis and cluster analysis, which she chose to name exploratory analysis and statistical analysis. She also prepared a ready spread sheet template for exploratory analysis. In this thesis both methods were used to analyse card sorting data. For the exploratory phase, the same sheet developed by Spencer (2009) was used, while for the second statistical phase, hierarchical cluster analysis has been used. Spencer (2009) mentioned that cluster analysis can be conducted by one of the following methods:

- **K-means cluster analysis:** depends on defining the group number by the researcher and based on statistics find the best group.
- **Multidimensional scaling:** provides a visual representation of closeness of data.

- **Hierarchical cluster analysis:** the statistics create a hierarchy the best fits the data relationships. One of the most commonly used manners to calculate the distance between cards is Euclidean distance.

With the initial distance calculation, the software combines the closest two cards into a cluster and recalculates the distance measure again (using the cluster as one object). It then creates a cluster from the next closest pair, recalculates the distance measure and so on until all cards have been included (Spencer, 2009). Spencer (2009) also mentioned that Euclidean distance can calculate the distance between clusters from different aspects. The researcher might select one of the following methods:

- Single linkage: the distance between two clusters is calculated as the distance of the two closest objects (about similarities).
- Complete linkage: the distance between two clusters is determined by the greatest distance between any two objects in the different clusters (about differences)
- Average linkage: the distance between clusters is determined by the average between objects in the clusters (balance between the two previous methods)

Since this thesis considers the similarities and the closeness of clusters to build categories, single linkage was considered.

3.5.3 Usability testing analysis (criterion base and coding)

To analyse the quantitative data of usability testing, criterion base and simple descriptive statistics were involved such as mean, median and SD. The number of participants involved in usability testing is usually small and does not allow for inferential statistics (Lazar, Feng and Hochheiser, 2010). The analysis relies on counting the correct and false number of clicks and on the time of completing certain tasks. It also considers the percentage of overall impression about the application. On the other hand, coding has been used to help analysing the qualitative data produced by the usability test.

3.5.4 Structural equation modelling (SEM) for online questionnaire

Structural equation modelling (SEM) has been used to analyse the quantitative data obtained from the online survey. Statistical techniques help identifying evidence of patterns and regularities in a particular phenomenon (Nachmias and Nachmias, 1996). Based on that evidence, generalized conclusions can be assumed (Oates, 2006). SEM is known by many names: covariance structure analysis, latent variable analysis, casual modelling, casual analysis, simultaneous equation modelling and sometimes by the name of software used to perform it, such as LISREL or AMOS (Hair Jr. et al., 2010; Tabachnick and Fidell, 2001). SEM is a collection of statistical techniques used by many scientific fields, mostly in behavioural and social science (Hox and Bechger, 2001; Kaplan, 2009) to test theories (Raykov and Marcoludies, 2006) and to examine and explain the relationships among variables (Hair Jr. et al., 2010; Ullman and Bentler, 2003).

Schreiber et al. (2006) pointed out that the focus of SEM is on estimating relationships among hypothesized latent constructs. SEM allows researchers to test theoretical propositions regarding how constructs are theoretically linked and the directionality of significant relationships. Schreiber et al. (2006) also identified two components associated with SEM: a measurement model (basically confirmatory factor analysis, CFA) and structural model.

Klem (2000) mentioned that SEM is a solution for factor analysis and path analysis limitations. Factor analysis deals with concepts but does not allow for casual relationships specifications among concepts. Path analysis allow for casual relationships deals with observed variables only. It can be viewed as a combination of factor analysis and regression or path analysis (Hox and Bechger, 2001). Ullman and Bentler (2003) were more specific and mentioned that SEM involves multiple regression and exploratory factor analysis (EFA). Schreiber et al. (2006) believed that SEM involves multiple regression and confirmatory factor analysis, since SEM is more of a confirmatory technique.

SEM has been used in this thesis for its numerous advantages. When relationships among factors are examined, the relationships are free of measurement error because the error has been estimated and removed, leaving only common variance. Reliability of measurement

can be accounted for explicitly within the analysis by estimating and removing the measurement error. Additionally complex relationships can be examined. When the phenomena of interest are complex and multidimensional, SEM is the only analysis that allows complete and simultaneous test of the relationships (Tabachnick and Fidell, 2001). Hair Jr. et al. (2010) identified the following three characteristics of SEM:

1. Estimation of multiple and interrelated dependence relationships

Unlike other multivariate techniques which use separate relationships for each set of dependent variables, SEM estimates a series of separate, but independent, multiple regression equations simultaneously by specifying the structural model used by the statistical program.

Multivariate techniques are either interdependent or dependent, while SEM is a combination of both. Dependent variables in one relationship can become independent variable in subsequent relationship because of the interdependent nature of SEM. Moreover, many of the same variables affect each of the dependent variables, but with differing effects. The SEM expresses these dependent relationships among independent and dependent variables, even when a dependent variable becomes an independent variable in other relationships. The proposed relationships are then translated into a series of structural equations similar to regression equations for each dependent variable. Other multivariate analysis allow only a single relationship between dependent and independent variables (Hair,Jr. et al., 2010).

2. An ability to represent unobserved concepts in these relationships and account for measurement error in the estimation process

Measuring the unobserved or latent constructs has two advantages. First we can represent theoretical concepts by using multiple measures of a concept to reduce the measurement error of that concept. Second, it improves the statistical estimation of the relationships between concepts by accounting for the measurement error in the concepts (Hair Jr. et al., 2010).

3. Defining a model to explain the entire set of relationships

A model is a representation of a theory. Theory can be thought of a systematic set of relationships providing a consistent and comprehensive explanation of phenomena. A conventional model in SEM terminology consists of really two models – the measurement model (representing how measured variables come together to represent constructs) and the structural model (showing how constructs are associated with each other). Two types of relationships are possible among constructs: dependence relationships and correlation (covariance) relationship (Hair Jr. et al., 2010).

3.6 Computer-assisted analysis tools

A number of computer-assisted analysis tools or softwares have been used in this thesis for the sake of facilitating the analysis of both qualitative and quantitative data. For qualitative data, computer-assisted tools have been used to manage data in terms of keeping records of ideas and analysis and improving the ease, accuracy and reliability of analysis (Gibbs, 2002). Qualitative computer-assisted analysis tools support a consistent and systematic strategy (Krueger, 1998). On the other hand, for quantitative data, computer-assisted tools have been used to run the calculation of statistical analysis.

3.6.1 Nvivo

For the purpose of managing focus group data, Nvivo 18 database management program has been used to manage and store the great amount of data. Nvivo provides a number of facilities to help in the analysis. It is a program that assists in organizing and identifying themes through a list of codes and categories created by the researcher for later retrieval. It circumvents the laborious process of repeatedly cutting and pasting (Vaughn, Schum and Sinagub, 1996), and renders it easier to update and modify a code (Kruger, 1998). In addition, it allows the researcher to identify the respondent from each code or create profile matrices (Bernard and Ryan, 2010). Furthermore, Nvivo helps the researcher to examine relationships in the text to assist in developing theoretical ideas and hypotheses (Gibbs, 2002).

3.6.2 UXSORT

UXSORT is a card sorting tool developed by a UX professional to help in planning card sorting sessions; managing participants and cards reaching up to 1000 cards; and analysing data and create a report. UXSORT has been designed to support hierarchical sorting and cluster analysis based Euclidian distance algorithms (UXSORT, 2009).

3.6.3 SPSS

Statistical Package for the Social Sciences (SPSS) is suitable for calculating and analysing quantitative data very quickly and in many different ways (Bryman and Cramer, 2005). It is capable of running complicated and extensive statistical techniques for both univariate and multivariate procedures (Landau and Everitt, 2004). In addition, the program will detect error in the form of the instructions given (Bryman and Cramer, 2005). In this thesis, SPSS version 20 has been used.

3.6.4 AMOS

Analysis of Moment Structures (AMOS) is among the first SEM programs to use a graphical interface for all functions so that a researcher never has to use syntax commands or computer code (Hair Jr. et al., 2010). The researcher draws the model in a user-friendly drawing interface and lets AMOS translate the drawing to a written data and conduct the necessary calculations (Blunch, 2008). AMOS version 20 has been used in this thesis.

3.7 Sampling

Gathering information from the entire population is usually impossible, expensive, or unfeasible (De Vaus, 2002), instead researchers use a sample of that population for the sake of making assumptions about the entire population (Nachmias and Nachmias, 1996).

Ideally sampling would be conducted randomly in a way that allows the researcher to declare the probability of how many chances has the unit or the participant to be included in the sample (Nachmias and Nachmias, 1996). Probability means that "each participant's inclusion can be computed and that the samples depend on random selection of participants

from a defined sampling frame" (Sue and Ritter, 2012, p.36), thus there is no bias in the sample, as everyone has an equal chance of being selected to participate. However, probability sampling can only be conducted if the population is well defined and listed (sampling frame) (De Vaus, 2002). In order to determine the sample, the researcher needs to start with a list with all sampling units or members of that population.

On the other hand, researchers may face certain situations that prevent them from conducting probability sampling. They may a face a situation where a list of population is not available. This could be due to not having a complete list of the target population, which Nachmias and Nachmias (1996, p.181) clarified that "rarely exists", or when conducting probability sampling researchers must spend a massive amount of money and time (Oates, 2006). It could also be due to a representative sample being unnecessary (Babbie, 1990). Researchers in these situations may opt for non-random or non-probability sampling (Sue and Ritter, 2012), which means that the probability cannot be defined (Nachmias and Nachmias, 1996). This sampling method is usually used in exploratory research (Nachmias and Nachmias, 1996).

The following table (table 3.6) lists the types of probability and non-probability samples with a highlighted technique used in this thesis (Babbie, 1990; Baker, 2002; Gomm, 2008; Nachmias and Nachmias, 1996; Oates, 2006; Sue and Ritter, 2012).

For focus group phase, Library staff and students in Zayed University in the UAE constituted the whole population; while for card sorting, usability testing and online questionnaires, students were considered only. Yet, forming a sample frame for students was not possible in this thesis: The number of students was not defined; and the researcher was not permitted to contact students directly but through the Ethical Committee of Zayed University.

Based on that, this thesis relied heavily on non-probability, convenience sampling technique to form the sample for card sorting, usability testing and the online questionnaires. An invitation through e-mail was sent to all students in Zayed University and whoever was interested in the study would send the researcher an e-mail, or answer the questionnaire. Focus group sampling however, was based on quota sampling. The focus

group phase involved sending e-mails and intercepting students in the library based on predetermined subcategories such as gender and level of education. The researcher has a prior knowledge of the subcategories of the whole population. The population consists of undergraduate students, postgraduate students, female and male students. Based on that the population was first divided into postgraduate students and undergraduate students considering their level and the population was also divided into female and male students.

Table 3.6: Probability and non-probability sampling techniques

Probability	Non-probability
Simple Random The sampling list assigned with random numbers and then sorted by that number. After that the researcher chooses for example the first 200 from the randomized list. *Systematic* The sampling list is determined by every n^{th} element of a population. The researcher selects a number and keep choosing participants based on that number. *Stratified* The sampling list is divided or stratified into two subgroups based on gender, age, or job category. Then either a simple random or systematic sample is selected for each subgroup. *Cluster* The sampling list is divided into clusters. Based on any previous mentioned procedure and then every individual in those clusters is invited to participate. (e.g. classes is school). This manner usually used when the population is large.	*Purposive/ judgmental samples* Sampling units are being selected based on the researcher subjective judgment of the sample representation of the population. So based on the researcher knowledge of the population, its elements and the nature of the research aim, the sample will be selected. Instead of choosing section of people to represent the wider population, the researcher would choose cases offering wide variety; possibly even extreme cases. It is appropriate in the initial design for questionnaires. *Snowball* Starts with selecting one participant who meet the criteria; asking him to refer someone else and so on until the sample snowballs in size. This method used with difficult to reached population. *Convenience* Obtaining sample units depends on their convenience availability. Researchers in this method either announce their particular topic and their need for respondents to collect data from anyone who responds; or intercept participants who happened to be there physically when a sample needed and ask them to participate. This way may or may not make that sample unrepresentative of the population. *Quota* The researcher selects respondents based on predetermined criteria such as age, sex and occupation (not the same criteria for all respondents like random sample). The researcher for example would have a list explains how many men and women should be interviewed and what their age groups are. However, this list depends on prior knowledge of the structure of the population and knowing the subcategories of the whole population. For example if the researcher knows that the population consists of equal number of men and women, then the researcher will collect data equally from both males and females.

(Babbie, 1990; Baker, 2002; Gomm, 2008; Nachmias and Nachmias, 1996; Oates, 2006; Sue and Ritter, 2012).

3.8 Quality of research

To judge the quality of research in general based on positivist point of view validity and reliability criteria must be met (Creswell, 2009). Validity involves checking whether the items in quantitative measure really measures hypothetical constructs or concepts (Creswell, 2009). Quantitative instruments in this thesis have been adopted from already tested and validated measures in the literature. As for qualitative measures, validity is concerned with exposing and reducing subjectivity, by linking data collection questions and measures to research questions and propositions (Yin, 2009). Following the recommendations of Yin (2009) and Rowley (2002) to increase validity, triangulation has been used and data have been collected from multiple sources. In addition a chain of evidence from research questions to conclusions have been maintained.

Reliability concerns whether the study can be replicated with similar results (Oates, 2006). For quantitative studies it means that the study maintains internal consistency (the items responses consistent across constructs) (Creswell, 2009). Reliability can be met by providing a number of items to measure one construct, rather than single item (De vaus, 2004) and by testing. Based on that this thesis used a number of items to measure constructs and the quantitative measures have been pilot tested.

In order to fulfil reliability in a qualitative study research, the procedure of conducting such study in this thesis have been documented in detail so that if another researcher repeated the same procedure would find the same results (Rowley, 2002; Yin, 2009).

3.9 Research process

This thesis combines both qualitative and quantitative strategy to explore and generate hypotheses, refine the theoretical framework and to test such hypotheses and validate the framework in a testing phase.

To fulfil the aim of the main broad strategies, a number of mixed qualitative and quantitative data collection and data analysis methods were used. It started with a preliminary prototype and focus group study that was analysed through thematic analysis by the use of NVIVO software to produce a refined framework as an outcome (1) and produce a list of library services as an outcome (2). Following that a card sorting method was conducted and analysed using cluster analysis method and UXSORT program to get an idea of how participants like to order the library services, obtained from focus group method, on a mobile application and then produce a refined prototype as a third outcome (3).

The pretesting phase involved testing the usability of second prototype or outcome (3). It was analysed using criterion base and coding with the help of SPSSS and NVIVO programs to help in modifying the prototype and producing easier prototype matching users' needs as an outcome (4).

Finally, in the testing phase, the refined framework (outcome 1) was tested by sending an online questionnaire accompanied with the modified prototype (outcome 4) to participants for the sake of validating the framework and testing the hypotheses. SEM was the analysis method used to analyse the quantitative data obtained from the online questionnaire and was processed by using AMOS software.

The following figure summarises the entire methodology process of data collection, data analysis, the software used to help in the analysis and the outcomes of collecting and analysis data of each phase.

Exploratory phase

Pre-Testing phase

Testing phase 2

Data collection method   Data analysis method   Analysis tools

Output   The output number
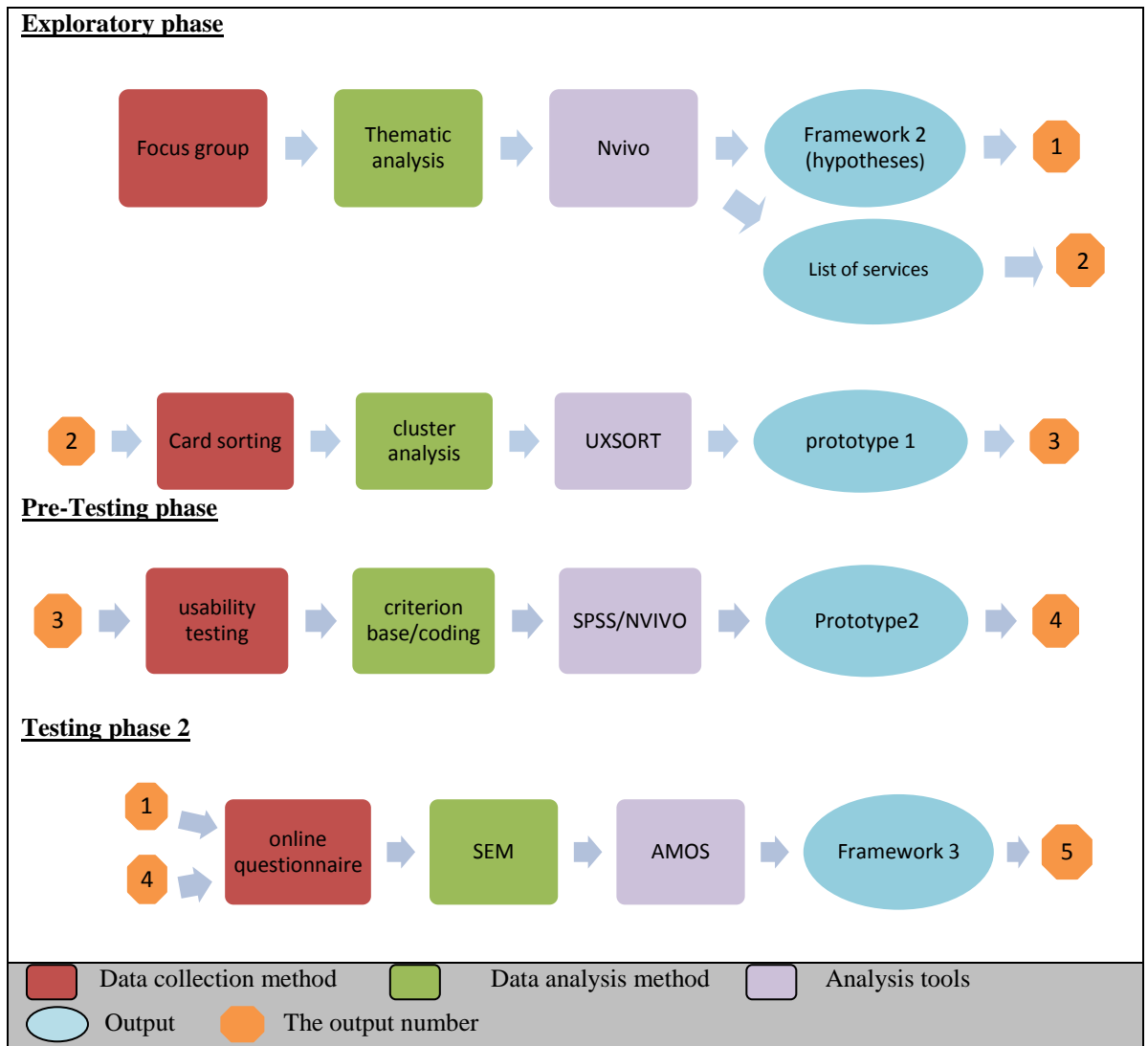
Figure 3.2: The methodology process

3.10 Summary

This chapter started by defining the philosophical point view that this thesis stands on, followed by the research design that included the sample and the broad strategy of this thesis. Detailed information then was given about the data collection and analysis methods and the rationale for choosing such methods. Following that, a brief description about computer tools that assisted in the analysis was presented. This chapter also provided

information about sampling methods used in this thesis and how it maintained reliable and valid results. Finally this chapter provided a summary of the entire research process.

The next chapter provides detailed information about the process of conducting and analysing both focus group and card sorting methodology that falls within the exploratory phase. It presents the results obtained from conducting such methods.

Chapter 4: Exploratory phase

4.1 Introduction

As discussed in the methodology chapter, this thesis applies qualitative methods to generate data in this exploratory phase. This chapter starts by illustrating the process of collecting and analysing data from focus group study to refine the proposed framework developed from the literature, to generate hypotheses, and to identify the mobile library services needed by participants. Focus group results are subsequently subjected to card sorting method, the second part of the exploratory phase. The process of collecting and analysing data from card sorting method was afterwards introduced for the sake of understanding the way participants group mobile library services to produce a user-centred prototype and arrange mobile library services based on participants' views. The sampling, instrument design, administration and data analyses procedures are explained in depth in this chapter.

4.2 Exploratory study 1: focus group

4.2.1 The sample

There is a lack of consensus in the literature over the appropriate number of people to use in a focus group. Barbour (2008) suggested that 3-8 participants is enough, since the researcher is required to recognize voices and seek further clarifications, while larger groups would demand further moderation and analysis. The same reasons were cited by Krueger and Casey (2000), but they believed that each group should comprise 6-8 people. Similarly, Stewart, Shamdasani and Rook (2007) proposed that the appropriate number is 6-12, assuming that at least two participants will not show up for the interview.

Morgan (1998) on the other hand, proposed a way for deciding the number of participants by calculating how much time the average participant gets to discuss a question. It depends on three things:

1. How many participants there are (typically 6 -10)

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2. How many questions there are (typically 8-12)

3. How long the group lasts (typically 1-2 hours).

Based on that, he proposed the following features:

Table 4.1: The number of focus group participants

No. of participants	No. of questions	Group length (mins)	Mins per person per question
6	8	120	2.5
8	10	90	1.1
10	12	60	0.5

Morgan (1998) explained that small groups that involve six or fewer participants allow them to narrate their personal stories, which is appropriate for discussing emotional, controversial or complex topics, whereas larger groups with 10 participants or more are used when participants have little to say or the goal is to hear several brief suggestions, as in brainstorming. Furthermore, too many participants can create an environment wherein participants do not feel comfortable sharing their thoughts, opinions, beliefs and experiences (Onwuegbuzie et al., 2009). Based on the previous discussion, keeping in mind that participants should have time to discuss, this research invited small groups to the study. Since the aim of conducting focus group in this research is to generate ideas about mobile library service and hear users' suggestions about the prototype, 4-6 participants was the target sample number for each group.

Likewise, there are no general rules concerning the best number of groups. Stewart, Shamdasani and Rook (2007) believed that researcher should conduct focus group until he/she reaches "theoretical saturation", or reaches a point where these groups become repetitive and nothing new emerges. The appropriate number of focus groups will depend on the research question, the range of people a researcher wishes to include and, time and resource limitations (Rosaline, Barbour and Kitizinger, 1999). So when the population of interest is relatively homogenous (have similar characteristics) and the research question is relatively simple, a single group or two may be sufficient (Stewart, Shamdasani and Rook, 2007). But when the population consists of different type of people, three to six different

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focus groups are adequate to reach data saturation (Krueger and Casey, 2009). Krueger and Casey (2009) also argued that mixing people with different expertise or power related to the issue should be avoided in order to provide a comfortable environment for participants. Conducting three to four groups facilitates the analysis process and helps the analyst finding themes across groups (Krueger and Casey, 2009). Although Zayed University applied a segregation rule between male and female students, this was not the main reason for dividing focus group participants based on gender. The composition of the groups in this thesis was organised following the advice of Kruger and Casey (2009) and Stewart, Shamdasani and Rook (2007). It aimed for forming focus groups for each type or category of individuals to cover female, male, undergraduate students, postgraduate students and librarians until theoretical saturation was reached.

Ten focus group discussions were held with a total of 49 participants. Nine of the focus groups involved student participants (n = 44) and the tenth group comprised of all librarians working in the library (n = 5). The student groups were divided by level of study (undergraduate, postgraduate) and gender. There were three focus groups with female undergraduates (n = 4 for each), three for male undergraduates (n = 4 for each), two female postgraduate (n = 9 and n = 5) and one for male postgraduates (n = 6). Table 4.2 shows the number of focus groups, participant categories and the number of participants.

Table 4.2: Focus group participants

Focus group number	Participants	Number of participants	Age range
1	Female postgraduates	9	23-29 (2) 30-36 (4) 37-43 (3)
2	Male postgraduates	6	23-29 (4) 30-36 (2)
3	Female postgraduates	5	23-29 (2) 30-36 (2) 37-43 (1)
4	Female undergraduates	4	18-22 (4)
5	Female undergraduates	4	18-22 (4)
6	Female undergraduates	4	18-22 (4)
7	Male undergraduates	4	18-22 (4)
8	Male undergraduates	4	18-22 (4)
9	Male undergraduates	4	18-22 (4)
10	Librarians	5	23-29 (1) 30-36 (1) 37-43 (1)

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			44-50 (1)
			> 50 (1)

4.2.2 Instrument design (focus group)

The process of designing the focus group instrument started with developing an interview outline that explains the purpose of conducting focus groups and lists a number of questions to be answered by participants. According to Peters (1993), an overview outline should be prepared so that all relevant points are covered. It should include the following items:

- Welcome and introductions
- Explanation of the purpose of the meeting
- A list of questions, starting with easy opening question (an 'icebreaker')

At the beginning of each focus group session and after welcoming the participants, the purpose of conducting focus groups was fully explained. The purpose of focus group in this research is to obtain input from library users and librarians about their preferences regarding mobile library services. Also to explore factors that would encourage the use of mobile digital library system.

4.2.3 Focus group questions

Focus group questions flowed from general to more specific - placing the general questions at the top and leaving the more specific ones at the end of the interview guide. Again, the most important questions should be at the top of the interview guide, while the less important questions should be placed near the end. However, it is important to recognize that it is part of the natural flow of focus group discussion to take its own course; the interview guide is just a *guide*, allowing for modification and digression if desirable (Stewart and Shamadasani, 1990).

Usually interview guides consists of fewer than twelve questions leaving time for adequate responses and to add new questions to the actual interview guide if needed (Stewart and Shamadasani, 1990). Focus group questions are organized into five categories, each with a

unique purpose in the flow of a focus group interview: opening, introductory, transition, key and ending (Krueger and Casey, 2009). Focus group questions in this research were inspired from Henderson (1994) who wrote about asking effective focus group questions and they consist of 12 main questions, including the opening question (see Appendix D-1).

The purpose of the opening question is to make people feel comfortable to start talking. The longer before someone says something in a group, the less likely he or she is to say something. So the opening question will encourage the participants to answer a factual question quickly within 30 seconds (Krueger and Casey, 2009).

After the opening question, the moderator (researcher) introduces the topic of discussion and gets people to start thinking about their connection with the topic. Introductory questions allow participants to describe how they see or understand the issue, service or product under investigation. Introductory questions can ask participants to remember an experience, or how they use a product or service, or even by asking "what is the first thing that comes to mind when they hear the phrase…?" This type of questions leads the moderator towards collecting clues of participants' views (Krueger and Casey, 2009).

To link the introductory questions and the key questions, and to move the conversation closer to the key questions, transition questions are used. Transition questions often ask more in-depth questions about participants' experiences and use of a product than introductory questions. During transition questions participants become aware of each other's views (Krueger and Casey, 2009).

The key questions are usually the first questions to be developed and the ones that require emphasis in the analysis, as this type of questions drive the study. Sufficient time also should be given to discuss this type of questions – around 10 to 20 minutes (Krueger and Casey, 2009).

Finally, to bring closure to the discussion and enable participants to reflect back on previous comments, two types of ending questions can be asked. The first type "all things considered" is used to determine the final position of participants. They will have the chance to reflect on comments shared in the discussion and then identify which aspects are

most important or most in need of action. The second type "the summary and final question" asks participants to respond and confirm the adequacy of a short oral summary given by the moderator about the discussion (Krueger and Casey, 2009).

4.2.4 Validity and pilot testing

Validity is the degree to which the procedure really measures what it supposed to measure (Krueger, 1988). So focus groups are valid if they are used carefully for a problem suitable for focus group inquiry. Typically focus groups have high validity because of the believability of comments from participants. People open up in focus groups and share insights that might not be available from individual interviews and questionnaires (Krueger, 1988).

Still focus group questions were pilot tested to ensure they were understood and ensure their validity. Stewart and Shamadasani (1990) proposed that it is impossible to predict in advance the way respondents will interpret and respond to questions without at least some degree of pretesting and trying out the questions on few individuals who fit the focus group screen. Krueger and Casey (2009) suggested at this point individually interviewing them and considering: the ease of asking the question without reading it; the smoothness of words flow; and the clarity of the question to the participants.

The other way that was used to pre-test focus groups questions was to conduct the actual first group. Krueger (1988); Krueger and Casey (2009) mentioned that conducting focus group requires too much intensive time and work to be considered only a pilot study. The results of the discussion should be included in the analysis if there are no major changes to the questions. On the other hand, if major changes are made in the questions or moderator procedure, then the results of the discussion are set aside and not used in later analysis. In this research, no major changes were made to the questions after conducting the pilot study. Based on that, the findings were included in the analysis.

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4.2.5 Focus group administration

4.2.5.1 The degree of structure

Focus group discussion basically depends on interviews that can be more structured (nominal, or extremely directive) or less structured (non-directive) (Morgan, 1998; Stewart, Shamadasani and Rook, 2007). The more structured approach depends on a predetermined set of questions and a controlled discussion carried between the moderator and each individual exclusively. The moderator needs to be relatively directive to keep the group on the topic and asks more questions than the less structured approach (Morgan, 1998).

The advantage of the more structured approach is the ability to obtain maximum focused information while the disadvantage is the failure to cover issues that are not included in the narrow predetermined set of questions. This style allows for detailed coverage of a topic but at the expense of group spontaneity (Stewart, Shamadasani and Rook, 2007). Deciding to use more a structured approach means that the researcher has clear cut goals and already knows what the right questions are. The more structured questions could be useful for sensitive topics that cause uncertainty or embarrassment to participants (Morgan, 1998).

On the other hand, the less structured approach depends on three to five broad questions, or starts by not even knowing what the right questions are, and letting the participants determine the content of the discussion (Morgan, 1998). This approach excludes moderator participation and depends totally on the participants. The moderator in this approach does more to facilitate rather than direct the discussion (Stewart, Shamadasani and Rook, 2007). The advantage of the less structured approach is stimulating new ideas and insights. However, the discussion in this approach is inconsistent and might take an unproductive direction. The moderator might find himself/herself in a predicament wondering whether to engage or not in the expense of losing data. Furthermore, less structured groups are difficult to analyse due to broad questions and depending on participants' own flow of discussion, rendering systematic comparisons across groups difficult if not impossible (Morgan, 1998). However, less structured groups are more useful for exploratory purposes,

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and are the best choice when the researcher is uncertain about what he/she needs to know (Morgan, 1998).

In order to overcome the limitation on both approaches, most focus group discussions involve interviewing style between the two (Stewart, Shamadasani and Rook, 2007). A moderately structured approach was adopted as the most appropriate to uncover both the research questions and the participants' interests (Morgan, 1998). The moderator's role was thus to facilitate the discussion and present the focus group with a series of questions. The first stage of all groups started with a general discussion about the concept of the mobile digital library. After that, participants were asked to list a number of services on a sheet of paper to give them time to think. Then they were asked to read aloud their services and pick the most important thing out of the list for the sake of locating the most needed services (Krueger and Casey, 2009). Although, Davis and Venkatesh (2004) declared that user acceptance can be predicted in the early pre-implementation phase – before building a working prototype or even writing a single code, little awareness of mobile digital library concept was expected at the early stage of focus group discussion. For that reason, this research chose to introduce a mobile digital library prototype as a stimulus material to get users involved in generating ideas and thinking about their needs that can be met by using this program (figure 4.1). Participants were asked to point out the positive and negative features of the application; to find key points that might help in marketing the application; suggest methods to enhance the application; and finally to state what do they need to know about the application in order to accept it or reject it.
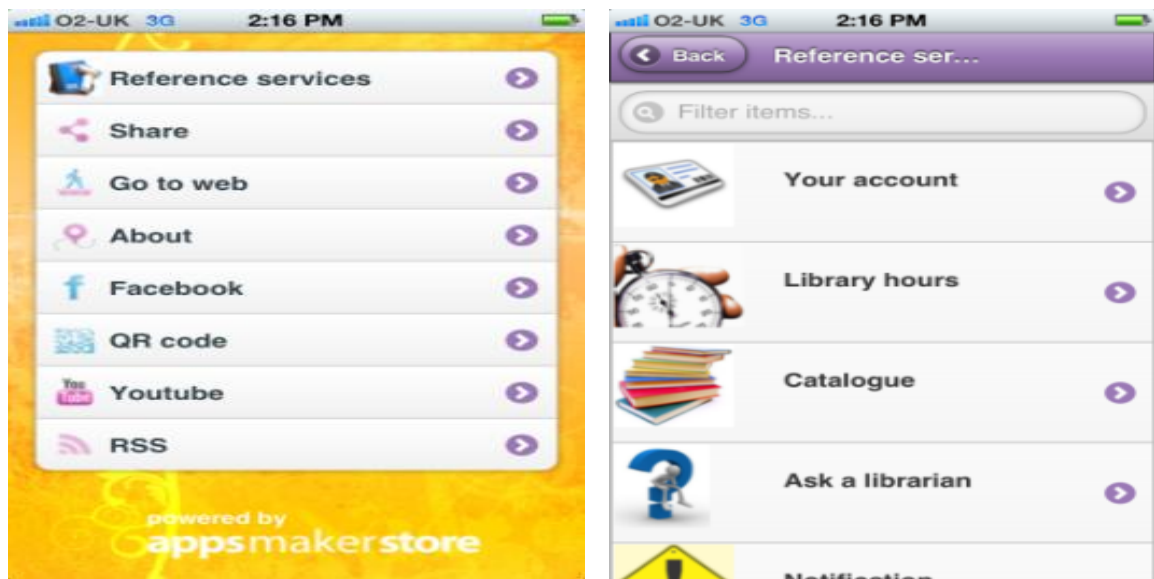
Figure 4.1: Mobile digital library first prototype

- The design of initial mobile digital library prototype

The prototype involved a number of services, including library hours, ask a librarian, the library catalogue, users account, booking study room, notification of overdue materials, YouTube, Facebook and RSS feeds for library news. The selection of these services was decided based on browsing available library services and selecting shared ones. Research about mobile digital libraries and libraries that has already implemented mobile services has also been reviewed (Vila, Galvez and Campos, 2010; Wilson and McCarthy, 2010). Their findings and recommendations have influenced the process of selecting digital library services. And finally based on the proposed framework and factors that believed to have an impact over users' acceptance of mobile digital libraries, services has been selected (for more details see Appendix C).

A number of softwares that do not require coding or programming experience were also investigated, such as: Seattleclouds (Seattleclouds, 2014), iBuildapp (iBuildapp, 2014) and appsmakerstore (appsmakerstore, 2014). Seattleclouds software has been chosen to build the application in this research for the following reasons:

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- It can be uploaded for different application platforms (i.e iPhone, iPad, Android, Kindle, Blackberry and mobile browsers).

- Easy to use, does not require coding skills.

- Push updates and changes in content.

- Has a dashboard that simulates a mobile screen.

- Has the feature of push notifications and pop-up messages from a website to users' devices.

- Converts RSS feeds into easy to use mobile page and many other features that made developing the application an easier process.

4.2.5.2 Setting

Consideration must be given to where the group sessions are actually going to take place. Vaughn, Schumm and Sinagub (1996) proposed three factors to consider when selecting the setting. The first factor is the size of the room. Rooms that are too big appear useless and stop the group benefiting from a comfortable environment, while rooms that are too small make people feel cramped and eager to leave. The second factor is the condition of the room. The room should be nonthreatening, comfortable (Peters, 1993), quiet, free of interruptions (Rosaline, Barbour and Kitzinnger, 1999) and inviting (Vaughn, Schumm and Sinagub, 1996). The third factor to consider is the extent to which equipment is available or can be used in the room. The fourth factor to consider is the location. The place should be easily accessible to participants, near where they live or work and also safe (Vaughn, Schumm and Sinagub, 1996). Focus groups in this research were held on-site, on Zayed University Library located in Dubai, for convenience and lower cost.

4.2.5.3 Time

Conducting several focus group discussions increases the possibility of individuals' participation by letting them choose from alternative times, dates and often locations according to their free time (Rosaline, Barbour and Kitzinnger, 1999). Well-designed focus groups usually last between 1 and 2 hours (Morgan, 1997; Vaughn, Schumm and Sinagub, 1996) allowing the participants to eat and socialize in addition to the discussion (Peters,

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1993). The best time to conduct these focus groups according to Margan (1998) is late afternoon and early evening, roughly starting from 5:00 to 7:00 pm, or 7:00 to 9:00 pm. Interestingly, those times were not convenient for all students. Most female students were met between 11:00 am and 2:00 pm, while male students were met after 5:00 pm according to university regulations (male students are usually not allowed to use the library at the same time as females).

4.2.5.4 Group moderator (researcher)

The role of the group moderator is extremely important. Clarifying the purpose of the meeting, covering the predetermined topics and questions and facilitating the group interaction is part of that role. The facilitation can take the form of encouraging participants to contribute openly and honestly, supporting comments, asking questions in an unbiased way and creating nonthreatening, positive and supportive environment (Peters, 1993). In order to achieve that role, the moderator needs to be familiar with the topic and group process and know how to work with different age groups (Peters, 1993). A group moderator also needs to know when to keep quiet and when to intervene to clarify ambiguous statements, enable incomplete sentences to be finished and encourage everyone to participate (Rosaline, Barbour and Kitzinnger, 1999).

In addition, the moderator needs to be knowledgeable or able to interpret the language, terminology, gestures and cultural meanings of the particular group with whom one is working. This is true for both for group facilitation and subsequent data interpretation. Without such ability the researcher will misinterpret the discussion data and lose credibility with research participants (Rosaline, Barbour and Kitzinnger, 1999).

4.2.5.5 Recording

For the sake of gathering the most information from participants, focus group discussions must be documented either by taking notes or by using a tape recorder (Peters, 1993). Taking notes and using flip charts to summarize the discussion, forms the basic level of focus group recording (Rosaline, Barbour and Kitzinger, 1999). However, waiting for the moderator to take notes disturbs the discussion comfort, free flowing and relaxation

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(Krueger, 1988). To maintain deeper access to the discussion, tape recorders must be used (Rosaline, Barbour and Kitzinger, 1999). Tape recorders are important valuable tools that must be available in focus group discussions (Krueger, 1988). At the beginning of each session participants were told that the session is being recorded and were asked to sign consent forms. They were also told about their right to withdraw from the study if they do not wish to consent to audio recording.

4.2.6 Focus group analysis (thematic analysis)

As mentioned in the methodology chapter, thematic analysis will be used to analyse data produced by focus groups. In addition, the analysis will be following Vaughn, Schum and Sinagub (1996) analysis list. It starts with identifying big ideas, coding units of information, followed by categorizing these units into categories and subcategories and finally refining these categories.

4.2.6.1 Inductive vs. deductive approach

To code means usually the use of words or short phrases to create a category that is used to describe a general feature (Gibson and Brown, 2009; Saldana, 2009). Coding in qualitative research can be conducted inductively or deductively. However, According to Bernard and Ryan (2010) research is never purely inductive or purely deductive but mostly inductive in exploratory phase and mostly deductive in the confirmatory stage. The following table shows the difference between the two approaches (Creswell, 2009; Bernard and Ryan, 2010):

Table 4.3: Inductive vs. deductive approach

Comparison	Inductive	Deductive
Definition	(Data driven) involves the search for patterns from observation and the development of explanations for those patterns through a series of hypothesis to generalized model or theory	(Theory driven) starts with theories which are derived from literature), derives hypothesis from them and moves to observation which either confirm or disconfirm the hypothesis.
Rationale	Gather information (e.g. interview, focus group) Asks open ended questions Analyse data to form themes or categories Look for broad patterns, generalizations, or theories from themes or categories Poses generalizations or theories from past experiences and literature	Test or verify a theory Test or verify hypothesis Gather information Define variables from theory Analyse data to Confirm or falsify a theory

This research mixed both approaches, beginning with a deductive phase to identify themes matching those identified in the literature and following with a stage of inductive coding to look for new emergent themes. The following table shows a priori constructs, derived from a review of the literature, which were used for the deductive coding exercise.

Table 4.4: A priori constructs used for deductive phase of coding

Construct	Description	Previous work
Perceived usefulness	The degree to which a person believes that using a system will enhance his/her job performance (Davis, 1989).	Found to affect *Behavioural intention* in multiple information systems application areas, including mobile digital libraries (Goh and Liew, 2009).
Perceived ease of use	The extent to which a person believes that using a system will be free of effort (Davis, 1989).	Found to affect intention use directly and indirectly through *Perceived usefulness* in multiple studies, including the mobile digital library domain (Goh and Liew, 2009).
System accessibility	Degree of convenience that allows an individual to locate specific computer systems and access data and information (Thong, Hong and Tam, 2002).	Has been found to affect *Behavioural intention* through *Perceived usefulness* and *Perceived ease of use* in the context of digital library adoption (Park et al., 2009; Thong, Hong and Tam, 2002).
Library Assistance	The extent to which librarians were helpful when assistance was needed (Park et al., 2009).	Found to be an important factor affecting *Perceived ease of use* and *Perceived usefulness* of e-library use (Park et al., 2009).
Relevance	In the context of digital libraries, relevance has been defined as the extent to which the library provides resources that match student needs (Thong, Hong and Tam, 2002).	Found to affect *Perceived usefulness* and *Perceived ease of use* of library services or mobile services (Kargin, Basolgu and Daim, 2009; Phan et al., 2010; Thong, Hong and Tam, 2002).
Interface characteristics	It is the medium between the system and the user and the platform for user action. It consists of	Found to affect *Perceived ease of use* of a digital library system (Jeong, 2011; Ramayah, 2006; Thong, Hong and Tam, 2002).

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Construct	Description	Previous work
	Terminology, *Screen design* and *Navigation* (Thong, Hong and Tam, 2002).	
Social influence	The person's perception that most people who are important to him think he should or should not perform the behaviour in question (Fishbein and Ajzen 1975, p.302).	A direct relationship with *Behavioural intention* has been found in the context of internet use, mobile commerce and e-services (Bhatti, 2007; Fusilier and Durlabhji, 2005; Liao, Chen and Yen, 2007). An indirect relationship with intention through *Perceived usefulness* in the context mobile commerce, e-services and e-learning (Bhatti, 2007; Lee, 2006; Liao, Chen and Yen, 2007) and *Perceived ease of use* in the context of e-library, mobile learning and mobile services (Kim 2010b; Lu et al., 2008; Park, Nam and Cha, 2012).
Trust	User's belief or faith in the degree to which a particular mobile application has no security or privacy threats (Gao, Krogsite and Gransaether, 2008).	Significant effect on *Behavioural intention* was found in the context of mobile services (Lu et al., 2008) and through *Perceived ease of use* in the context of mobile learning and digital libraries (Kim, 2010; Park, Nam and Cha, 2012) and *Perceived usefulness* in the context of e-services and mobile services (Liao, Chen and Yen, 2007; Lu et al., 2008).
Domain knowledge	An individual's knowledge of the field (Thong, Hong and Tam, 2002).	Found to affect *Perceived ease of use* (Park et al., 2009) and *Perceived usefulness* (Miller and Khera, 2010; Vaidyanthan, Sabbaghi and Bargellini, 2005) of a digital library system
Computing experience	An individual's general computer experience (Thong, Hong and Tam, 2002).	Found to affect *Perceived ease of use* in the context of digital libraries (Park et al., 2009; Thong, Hong and Tam, 2002)
Self-efficacy	An individual judgment of one's capability to use a computer (Compeau and Higgins, 1995, p.192).	Found to affect *Behavioural intention* directly in the context of mobile services (Wang, Lin and Luarn, 2006). Also found to affect the indention indirectly through *Perceived ease of use* and *Perceived usefulness* in the context of mobile digital library (Goh, 2011; Goh and Liew, 2009).
English language skill	Having language skills in order to understand the system (Park et al., 2009).	Found to be a barrier to using a digital library system (Byrne, 2003) or the internet in general (Du, 1999). Park et al. (2009) found a significant effect on *Perceived usefulness* and *Perceived ease of use* on e-library use.

In addition to the deductive coding, an inductive approach was taken, attempting to identify supplementary themes in the data which were not already represented by the a priori codes generated from the literature.

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Finally the data was examined for evidence of relationships between identified themes/constructs, both to look for confirmation of relationships identified in the previous research and to generate new relationships specific to this research context.

4.2.6.2 Patterns

Boyatzis (1998) claimed that seeing a pattern is the beginning of thematic analysis process. Saldana (2009) also said that patterns start with coding or organizing coded data into categories. Grouping these codes can be because they are exactly alike or very much alike, or because they might also have something in common even if that commonality consists of differences. Saldana (2009) illustrated further that patterns can be categorized by: similarities, differences, frequency, sequence, correspondence and causation. Bernard and Ryan (2010) added further techniques to identify themes or patterns:

- Repetition
- Indigenous typology or categories
- Metaphors and analogies
- Transition
- Similarities and differences
- Linguistic connectors
- Missing data
- Theory related material

Patterns in this research have been found using similarities differences technique. In order to manage focus group data, Nvivo have been used. As mentioned in chapter 3, Nvivo can assist in the process of organizing and identifying themes. In addition it allows the researcher to identify the respondent from each code or create profile matrices (Bernard and Ryan, 2010). For detailed respondents profile matrices see appendix D-2.

4.2.7 Focus group findings

Analysis of the focus group discussion revealed a number of themes. These generally supported the factors identified from previous literature, although with some modifications. Several new themes were also identified through inductive coding. The sections below describe and discuss the results in more detail.

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4.2.7.1 Theme 1: Perceived Usefulness/Enhance their Work

Perceived usefulness was intensively discussed in all focus groups and linked with many other factors, supporting the applicability of previous findings (Chang, Chao and Tung, 2008; Goh and Liew, 2009; Thong, Hong and Tam, 2002; Venkatesh and Davis, 2000) to the mobile digital library context. Usefulness was clearly related to *Behavioural intention* as students agreed that they would definitely use the app because it facilitates their work and solves so many issues. They perceive smartphone use and the app use as a convenient, useful process that saves their time and this affects their acceptance of such an app. It is the program that will satisfy their needs and facilitates their communication with the library. Librarians were satisfied with using "useful" as a key word for marketing the app. Typical comments include:

> "Yes. It will be very useful for students" (P16: F/PG)
>
> "It will help me not to come and go to check the library. It saves my time" (P13: M/PG)
>
> "It will be helpful for research" (P26: F/UG)

This indicates a relation between *Perceived usefulness* and *Behavioural intention*. Hence, this research hypothesizes the following:

Hypothesis 1: Perceived usefulness has a significant impact on behavioural intention to use mobile digital library

4.2.7.2 Theme 2: Perceived Ease of Use/Free of Effort

Perceived ease of use was discussed deeply in all focus groups and linked with a number of other factors. Librarians believed the app is simple and easy requiring only one click for installation. Generally, students' main concern was that the app should be user-friendly and easy to use otherwise they will not bother to use it or download it. This suggests a clear relationship with *Behavioural intention*. There was also recognition from participants that by making it easy to use, the application would better serve users, giving them better access to the information they need. This suggests a relationship with *Perceived usefulness*. Relevant comments include:

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> "My main emphasis is to have user-friendly otherwise I wouldn't use it a lot you know" (P9: F/PG)

> "I think I will advise everyone to use it because it is very easy and friendly. It will serve them" (P38: M/UG)

Accordingly, this research hypothesizes the following:

Hypothesis 2: Perceived ease of use has a significant impact on behavioural intention to use mobile digital library

Hypothesis 3: Perceived ease of use has a significant impact on Perceived usefulness of mobile digital library

4.2.7.3 Theme 3: Quality of Working Life

A closely related construct also emerged inductively, whereby participants discussed how the app would make users' lives easier. A sample of comments includes:

> "Make student's life much easier. It is easy to book a room and many other services" (P16: F/PG)

> "Yes easier. Really the university students are in need for this program" (P19: F/PG)

> "Make your life easy" (P22: F/UG)

While *Perceived ease of use* would appear to be a prerequisite to this construct, it does appear to be qualitatively different, with a broader focus on making life easier. Interestingly, recent work by Tarhini, Hone and Liu (2013) has found *Quality of Working Life* to be a significant predictor of *Behavioural intention* towards an e-learning system within an Arabic context. The inductive identification of a similar construct in our work, suggests this might also be worth investigating further in relation to mobile digital libraries. However, to have used this construct within the current research would have required designing a scale from the scratch; hence it is not included in the framework. Scale development is a creative time consuming process that could not be achieved within the time constraints of this research. It starts with brainstorming sessions, focus groups or in depth interviews with experienced users to generate item pool or a set of dozen or more attitude statements (Oppenheim, 2001). Those statements then categorized based on their similarities and checked for their clarity and free ambiguity (Chuttur, 2009). For scaling

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purposes, reducing the number of statements and to check the reliability and validity of the generated items, a pilot work with 100-150 respondents is usually conducted and analysed using principle component analysis and factor analysis (Oppenheim, 2001). If the number of remained items is still large, then another refinement process and laboratory studies is needed to make the scale more practical for real world situation (Chuttur, 2009; Davis, 1989).

4.2.7.4 Theme 4: Mobility

In the initial deductive coding of the data, a number of comments were found which could be coded under the *System accessibility* construct (see table 4.4). However, it was felt that this construct did not adequately capture the full meaning of the themes that emerged from the discussion. After iterative inductive coding the alternative construct of mobility is proposed to better represent the fact that participants' conception of *System accessibility* has shifted with the widespread adoption of mobile technology; the focus becomes less on the ability to locate computers and more on the ability to connect anywhere, anytime.

Mobility was a highly important issue raised by all focus groups. Focus group users are looking for a 'movable library'. Students carry around their smartphones and tablets to get instant access in car, class, home, or anywhere while they are on the move. Many students mentioned that mobile library will reduce their attendance in the library or at least manage their attendance. They believe that there are certain services that can be addressed remotely without having the need to be in the library. One participant (P30: F/UG) mentioned: "we all have phones, but we still come to the library. If this application is available we do not have to come for every service". According to librarians, students might also need to request books from anywhere outside the library if they are not be able to come to the library. In that sense, *Mobility* has an impact on students' intention of use.

Comments from students also suggest that *Mobility* is in itself a key influence on *Perceived usefulness*. The mobility of the service provides much of its utility from a student perspective as they described needing to renew a book or, book a study room remotely. Furthermore students described how the mobility that smartphones provide makes it easy

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for them to use library services. They described this process as a successful and easy access. This suggests that mobility have an impact on *Perceived ease of use* and/or quality of working life. This is captured by the following quote: "The smartphone is everywhere which makes it easier to use the library" (P17: F/PG).

While the *Mobility* construct was coded inductively in this research, it does also appear in earlier literature. *Mobility* according to Kargin, Basoglu and Daim (2009) means having the ability to access resources from anywhere, anytime. Research shows that the more mobile the user, the more valuable mobile computing to the user (Pagani, 2004). Prior studies found out that *Mobility* can be a barrier and influence the intention of mobile services use directly (Schierz, Schilke and Wirtz, 2010) or through *Perceived usefulness* (Kargin, Basoglu and Daim, 2009; Schierz, Schilke and Wirtz, 2010) and *Perceived ease of use* (Kim, Mirusmonov and Lee, 2010).

From previous discussion, this research hypothesizes:

Hypothesis 4: Mobility has a significant impact on behavioural intention to use mobile digital library application

Hypothesis 5: Mobility has a significant impact on Perceived usefulness of mobile digital library application

Hypothesis 6: Mobility has a significant impact on Perceived ease of use of mobile digital library application

4.2.7.5 Theme 5: System Coverage

From inductive coding we identified a category of *Facilitating conditions* specific to the use of mobile technology, which was the availability of mobile or internet coverage. Participants mentioned that the unavailability of wireless connections might prevent them from using the mobile program outside the university; as P18 said:

> "And if there is no connection also we will not be able to use it. For example, if we are in car or a mall and we do not have internet coverage" (F/PG)

One female postgraduate group suggested a mobile program that works offline to avoid internet coverage issues. Thus:

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"If they can create an app that does not require a wireless connection" (P19: F/PG)

"Even from anywhere even if no net is available" (P20: F/PG)

The discussion thus suggests that system coverage would affect usage, though this could be somewhat offset by appropriate system design. *System coverage* also seems closely related to mobility. However, this construct will not be part of the framework since it requires designing a new scale for it.

4.2.7.6 Theme 6: Library Assistance

Park et al. (2009) previously identified *Library assistance* as a factor affecting both *Perceived ease of use* and *Perceived usefulness* of a digital library. While their justification for including this was previous research on the value of technical support, their operationalization of the construct focused primarily on the role of support from librarians. The findings of our focus group discussions supported a broad conception of *Library assistance*, encompassing support from both librarians and teachers as well as technical support. Although library technical support was not mentioned intensively in all focus group discussions, it was raised in more than one group. A female postgraduate respondent expected assistance in using library services especially for finding a book. A female undergraduate student also expected assistance but in using the app. Similarly, a male undergraduate respondent expected assistance for using the app but from the teacher who would ask them to use the app:

"It is a mobile phone you should be able to talk with your library" (P4: F/PG)

"Like ask a librarian or contact information" (P5: F/PG)

"Maybe asking if the book is available" (P4: F/PG)

It was not obvious from focus group discussions whether there is a relationship between *Library assistance* and *Perceived usefulness*. However, there is a hint of relationship with *Perceived ease of use*.

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> "Libraries used to inform users about the new arrivals, the new books, new materials. But I don't know if it is possible to add that to our library…" (P3: F/PG)

> "What happened here is that students would primary come with their blackberries" (P46: librarian)

> "It is the new century. They would show us a picture. It is keen for them" (P49: librarian)

> "They are taking a picture of the book or the title of the book and bring it to us" (P47: librarian)

Hypothesis 7: Library assistance has a significant impact on Perceived ease of use of mobile digital library

4.2.7.7 Theme 7: Interface design

The three united interface characteristics (*Terminology*, *Navigation*, *Screen design*) (Thong, Hong and Tam, 2002) within the specific context of use on a small screen (coded inductively) emerged from discussion as such tightly interwoven concepts that we have coded them under one broad theme of *Interface design*. Participants discussed customisation and the use of images and short cuts as important design feature, for example:

> "One more thing. I think we can re-arrange the order of the services by getting into our accounts. First you log in, then you arrange" (P32: F/UG)

> "Pictures make you understand immediately" (P27: F/UG)

> "We like short cuts" (P25: F/UG)

There was also a strong emphasis on having a user-friendly or usable mobile application and comments about *Interface design* features were very strongly interwoven with this narrative. Ordering of services on the screen and organising services into categories with simple terminology were discussed as examples of features that led to ease of navigation and consequently ease of use. The discussions suggest a strong antecedent relationship from these design features to ease of use, illustrated in the following quotes:

> "If you make it user-friendly with not enough content still ok but if you make it brilliant but hard to navigate no one will use it" (P2: F/PG)

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"It would be easy to have big title easy to catch" (P3: F/PG)

"I think you should not make it scroll down. The last thing mobile users want is to go down. They want to see for example 4 or 5 categories but in one page no need to scroll down. It is very boring for me" (P2: F/PG)

"Maybe when you click on an icon you will get subtopics and maybe again click it and get subtopics. It will be easier this way" (P18: F/PG)

"But this way will confuse the user. I prefer the way you present it" (P20: F/PG)

Some discussion also reflected the interrelationship between *Interface design* and screen size. A number of students mentioned that smartphone screen size would not attract them to use the library database or read full articles, while they would be more comfortable reading on their ipad or tablet, for example:

"I just don't like to have a lot of text on my mobile" (P10: M/PG)

"I am not going to read it on my mobile because it is little bit annoying" (P9: F/PG)

This illustrates that the functionality that the interface should easily provide access to may vary with context/device used. Derived from those discussions, the research hypothesizes the following:

Hypothesis 8: Interface design has a significant effect on Perceived ease of use of mobile digital library application

4.2.7.8 Theme 8: Relevance

It was clear from focus group discussions that students are looking for innovations that suit their needs, supporting the importance of relevance. Students listed a number of features and functions that they would require from the system which would make it relevant to their needs. Interestingly, the concept of *Relevance* emerged as dynamic and context-dependent, so that different functions would be relevant for different contexts of use (in terms of location, technology and mobile coverage). The discussion of relevance also overlaps with *Perceived usefulness*. For example:

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> "You don't know what it is going to happen whether you are outside or something suddenly you get this notification that you have to solve. You have to think of it…. Whenever you want to solve an issue solve it on the spot and that's it. Forget about it" (P9: F/PG)

> "Or maybe an app that allows you to search about a book, rather than going through the shelves. It will waste our time" (P18: F/PG)

> "Sometimes we need a discussion group about books proposed by faculty like a review. Book review" (P37: M/UG)

> "Yes when you read a book you do not know whether it is good for you or not. If someone else read it and review it you will know" (P22: F/UG)

Hence, this research hypothesizes the following:

Hypothesis 9: Relevance has a significant effect on Perceived usefulness of mobile digital library application

4.2.7.9 Theme 9: Social Influence

The importance of consulting and interacting with social networks was confirmed through focus group discussions. Students showed an initiation of consulting their friends who already started to use the app or their teacher who probably asked them to download the app. A number of participants would also influence the decision of their friends and push them towards using the app:

> "I would say to my friends you have to have it. I will push them to have it because you don't know what is going to happen…" (P9: F/PG)

> "If a teacher asks us to download it we are going to download it" (P43: M/UG)

Several previous studies implied that there is a relationship between *Social influence* and *Perceived usefulness* (Bhatti, 2007; Lee, 2006; Liao, Chen and Yen, 2007). While this did not emerge strongly from the focus group discussions, one participant's comment does lend some support for such a relationship:

> "I would see if someone else used it before and ask them if it is really useful. If it was easy for them, then it is easy for me. I am no less than them" (P16: F/PG)

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Interestingly, this quote also suggests a relationship between *Social influence* and *Perceived ease of use*; because seeing someone else use the application would give this person confidence that they too could use it.

Based on that, the research hypothesizes:

Hypothesis 10: Social influence has a significant impact on behavioural intention to use mobile digital library

Hypothesis 11: Social influence has a significant impact on Perceived ease of use of mobile digital library

Hypothesis 12: Social influence has a significant impact on Perceived usefulness of mobile digital library

4.2.7.10 Theme 10: Distinctiveness/Prestige

Distinctiveness or *prestige* was a new construct discovered inductively. Most student groups were not directly saying that using the app will make them feel distinctive. But they were accepting the app because of many great qualities that in a way enhance their image and make them feel unique.

Female postgraduate groups were looking for a privilege of using "creative", "brilliant", "useful" and "a new program that cannot be found elsewhere". The male postgraduate group also found the app a "great idea" and "a ground breaking technology". Female undergraduate groups believe that the idea itself would receive an award. They indicated that it is a new application that they have not heard about before. They will be among the first people to use it as it is original and useful:

> "I feel it something new. I haven't heard any university started using this application" (P38: M/UG)

Librarians' discussion was more clearly about prestige. Librarians think that providing such application among students will let students feel distinctive in a way that enhance library image.

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> "First it will improve the library image. For many students the library is just the physical items. Brings the physical documents and other services in one place" (P46: librarian)

The *distinctiveness* factor identified here has features in common with the concept of *Image* identified in some previous work. For example Hong, Tam and Kim (2006) and Kargin, Basoglu and Daim (2009) believe users like to feel unique because of their services. Kargin, Basoglu and Daim (2009) found that image significantly affects the *Perceived usefulness* of mobile services. Our focus group discussion supported a similar relationship between distinctiveness and *Perceived usefulness*, for example:

> "New program, useful" (P19: F/PG)

> "Maybe because this program is original, useful for many students. For me I will be among the first people who use it" (P38: M/UG)

According to these results, this research hypothesizes the following:

Hypothesis 13: distinctiveness has a significant impact on behavioural intention to use mobile digital library application

Hypothesis 14: distinctiveness has a significant impact on Perceived usefulness of mobile digital library application

4.2.7.11 Theme 11: Trust

Trust emerged clearly as a factor from the focus group discussions, as did its impact over *Behavioural intention*. Within the overarching discussion of *Perceived trust* it was interesting to note that a number of facets of the construct emerged; these included security, reliability and credibility as discussed below.

Sub-theme 11a: Security

Interestingly, there was a difference between male and female students when it comes to their perception of security and *Perceived trust* issues in relation to online payment. Female participants were concerned about the security of their accounts or the security of mobile payment. They wonder if it is safe to download such application on their mobile or if it safe to pay online. P29 (F/UG) asked: "is it safe to use or download on my phone? Is it

safe for my account?" When they were asked whether they trust paying through their mobile, P29 (F/UG) clearly said: "no" but P7 (F/PG) mentioned: "I trust my mobile because there is no money in my account", which in fact insinuates that she does not trust that method of payment. They think that direct payment is safer, e.g. P30 (F/UG): "better to pay cash or by card". Participants like 31 (F/UG) and 32 (F/UG) would rather come to the library to pay: "I will come to the library to pay" and "I prefer if they can tell us only come and pay your fees. We will come in that case and pay for the library". Postgraduate male students on the other hand felt more secure about an online payment service. As a matter of fact they found it as the most important service. P13 (M/PG) stated: "yes I trust my mobile" and P11 (M/PG) said: "if they are going to send me a reminder I will be thinking of a way to pay".

Sub-theme 11b: Reliability

Female undergraduate groups were also concerned about the reliability of the information and who might be involved in designing the app and providing this information. The following quote provides an example of their reliability concerns:

"If the application is reliable too? Who has developed it?" (P31: F/UG)

Sub-theme 11c: Credibility

Male undergraduate groups believed that the university will provide them with reliable trustworthy information ("If it is developed by the university, then it is reliable"); if the university is the developer of the app, then they would trust it. There therefore appears to be a close association between credibility of the developer and expectations around reliability. Thus the research hypothesizes the following:

Hypothesis 15: Trust has a significant effect on behavioural intention to use mobile digital library application

Hypothesis 16: Gender is a moderator that has a significant effect on the relationship between Trust and behaviour **intention to use mobile** *digital library application*

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4.2.7.12 Theme 12: Mobile and web search experience

While previous digital library research has suggested that *Domain knowledge* is an important predictor of *Perceived ease of use* and *Perceived usefulness* (e.g. Thong, Hong and Tam, 2002) specific-subject knowledge did not emerge strongly as a theme from our focus group discussions. Instead it was the more generic experience dimensions of first, smart phone experience and second, web search skill that were discussed most frequently. The results show that users with no smart phone background are not in favour of using library services via smart phone. However, more experienced users felt it was inevitable that in future everyone would be using the technology. This is illustrated by the following exchange:

> "I am using an old phone so what is going to happen to me" (P4: F/PG)

> "When you back to the marketing numbers you find out the uptake for the smartphone you can say shocking number. It is about 80% of the newcomers to the market that have a smartphone. So sooner or later you will change your phone" (P6: F/PG)

Discussions also showed that a number of participants had strong experience of web searching and tend to consult a number of different sources, for example they cross-check available resources in the library with reviews on Amazon. Users with strong search experience tended to expect advanced search features to be provided in the app, suggesting possible relationships between search experience and relevance. Illustrative quotes include:

> "And as [P6] said I can see the review of this book from Amazon or others because for example I search Zayed and then for quality I search Amazon and see how many stars are there" (P2: F/PG)

> "I need to search by the author, title and so on" (P42: M/UG)

There also appeared to be a relationship between web search experience and smart-phone experience, in that those with high search knowledge are also skilful smartphone users.

This research is exploring these relationships by hypothesizing the following:

Hypothesis 17: Mobile and web search experience has a significant impact on behavioural intention to use mobile digital library application

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4.2.7.13 Theme13: Mobile Self-Efficacy

While the deductive coding of the data focused on general *Computer self-efficacy*, which has been described in the literature as having a positive impact on computer usage, it became clear through our inductive analysis that it would be more appropriate to consider the narrower construct of *Mobile self-efficacy*. It was clear from discussions that students felt this factor could have a positive or negative impact on mobile library use. For some, their existing confidence in using smartphones gave them confidence that they could also use this app. There was also some suggestion that *Mobile self-efficacy* might mediate the relationship between *Social influence* and *Perceived ease of use*. Thus, from the same example discussed under theme 9 above, a participant in one of female postgraduate groups was comparing her capability of use to other students. She reasoned that if they are capable of use then she is too.

"For me I will be among the first people who use it" (P38: M/UG)

"Everything in the app is usable" (P31: F/UG)

"Especially that our generation is all about technology. I believe it will be easier for us" (P18: F/PG)

"I need to know the services provided before I start using" (P39: M/UG)

"…Now when I knew about it, I feel really I want to use it" (P38: M/UG)

Based on the previous results, this research explores the following hypotheses:

Hypothesis 18: Mobile self-efficacy has a significant impact on behavioural intention to use mobile digital library application

Hypothesis 19: Mobile self-efficacy has a significant impact on Perceived ease of use of the mobile digital library application

4.2.7.14 Theme 14: Experimentation

A number of comments, coded inductively, suggested that users like to experiment with the new technology before deciding to adopt it. A number of students mentioned that they have to try the app first to judge their capability of use. Two male undergraduate groups were uncertain about their capability of use so they proposed to try the app first and then

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decide. This suggests a possible relationship between *Experimentation* and *Mobile self-efficacy* judgements:

> "I have to try it first in order to decide to use it" (P41: M/UG)

> "We have to. For example how can I borrow a book? I have to know. I have to try it first" (42: M/UG)

> "I will have to try it first if I do not like it I will delete it" (P33: M/UG)

This new theme may be indicative of the way that users now interact with mobile apps. The low barriers to entry (in terms of both cost and access) encourage them to try the technology. While this makes the initial adoption decision relatively easy, the flip side is that the technology can be discarded equally easily if the user doesn't like it in practice. This suggests that the emphasis is studying adoption of this technology should be on intention to continue using the technology once users have tried it for themselves. This construct however, is not included in the framework at this stage because it requires developing a scale from scratch.

4.2.7.15 Theme 15: English Literacy

An interesting finding that emerged was that although students consider themselves literate in English, they would like to include both languages Arabic and English in the app. Having both languages will make the app easy to use and match their search needs.

> "We can make it Arabic and English" (P17: F/PG)

> "Both. I prefer if it gives me the choice to select the language" (P18: F/PG)

> "If you can do it in every language is a good thing… I mean that it is better to have the choice" (P21: F/UG)

> "…. But there are some students especially first year students who are not sufficient in English" (P23: F/UG)

> "We should consider them. It must be easy for them to use" (P24: F/UG)

On the contrary, librarians think that students at this stage must be literate and confident speaking the language. Then again, Arabic language can be considered if there is a service

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of a dictionary or encyclopaedia in the app; or when the app is developed for all universities.

> "The university urges students to use English language although some students still not using English language but as a university rule they must use it" (P45: librarian)

> "If you go to another university you will find students who learn in Arabic language. So if your application is for everyone it is better to have both languages" (P46: librarian)

> "I agree if it is for everyone then you can use both languages but you still find that most universities are using English language" (P48: librarian)

Therefore, this research proposes the following hypotheses:

Hypothesis 20: English literacy has a significant impact on Perceived ease of use of mobile digital library application

4.2.8 Refined framework

The purpose of this study was to explore factors that affect intention to use mobile digital library service. Conducting qualitative focus group research provides overall support for a number of constructs identified from the literature, including the main TAM constructs. However, it also provided additional insights which might not have been reached without the use of a qualitative exploratory approach (i.e. new constructs and revised constructs from the literature). The key findings are summarised in the following tables.

Table 4.5: Findings in relation to a priori constructs

Construct	Findings	Comments and suggested relationship(s) to other constructs
Perceived usefulness	Supported	Antecedent to *Behavioural intention*
Perceived ease of use	Supported	Antecedent to *Behavioural intention* Relationship to *Perceived usefulness*
System accessibility	Not supported	The related constructs of mobility and system coverage emerged as more relevant for the mobile digital library context (see table 4.6)
Library assistance	Supported (adapted version)	Results suggest support for an inclusive definition of *Library assistance* encompassing support from librarians and teachers as well as technical support. Discussions suggest *Library assistance* plays a possible role in affecting *Perceived ease of use*.
Interface characteristics	Supported (adapted version)	A broad concept of *Interface design* was proposed to involve customisation, use of images and shortcuts, terminology, screen design, navigation and screen size. Antecedent to *Perceived ease of use*.
Relevance	Supported	The concept of relevance emerged as dynamic and context dependent. Possible relationships were inferred with *Perceived usefulness*
Social influence	Supported	Antecedent to *Behavioural intention* Antecedent to *Perceived usefulness* Antecedent to *Perceived ease of use* May affect judgements of *mobile self-efficacy*
Trust	Supported	Antecedent to *Behavioural intention* *Trust* is related to judgements of security, reliability and credibility Association between credibility and reliability Gender affects judgements of security
Domain knowledge	Not supported	The role of subject-specific knowledge did not emerge as a theme, however, *mobile and web experience* was discussed (see table 4.6)
Computing experience	Supported (adapted version)	*Mobile and web search experience* were identified as key features. Web search skill related to expectations for relevant features and design. Lack of smartphone experience was a clear barrier to adoption
Self-efficacy	Supported (adapted version)	A narrower construct of *Mobile self-efficacy* was proposed for this application area. Discussion suggests a relationship to *Behavioural intention* and *Perceived ease of use*.
English literacy	Supported	Antecedent to *Perceived ease of use*

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Table 4.6: New and adapted constructs identified inductively

Construct	Definition	Suggested relationship(s) to other constructs
Quality of working life	Belief that a system will improve the quality of working life (e.g. through saving time or expenses)	Antecedent to *Behavioural intention*.
Mobility	The ability to connect anywhere and anytime	Antecedent to *Behavioural intention* Antecedent to *Perceived usefulness* Antecedent to *Perceived ease of use*
System coverage	Availability of mobile and internet coverage	May affect *Behavioural intention* Closely related to concept of mobility
Distinctiveness / prestige	Belief that the a system will improve individual's status	Antecedent to *Behavioural intention*
Experimentation	A user's willingness to try out a new technology before making an adoption decision.	Antecedent to *Behavioural intention* Possible relationship with *Mobile self-efficacy*

The research provides a refined framework to suggest the features that will affect adoption of mobile digital library technology. However, only constructs with pre-existing measures were adopted to form the refined framework. So "*Quality of working life*", "*Experimentation*" and "*System coverage*" constructs were excluded from the framework at this stage. The following figure shows the new modified theoretical framework emerged from focus group analysis:

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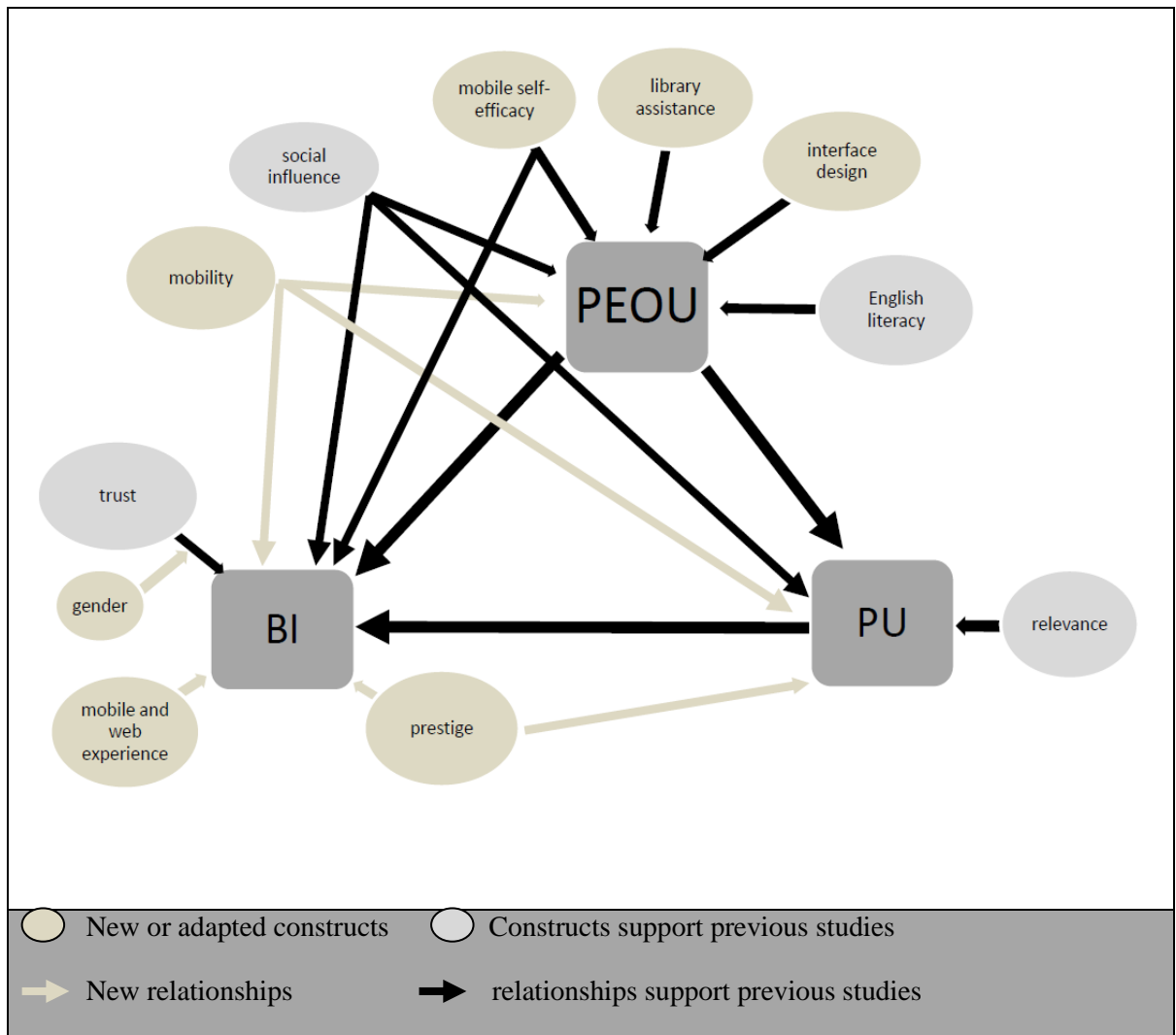
Figure 4.2: Refined framework

4.2.9 User requirements

It was mentioned in the introduction of this chapter that conducting focus groups helped not only in generating themes and hypotheses but also helped in capturing user requirements.

Through participants' discussions and the analysis of their list of service preferences, the main focus was on the library catalogue and getting access to books. A lot of similarities were spotted between different focus groups. It seems that their major needs centred around books. They need to have e-books, alerts with new arrival books, suggesting books, search for books, book reviews, and interlibrary loan ordering.

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Their second priority was around user account to check previously borrowed materials or having alerts to renew overdue materials. They also expected to be able to manage that account and select books related to their interests. Checking library hours, paying fines, ask a librarian, and book study rooms were also among services needed by most focus groups. While locating books with a map, printing remotely and receive notifications about free computer availability were not crucial but extra privilege services. The following table summarises the required services which emerged from focus groups analysis:

Table 4.7: List of services required by users

Services provided by the preliminary prototype	Refined services and technical issues from focus group
Library Catalogue OPAC	All services plus
Student account	E-books and database (on Tablets only)
Library opening hours	History log of borrowed materials
Notifications (Renew alerts)	Interlibrary loan
Ask a librarian	Book reviews and Suggesting books
New books	Paying fines
Library news (Rss)	Technical issues
Book study room	Both languages Arabic and English
Video tutorials	No exhaustive scrolling down
About the library	Short text
Map	The logo should be smaller
Contact us	The background colour is suitable
Zayed university homepage	
British library catalogue	
Facebook	

4.3 Exploratory study 2: card sorting

4.3.1 The sample

As mentioned in the methodology chapter card sorting would determine the information architecture of mobile digital library program by understanding participants' logic of organizing categories and concepts (Spencer, 2009). Nielsen (2004) suggested that five participants will result in a correlation of only 0.75 in a card sorting test while 15 will result in a correlation of 0.90. To find similarities between library users and understand the way they group information, 40 students were sampled. Most focus group participants agreed to participate in the card sorting methodology. The postgraduate sample consisted of 12 females and 5 males, while the undergraduate participants comprised 11 females and 12 males. Their ages varied between 18 and 43.

4.3.2 Selecting the appropriate sorting technique

Card sorting method can be open or closed (Maurer and Warfel, 2004). In an open card sort, participants sort cards into as many groups as desired and then name the groups. In closed card sort, participants are asked to sort cards into pre-defined groups (Lewis and Hepburn, 2010). Depending on the goals of the protocol the categories are predefined and named, or the participant determines the number of the categories and their names (Turnbow et al., 2005). For the sake of collecting information about the most natural categories from a participant point of view and the cards that go into the categories, open card sorting was used.

4.3.3 Instrument design

Library services items that were generated from the output of the focus groups were printed on 3×5 inch white indexing cards just like Spencer (2009) suggested. 15 cards with 15 services written on them were generated. 36 is the font size that has been used for the services while 18 is the font size that has been used for services' definition. Turnbow et al., (2005) recommended adding definition to the services to protect participants' sorts from hindrance by the lack of knowledge of library services or of the terms provided. The following table presents services used in the study along with their definitions.

Table 4.8: List of library services and their definitions used on card sorting

Services	Definition
Catalogue	To search for books and other library items
Your account	To check your account and renew your items
Library hours	To check the library opining hours
Ask a librarian	-
Notification	To adjust your library notices (by e-mail or SMS)
New books	New arrival books
About us	Description about the mission of the library
Zayed university homepage	-
British library homepage	Interlibrary loan from other library calogues
Map	Shows the location of the library
Contact us	By phone, fax, e-mail
Facebook	Library facebook page
Youtube	Video tutorials
RSS feeds	Latest news about the library
Book study room	-

4.3.4 Sorting session administration

Those who agreed to participate were given an informed consent sheet (see appendix E) and were given an hour to complete the card sort. At the beginning a brief explanation was given about the project in general. This was followed by an example to illustrate how card sorting works. We used a set of cards with general categories such as colours and fruit just to deliver the idea. Afterwards, each participant were given a stack of blank cards and told to use them if they need to duplicate a service. They were asked to lay the cards in front of them on the table, arrange the cards into groups or piles that make sense to them and reminded that there were no right or wrong answers. They were also given a stack of coloured cards to add labels or categories that can be a word, a phrase or a sentence (Zimmerman and Akerelrea, 2002).

Participants were met individually as they finished sorting and labelling to review their labels and to ask questions when clarification of the label's meaning is needed (Zimmerman and Akerelrea, 2002).

4.3.5 Card sorting analysis

As discussed in chapter 3, the analysis of card sorting involved exploratory analysis and cluster analysis.

4.3.5.1 Exploratory analysis

The results of card sorting were extremely helpful to understand what labels are more related to the user. The card sort results were put into the spread sheet template developed by Spencer (2009) to identify the most common terms used by students just like Maurer and Warfel (2004) suggested. Since participants used many different terms and phrases to categorize their card set, standardized terms were needed. A list of all labels used were sorted and grouped based on their similarities and then standard labels were created to gather all similar participant terms. The participants created a total of 181 categories and the number of categories created individually ranged from 3-7. The following table

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provides details about phrases used by participants and standardized phrases created based on their interpretation to decrease those categories into 12.

Table 4.9: Card sorting phrases

Variants (original categories)	Most common terms
Zayed library services and information General helping material Library information General information about the library Information More services For more information All important information in the library More information Information about the library How to use the app	Library information
Service request Services Library services Asking anything inside library More details Users services Quick and useful services Library Other services Library reference services Services and help Important for students Library guide References	Library services
Personalizing my settings Manage account Personal Account My account Account services Your account Student account Student's guide Personal account Student's log in What matters to me as a user Students' log My library Students' profile Student services	Student account

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Variants (original categories)	Most common terms
Finding a book Library search Search Search the library Library content Books Books and classification Catalogue Search for a book All about books Check	Search
Contact us Contact your library Communication Communication services Find us Location How you can contact us	Contact us
About us About Zayed library About the library The library Know your library Our library About library Information about the library About	About us
Ask for help Help Help students Do you need help? We are here Help me Ask a librarian	Help
Important links External library links/useful links Links Other catalogues New website Related website External links Library links Go online resources	External links
Alerts New materials What's on Library news New materials New trends settings	Alerts

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Variants (original categories)	Most common terms
Online services Social website Our social networking Facebook Social media (connect with us) Social media Share and learn	Social media
General Other General information Options	General information
Library homepage Zayed main page Main page Home page First page	Home page

The results were also useful in exploring the organization of services under each of the categories created by the user. The following table shows the percentage of agreement upon cards distribution within each category.

Table 4.10: Cards distribution within categories

Card no	Card name	library information	student account	search	external links	alerts	contact us	library services	social media	about us	help	home page	general information
1	catalogue: to search for books and other library items	5%	8%	28%		8%	3%	38%		5%		5%	
2	notification: to adjust your library notices by e-mail or SMS	5%	43%	5%		18%	3%	20%			5%		3%
3	rss feeds: latest news about the library	20%	5%	3%	3%	30%	3%	13%	10%	8%	3%	3%	3%
4	book study room	3%	23%	5%			5%	50%		3%	8%		5%
5	library hours: to check the library opining hours	28%	5%	3%		3%	13%	30%		13%	5%		
6	Zayed university homepage	23%		3%	28%		8%	5%	3%	8%		23%	
7	contact us	30%	3%				25%	13%	3%	10%	13%	5%	
8	map: shows the location of the library	35%	3%				13%	15%		23%	3%	5%	3%
9	about us: description about the mission of the library	43%					3%	15%		33%	3%	3%	3%
10	facebook	10%	3%		23%		13%	8%	33%	5%			5%
11	youtube: video tutorials	10%	10%	5%	15%		5%	8%	28%	15%	3%		3%
12	british library homepage: interlibrary loan from other library catalogue	18%		10%	30%	3%		18%	3%	10%		10%	
13	your account:to check your account and renew your items	3%	58%	3%				23%			3%	8%	5%
14	new books	8%		25%	3%	30%		30%				3%	
15	ask a libraian	10%	3%	8%			20%	38%			23%		

Certain cards showed a good agreement as they repeatedly appeared in a similar category. For example, half of the participants put a card that said "Book study room" under the category they called "library services" and 58% of the participants put the card "your

account" under the category they named "Student account". Also 43% of the participants put the "notification" under "student account" category.

However, it is very clear that there is a very low agreement on "homepage", "general information", "help" categories, so they should be reconsidered in the application design.

In addition, there were some cards that appeared in a variety of categories. For example, participants put "catalogue" in two different categories, including "search" and "library services". Also, "about us" was placed under "library information" and "about us". Similarly, "library hours" appeared in two different categories: "library information" and "library services". Furthermore, "new books" appeared under "search", "alerts" and "library services". A decision has to be taken in regards to the most suitable place for these services. For that reason, cluster analysis was used as the next stage of analysis.

4.3.5.2 Cluster analysis

As mentioned in the methodology chapter, cluster analysis has been used to analyse data retrieved from card sorting and UXSORT software has been used to help in that analysis (UXSORT, 2009). Cluster analysis is a quantitative method that draws a visual diagram showing the distance between groups of categories (Aldenderfer and Blashfield, 1984). Euclidean distance, a Hierarchical cluster analysis has been used to calculate the distance between cards by creating a hierarchy of best fit relationship. More specifically, single linkage method has been used to calculate the distance of the two closest objects and looking for similarities (Spencer, 2009).

4.3.6 Card sorting findings

The analysis of card sorting reduced the number of categories emerged from the exploratory analysis to reach only six, as shown in the following figure.

_____
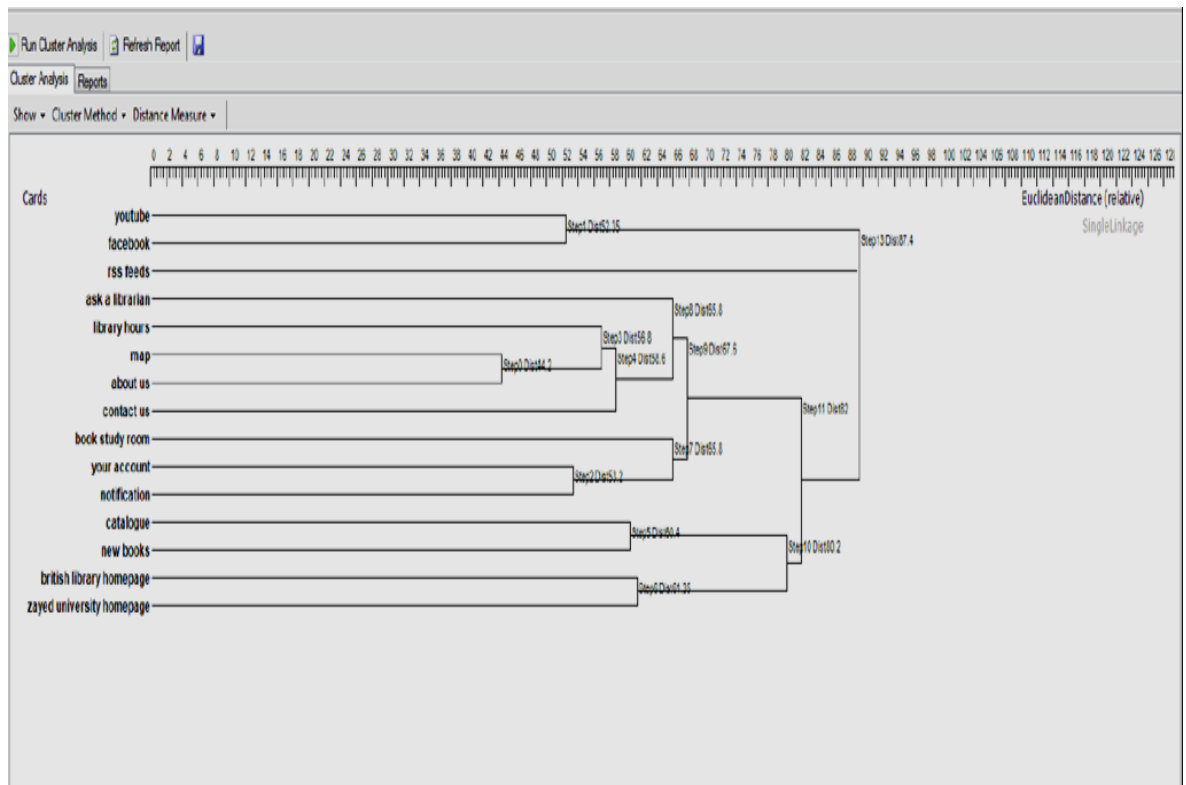
Figure 4.3: Cluster analysis

The categories have been labelled based on the standard labelling emerged from the exploratory analysis.

Cluster 1 (Social Media): YouTube, Facebook

Cluster 2 (Alerts): RSS feeds

Cluster 3 (Library information): ask a librarian, library hours, map, about us, contact us

Cluster 4 (Student account): book study room, your account, notification

Cluster 5 (Library services): catalogue, new books

Cluster 6 (External links): British Library homepage, Zayed University homepage

_____

And for the purpose of marketing the application between users, this research chooses to add one more category to the application, "Share" that will help them to share this application with each other through e-mail, Facebook, or twitter.

Specifying categories and services helps structuring the content and the navigation of the mobile library application in a way that is meaningful to students. Figure 4.4 shows how the findings of the two exploratory studies: focus group and card sorting helped refining the first prototype to produce a second one.

Figure 4.4: The second prototype

4.4 Summary

This chapter provided detailed information about the process of conducting and analysing the exploratory phase data. Starting with focus group study helped in exploring new constructs; generating hypothesis; refining the preliminary theoretical framework; and exploring services needed by library users. Once library services were identified, the card sorting method, the second part of the exploratory phase was conducted. The analysis of this method allowed for understanding terms preferred by students and the way they prefer to organize those services on a mobile prototype. The analyses of this method also lead to modifying the preliminary prototype and producing a second one more relevant to them.

The next chapter provides detailed information about the process of testing the usability of the new modified prototype and how it can be further modified to be used simultaneously

in the testing phase. It also explains the process of conducting and analysing an online questionnaire to test the hypotheses and validate the framework produced in this chapter.

Chapter 5: Testing phase

5.1 Introduction

The aim of this chapter is to test the theoretical framework and hypotheses generated in the exploratory phase. However, this chapter starts by explaining the process of conducting and analysing the pre-testing phase discussed in the methodology chapter. This phase consists of testing the usability of the prototype application and how easily it can be navigated by users. Any technical problems or in the terminology, navigation and screen design can be detected through this type of test. Accordingly, the chapter starts with testing the second prototype generated from the exploratory phase to produce a final user-centred designed one that would be used simultaneously during the testing phase (the online questionnaire data collection). The participants would have the chance to use the prototype when they answer the online questionnaire. Based on that, this chapter starts by giving details about the sample, the setting, the instrument design, instrument administration, analysis and results of usability test followed by the process of conducting and analysing the online questionnaire. The online questionnaire data was analysed based on SEM technique.

5.2 The pre-testing phase (usability testing)

To overcome the literature gap, the mobile digital library prototype was designed and organized based on users' needs. Based on the amendments obtained from focus group results and card sorting in the previous chapter, a refined user-centred prototype was produced. This prototype was tested for usability and ease of use before sending it to students in the testing phase. The following sections provide detailed information about the process and results attained from the usability test.

5.2.1 The sample

The number of participants in usability tests is not fixed, but tends to fall in a range between three and twelve people. Nielson and Molich (1990) found that three participants were enough to detect half of all major usability problems. Nielsen (1993) supported the previous study by finding that six participants allowed him to identify the majority of important problems. Dumas and Redish (1993) also mentioned that a typical usability study should include six to twelve participants, and any additional participants will not reveal any new information. Nielsen (2000) stated that the best results come from testing no more than five users, and noted that even when the target population consists of highly diverse groups (e.g. children and adults) there will be many similar results, because usability is more mechanical and less related to influence by demographic variables.

Based on the previously discussed findings, this research initially started with five participants and then additional participants were added until saturation is reached and no new issues were observed. Eleven students with varying levels from different majors formed the sample for this study, and they were observed while using the mobile digital library application. The sample included undergraduate and postgraduate students from Computer Science, Information System, Economics and Marketing departments. For more demographic information see Appendix F-2.

5.2.2 Field vs. lab testing

The goal of conducting a usability test for a particular program is not to discover every possible problem but to find the biggest and most fatal problems within a strict limitation of budget and time (Nielsen and Landauer, 1993). By comparing lab and field usability tests, Kaikkonen et al. (2005) found that the test location did not significantly affect speed and success of the task execution of the users. They also found that there was no difference in the number of problems that occurred in the two test settings. However, conducting the usability

test in laboratory seems to be preferable for researchers; Kjeldskov and Graham (2003) indicated that 71% of mobile device evaluations were done in laboratory settings.

Kjedskov et al. (2004) and Kaikkonen et al. (2005) believe that field testing may not add significantly to the validity when performing user interface evaluation of mobile application devices. They clarified that despite the development of suitable tools for testing, field testing is more time-consuming than testing in laboratory settings. It may also require extra effort from test users and leaders. It requires a pre-test or pilot test due to the high probability of details that can go wrong, interruptions and unexpected events. Hence, the usability test in this thesis was conducted in a laboratory.

5.2.3 Instrument design

5.2.3.1 Equipment

The laboratory test was conducted in a typical usability test environment. There were no unexpected external interruptions and disturbing noises. The test was created to finish within a maximum of one hour as suggested by Prasse, the consulting user interface designer and manager of the OCLC Usability Lab (OCLC Newsletter, 1997). The test was facilitated by a range of equipment, comprising a personal computer, operating system (Movie Maker), Smartphone and Webcam to help the researcher observe and record participants' actions and speech.

5.2.3.2 Measurement

The usability study was divided into three parts: the first and the final part involved questionnaires, while the second part involved a number of tasks. The structure and questionnaire items were adapted from previous studies and modified to fit the mobile digital library domain. The items were adapted from a study conducted to assess the usability of a digital library (Jeng, 2005) and from the University of Texas at Austin website (2007). The final usability test is available in Appendix F-1. The first (pre-test) questionnaire consisted of

9 demographic questions including gender, age, major, nationality and education level and grade level, how often they use the internet and for what reasons and years of smartphone expertise.

The second part of the test consisted of 10 tasks as follows:

- Find a book
- Renew a book
- Ask a librarian
- Check library news
- Check library opening hours
- Search other library catalogue
- Reserve library study room
- Find a tutorial video
- Share the app with a friend
- Tailor their overdue notices (SMS/e-mail)

The post-test questionnaire included 13 questions to measure participants' overall impression and their comments concerning ease of use, organization of information, terminology, visual appearance, contents and error recovery and navigation of the mobile library application (Jeng, 2005; Lee and Grice, 2004).

The final and task tests are measured using five-point Likert scale whereby 1 represents easy, clear, attractive and satisfied and 5 means difficult, unclear, unattractive and dissatisfied.

5.2.4 Usability test administration

A pilot test with 2 participants who were not part of the real study was conducted to avoid any technical problems. According to the usability.gov (2014) conducting a pilot test with 1 or 2 volunteer participants allows for testing the equipments; practicing note taking; and checking that the scenarios and questions are understandable. Rubin and Chisnell (2008) supported the same notion as they mentioned that 2 participants would be enough to discover any problems

in the questions, plan or that certain task is not applicable. Since no problems were discovered during the pilot study, the real usability testing was conducted.

At the beginning of the test, an explanation of the process of the usability test was introduced to users. They were informed that the test consists of three parts: pre-test, task test and post-test and that the session will be videotaped for later coding and analysis (Lingaard, 1994). It was also made clear to each participant that the purpose of this test is to determine the application's ease of use through observing their use and not to judge their research skills.

After signing a consent form and filling the pre-test questionnaire, participants were asked to think aloud while finding information. Users were asked to explain what they were doing, what they expected to happen when making selections and whether something unexpected happened after the selection. Think aloud protocol provides real-time feedback on potential problems in the design and organization of the website (Turnbow et al., 2005). Verbalizing thoughts while completing tasks eliminates the need to rely on long-term memory that is necessary when asked to explain behaviour after the task has been completed, thus providing a more accurate account of behaviour (Ericsson, 2002).

The goal of the usability test is not only to record the actual clicks that participants made but also to try to understand why they made their decisions (Swanson and Green, 2011). Based on that, the observer or the researcher administering the test kept a log of what the participants said and recorded the paths that they took while attempting to solve the information-seeking task. It is often difficult to write quickly enough to record everything that the participant is saying and doing, then it is helpful to tape record the session and not to interrupt or make recommendations to the participant as they interact with the page (McMullen, 2001). Upon completion of the the tasks, participants were asked to report their general impression of the app, suggestions, or any other comments. This quantitative data gathering is useful in determining each participant's level of experience and their overall satisfaction with the app (McMullen, 2001).

5.2.4.1 Recording

The test session was recorded with video camera, focusing on the smartphone screen. Participant's mobile screen was projected on the researcher's computer screen for better and more comfortable note taking (Swanson and Green, 2011). The researcher recorded the participants' search strategy, their comments and responses to the tasks. Task success and the time to complete the task were also recorded.

5.2.4.2 Analysis

Results from the think aloud protocol allows for quantitative and qualitative data gathering. Quantitative data usually involve success, partial success and failure while qualitative data is taken from participants' comments and observations (Turnbow et al., 2005). For the sake of analysing quantitative data, a criterion count was used; while Nvivo was used to analyse the qualitative data.

5.2.4.3 Criterion count

Jeng (2005) illustrated the way each usability attribute can be measured:

- *Effectiveness:* evaluates whether the system as a whole can provide information and functionality effectively. It was measured by how many answers are correct.
- *Efficiency:* evaluates whether the system as a whole can be used to retrieve information efficiently. It was measured by 1) how much time it takes to complete tasks and 2) how many steps are required.
- *Satisfaction:* concerns areas of ease of use, organization of information, clear labelling, visual appearance, content and error correction. It was measured by questionnaires and Likert scale questions.

5.2.4.4 Coding using Nvivo

The qualitative data that has been produced through participants' comments and views have been coded and categorised using Nvivo. The categories have been shaped based on

similarities looking for patterns. The categories were formed based on usability elements: such as general ease of use, content, visual appearance and organization and terminology.

5.2.5 Results

The effectiveness in this study as mentioned earlier is measured by how many answers are correct. The results showed that most tasks were completed correctly, except for finding the YouTube tutorial, library news and book study room. Some participants faced difficulty locating that information. Table 5.1 shows the effectiveness scores of participants attempting to fulfil the 10 tasks.

Table 5.1: The effectiveness of the prototype

Qs	Tasks	N	PCA	Mean	Median	SD	NF
Q1	Search catalogue	11	100%	1.00	1.00	.000	0
Q2	Renew	11	100%	1.00	1.00	.000	0
Q3	Ask a librarian	11	100%	1.00	1.00	.000	0
Q4	Library news	11	72.7%	1.27	1.00	.467	4
Q5	Library hours	11	100%	1.00	1.00	.000	0
Q6	Interlibrary loan	11	100%	1.00	1.00	.000	0
Q7	Book study room	11	90.9%	1.09	1.00	.302	1
Q8	YouTube tutorial	11	45.5%	1.45	1.00	.522	7
Q9	Share	11	100%	1.00	1.00	.000	0
Q10	Notification	11	100%	1.00	1.00	.000	0
N (number of participants), PCA (percentage of correct answers), NF (number of fault answers)							

The efficiency in this study however, concerns about how much time it took the participants to complete a task correctly. The following table shows that participants completed the tasks in a short time ranges between 1.69 and 40.56 seconds.

Table 5.2: The efficiency of the prototype

Qs	Tasks	N	Mean of Time/sec	SD
Q1	Search the catalogue	11	40.56 sec	18.07
Q2	Renew	11	14.29 sec	5.01
Q3	Ask a librarian	11	6.57 sec	2.13
Q4	Library news	11	19.91 sec	19.70
Q5	Library hours	11	4.34 sec	1.05
Q6	interlibrary loan	11	6.47 sec	2.39
Q7	Book study room	11	6.65 sec	5.93
Q8	YouTube tutorial	11	29.93 sec	22.83
Q9	Share	11	1.69 sec	.63
Q10	Notification	11	9.29 sec	9.81
N (number of participants)				

For getting the overall impression about the prototype and examining the ease of use, organization of information, terminology, visual appearance and navigation a post-test was used with five-point Likert scale questioning. 90.9% of participants were satisfied and found that the application was very easy in general. 63.6% of participants believed the application was organized and 90.9% found that the terminology used was easy to understand. Only 10.2% of them felt lost in some cases. Taking in to consideration their comments to change or replace certain services will make the application more organized and easy to use. All participants found that the application is visually attractive, easy to navigate, met their expectations and allowed them to recover from mistakes easily.

The results showed that participants' overall navigation of the application was successful and they answered questions quickly. The categories seemed to provide a good sense of the included content. Participants were easily navigating through categories and subcategories. Nevertheless, certain categories or subcategories confused the users, thus they suggested renaming or relocating those categories, including the following:

- Rename "alerts" service to "recent events" or "events" to represent the service. Or move it under "library information" category. RSS or finding library events was one of the questions that four students were unable to find. Based on that, the students thought that having RSS or library news under library information would be preferable. Seven

students thought that RSS does not represent library news and should be replaced with one of the following: "events", "recent events", "special events", "activities", "updated news" and "what's going on".

- Rename the "YouTube" service "Tutorials". A number of students suggested that this service should be moved under "library information" or "user account". Finding YouTube tutorials was also among tasks that users failed to complete. Although three students mentioned that it was clear that YouTube videos are under social media and it was easy to locate that service, seven students failed to locate it. They mentioned that it was not obvious and was hard to find. They felt that YouTube does not really tell them what is happening in this context, and felt that it should be part of "library information" or "library services". They also thought that it should be replaced with "instructions" or "tutorials".

- Some students think that "book study room" should be moved to library services. Only one student failed to find that service, but four students who had wrong clicks suggested moving it under "library services". One student who thought that this service is very important and should be on the main homepage. They felt that having this service under "student account" is strange, since student account deals with renewals only.

- "Ask a librarian" should be moved under "library services". All students found that service easily under "library information"; however three students thought that it might also be sought under "library services".

- Link the catalogue of other libraries with the current library. Finding the interlibrary loan catalogue was so easy from users' perspectives, but two students mentioned that adding a link within the catalogue search engine would be better.

Participants were also asked to point out the best and worst feature (s) of the application. They almost mentioned all services. They think that notifications, library information, room booking, renewing, student account, searching books, external links, share and library services are the best features. However a number of participants agreed that alerts service is not the

best terminology and should be replaced with another phrase. The following table summarises participants' overall impressions concerning the prototype.

Table 5.3: Overall impressions about the prototype

Application impression	N	Percentage	Percentage
Ease of use	11	90.9% very easy	9.1% easy
Organization	11	63.6% very clear	36.4% clear
Terminology	11	90.9% very clear	9.1% clear
Visual attractiveness	11	100% very attractive	-
Recover from mistakes	11	100% very easy	-
Overall reaction	11	90.9% very satisfied	9.1% satisfied
Feel lost	11	81.8% no	10.2% yes
Ease of navigation	11	100% yes	-
Meet expectation	11	100% yes	-
N (number of participants)			

Detailed information about the status of whether a task has been completed or not, time to complete a task, the number of correct and fault answers and satisfaction rate for each participant is available in Appendix F-2 along with participants' comments.

The usability test contributed in refining the second prototype to reach its final status (see figure 5.1). A diagram of the full system architecture is available in Appendix E-1.

Figure 5.1: The final prototype

Based on the results gained from the participants, "Alerts" service was renamed "Recent events". "YouTube" service was divided into two services to cover students' expectations.

General YouTube service was kept under social media; while videos with tutorials on how to use library services moved under library information section and renamed as "Tutorials". "Book study room" was moved under library services section. "Ask a librarian" was maintained under library information section since all participants succeeded in locating such service in a short time. The catalogues of other libraries that share interlibrary loan service with Zayed University were grouped into the same catalogue page of Zayed University with the advantage of selection. After producing the final prototype, it was accompanied with the questionnaire that will be discussed in the next stage for framework testing.

5.3 Framework testing phase

In order to test and validate the framework and factors affecting the adoption and acceptance of mobile digital library service which emerged from the exploratory phase, an experiential online questionnaire was distributed to students. Experiential questionnaire method has been used in prior studies to test the adoption of e-services and to simulate real world scenarios (De Ruyter et al., 2001; Gefen and Straub, 2000; Grabner-Kräuter and Kaluscha, 2003; Jarvenpaa et al., 1999, 2000). The online questionnaire in this research was accompanied with a video of the mobile digital library prototype and a link to allow participants to download the prototype on their smartphones from iTunes store or Google play platforms and then answer the questionnaire.

5.3.1 Questionnaire design

5.3.1.1 Questionnaire items

For the sake of fulfilling one of the objectives of this research; and measure the acceptance of mobile digital library, a questionnaire instrument has been designed. Questionnaire items measuring the constructs were adapted from scales that have previously been validated in contexts similar to mobile digital library. They were adapted mostly from research focused on digital library acceptance and the acceptance of mobile services and have been modified to fit

the domain of the mobile digital library. The final version of the adoption and acceptance survey of mobile digital library is included in the (Appendix G). The questionnaire consists of 78 closed questions, comprising six demographic questions (relating to age, gender, department, education level and years of smartphone expertise) and 72 questions to measure 13 constructs organized into three main categories (interface characteristics, system characteristics and personal characteristics). Those items believed to affect the adoption and acceptance of mobile digital library and were selected for inclusion based on the results of the exploratory research phase reported in chapter 4. See table 5.4 for constructs and items sources.

The entire items in this research were measured on a five-point Likert scale - running from 'strongly agree' to 'agree', 'undecided', 'disagree' and 'strongly disagree' except for demographic information. Likert scale's simple format makes it very popular among researchers in a vast number of fields, especially social sciences (Chimi and Russell, 2009), as it allows the efficient analysis of attitudes (Oppenheim, 2001).

The five-point Likert scale is the most popular scaling procedure in use (Sue and Ritter, 2012), as it is best not to have many neutral items or many extreme items at either end of the continuum (Oppenheim, 2001). The five-point scale is the most suitable data collection for attitudes and opinions (Sue and Ritter, 2012).

Table 5.4: Construct and items source

Construct	Source	Items (modified)
TAM		
Perceived usefulness (PU)	Davis (1989)	Using the mobile digital library application would help me to accomplish tasks more quickly Using the mobile library application would improve my performance in my study Using the mobile library application would increase my learning productivity Using the mobile library application would enhance my effectiveness in learning Using mobile digital library would make it easier to do my assignments I would find mobile digital library useful in my study
Perceived ease of use (PEOU)	Davis (1989)	Learning to operate the mobile digital library application would be easy for me I would find it easy to get the mobile digital library application to do what I want it to do My interaction with mobile digital library application would be clear and understandable I would find mobile digital library application to be flexible to interact with It would be easy for me to become skilful at using the mobile digital library application I would find the mobile digital library application easy to use
Behavioural intention (BI)	Jeong (2011)	Assuming that I have access to mobile digital library application... I intend to continue using the application in the future I would continue using the application in the future I would regularly use the application in the future I intend to increase my use of the application in the future
System characteristics		
Relevance (REL)	Park et al. (2009)	The mobile digital library application provides up-to-date information in my area(s) of interest The services included in the mobile digital library application relate well to my needs The information I find in the mobile digital library application are generally applicable to my area of interest The mobile digital library application has enough resources for my needs In general, the information from the mobile digital library application are not relevant to me
Assistance (ASSIS)	Kim (2010)	I can get help easily from a librarian Librarians respond to my problem quickly I find librarians knowledgeable to direct me where I can find information I need I find librarians capable of directing me where I can find information

Construct	Source	Items (modified)
Personal characteristics		
Social influence (SOC)	Nysveen, Pedersen and Thorbjornsen (2005); Schierz, Schilke and Wirtz (2010)	People important to me think I should use mobile digital library application It is expected that people like me use mobile digital library application People I look up to expect me to use mobile digital library application People who are important to me would recommend using mobile digital library application People who are important to me would find using mobile digital library application beneficial People who are important to me would find using mobile digital library application a good idea
English literacy (ENG)	Park et al. (2009)	I feel comfortable reading articles in English My reading ability in English is very poor I feel comfortable using mobile applications in English language Generally, my English language is very good
Mobility (MOB)	Schierz, Schilke and Wirtz (2010)	I like to be able to keep in touch with the library everywhere I am I like to be able to coordinate my daily tasks no matter what time it is I would like to be able to coordinate my daily tasks everywhere I am I could imagine having multiple tasks at a time
Mobile self-efficacy (MSE)	Thong, Hong and Tam (2002)	I could complete a task using mobile digital library application if there was no one around to tell me what to do I could complete a task using the mobile digital library application if I had only manuals for reference I could complete a task using the mobile digital library application if someone else helped me get started I could complete a task using the mobile digital library application if I had seen someone else using it before trying it my self I could complete a task using the mobile digital library application if I could call someone for help if I got stuck I could use the mobile digital library application if I had a lot of time to complete a task I could complete a task using the mobile digital library application if I had just the built-in help facility for assistance

Construct	Source	Items (modified)
Trust (TRU)	Suh and Han (2002)	The mobile digital library application is trustworthy I trust in the benefits of this mobile digital library application This mobile digital library application keeps its promises and commitments The mobile digital library application keeps students' best interest in mind This mobile digital library application would do the job right I trust this mobile digital library application
Mobile and web search experience (EXP)	Ball and Levy (2008)	Please indicate your level of experience with the following technologies: Smartphones Mobile applications E-mail via smartphones Internet or World Wide Web via smartphones Library Database via internet Blackboard via internet Reading news or weather reports on the internet
Distinctiveness/ Prestige (PRE)	Carter and Belanger (2005)	People who use mobile applications to gather information have a high profile People who use library services on their mobile have a high profile People who use the mobile applications to gather information have high more prestige than those who do not People who use library services on their mobile have less prestige than those who do not
Interface characteristics		
Interface design (IND) *Navigation* *Terminology* *Screen design*	Navigation: Jeong (2011); Terminology: Jeong (2011); Screen design: Jeong (2011)	It is easy to navigate the mobile digital library application In the mobile digital library, I can easily navigate to where I want The mobile digital library application's directions and navigations are clear I understand most of the terms that are used throughout the mobile digital library application The use of terms throughout the mobile digital library is consistent The mobile digital library provide terms that are easy to understand The mobile digital library commands are well depicted by buttons and symbols The layout of the mobile digital library screens is clear and consistent Fonts (style, colour and saturation) are easy to read on-screen

5.3.1.2 Translation

Both an English and Arabic version of the questionnaire was developed to give students the choice of selecting the most comfortable version to answer. Translating the questionnaire was done by back-translation method (Douglas and Craig, 2007), by translating the questionnaire from English into Arabic language and then back again to English by a third-party to ensure the veracity of the Arabic version used.

5.3.1.3 Instrument validation

To assure instrument validity or the degree to which the questionnaire really measures what it supposed to measure (Pallant, 2010), the questionnaire was peer reviewed with six bilingual PhD students who were familiar with questionnaire design and who were not part of the study. Sue and Ritter (2012) mentioned that 5-10 colleagues, friends, or paid testers should be adequate to pre-test the questionnaire. They were responsible for criticizing the questionnaire items; commenting on how long it took them to complete a survey; and reporting any technical problems.

- The peer review suggested minor changes to the Arabic phrases used.
- The peer review also revealed the importance of deleting item 8 ('I could complete a task using the mobile digital library application if someone showed me how to do it first') under *Mobile self-efficacy* as the Arabic translation of it was very similar to item 3 ('I could complete a task using the mobile digital library application if someone else helped me get started').

Questionnaire validity depends on true responses that might be threatened and affected with respondents desire to appear informed, concur with social norms, or help the researcher by providing an opinion that does not exist (Sue and Ritter, 2012). Since respondents become more honest with computer screens (Sue and Ritter, 2012), this research choose online

questionnaire to increase their honesty. In addition, respondents were repeatedly reminded of questionnaire anonymity and confidentiality. Furthermore, respondents were provided with a scale that allows them to be neutral and does not force them to have an opinion.

5.3.2 Pilot testing

Pilot work refers to the process of designing and trying out questions and procedures (Oppenheim, 2001, p.47). Pretesting is the only way to evaluate in advance whether a questionnaire causes problems for respondents and leads to improved questionnaires afterwards (Presser et al., 2004). According to Sheatsley (1983), 12-25 cases are enough to discover the major difficulties and weaknesses in a pre-test questionnaire. Sudman (1983) on the other hand believes that 20-50 cases are sufficient to discover the major flaws in a questionnaire. In this research the questionnaire was pilot tested among 30 students in a government university in, Kuwait, one of the GCC countries. It was tested among both male and females; undergraduate and postgraduates from different majors; and from a wide range of ages. Respondents in pilot studies should be as similar as possible to those in the main study (Presser et al., 2004).

5.3.3 Reliability results

According to Oppenheim (2001) reliability refers to the clarity and internal consistency of a measure. In other words, reliability indicates that all items tied together and free of random errors (Sue and Ritter, 2012). After pilot testing the instrument with 30 students, the reliability has been confirmed with Cronbach's Alpha. Internal consistency usually measured by Cronbach's Coefficient Alpha available on SPSS (Pallant, 2010). The model reliability coefficient is .946 which exceeds the 0.7 cut-off value of Nunnally (1978). Table 5.5 shows the reliability results for each measure or construct.

Table 5.5: Constructs reliability for pilot testing (n=30)

Construct	Reliability in the literature	Reliability in the pilot study
Perceived usefulness (PU)	.97	.850
Perceived ease of use (PEOU)	.86	.861
Behavioural intention (BI)	.94	.816
Prestige (PRE)	.81	.705
Social influence (SOC)	.82	.753
English literacy (ENG)	.81	.828
Mobility (MOB)	.84	.806
Mobile self-efficacy (MSE)	.9	.902
Trust (TRU)	.93	.854
Relevance (REL)	.80	.670
Assistance (ASSIS)	.94	.800
Interface design (IND) Navigation+ Terminology +Screen design	.89 .88 .87	.895
Mobile and web search experience (EXP)	.85	.914

The results from the table above show that the reliability of the instrument by Cronbach's Alpha measurement ranges between 0.670-0.914. This indicates that the instrument is reliable and has a good internal consistency with the goal of this study. Although, the value of Cronbach's Alpha should not be less than 0.7 (Nunnally, 1978), the researcher decided to maintain the relevance construct as the sample size is small and might affect the reliability. In addition, Pallant (2010) mentioned that finding low Alpha is usual with scale less than 10 items.

5.3.4 Questionnaire administration

Self-administered questionnaires provide the respondents the comfort of completing the questionnaire on their own environment and without the help or hindrance of the researcher (Sue and Ritter, 2012). Based on that, this research chooses to run a self-administered questionnaire through e-mail. Basically, the respondent will be able to access the questionnaire through a hyperlink sent to him/her through questionnaire invitation. After completing the

questionnaire the respondent will submit the answers by clicking on a submit button. For privacy reasons, the invitation was sent to the research office of the university who is in turn sent it to students. To check whether participants actually watched the attached video of the mobile digital library prototype or downloaded the prototype on their mobile phones, YouTube channel, iTunes store, and Google play platforms were checked. 172 participants reviewed the prototype by watching the YouTube video; 23 downloaded the prototype through iTunes platform; while 16 participants downloaded the prototype through Google play.

5.3.4.1 The sample

Based on a convenience sampling mentioned as described in the methodology chapter, the questionnaire has been established and its link has been sent by e-mail through Zayed University Ethical Committee to all students in both campuses Dubai and Abu Dhabi. It took approximately 3 months to collect a total of 211 responses.

5.3.4.2 Demographic factors

This section provides a demographic summary of 210 participants (the reduction in sample size is based on data screening reason that will be discussed further in section 5.3.5.2.2). The questionnaire captured demographic information such as gender, age group, college, educational level, nationality and years of experience in Smartphone use. The following table exhibits the frequency and percentage distribution for each factor.

Table 5.6: Frequency and percentage distribution for demographic factors

Demographic factors		Frequency	Percentage
Gender	Male	78	37.1
	Female	132	62.9
	Total	210	100
Age group	under 20 years old	88	41.9
	between 21-25 years	77	36.7
	between 26-30 years	12	5.7

Demographic factors		Frequency	Percentage
	above 30 years	33	15.7
	Total	210	100
College	College of Education	35	16.7
	College of Business Administration	38	18.1
	College of Social Science	31	14.8
	College of Science	38	18.1
	College of Arts	31	14.8
	General	37	17.6
	Total	210	100
Educational level	Bachelor degree	182	86.7
	Master degree	17	8.1
	Doctoral degree	11	5.2
	Total	210	100
Nationality	Emirati	194	92.4
	GCC countries	12	5.7
	Other	4	1.9
	Total	210	100
Years of experience in smartphone use	Less than a year	11	5.2
	1-2 years	35	16.7
	3-5 years	89	42.4
	More than 5 years	75	35.7
	Total	210	100

- Gender

As for gender, the analysis revealed that 37.1% are male and 62.9% are female. Thus the majority of respondents were female.

- Age group

For the age group, we observe that 88 (41.9%) of respondents were under 20 years old, 77 (36.7%) were between 21-25 years, 12 (5.7%) were between 26-30 years, 33 (15.7%) were aged over 30.

- College

The research respondents were distributed among a number of colleges. The colleges of Business Administration and Science had equal responses (18.1%) followed by students of

General Studies (17.6%), Education (16.7%) and Arts and Social Science (14.8%). Those colleges consist of a number of majors as follows:

- Social science (human resources, advertising, political science, international studies)
- Science (IT, mathematics, health and nutrition, biology)
- Art (languages, multimedia, history, psychology, graphic design and art)
- Business (marketing, finance, administration)
- Education

- Education level

From table 5.6 we notice that 86.7% of the respondents are currently studying for a bachelor's degree and only 13.3% are post-graduate students or completed higher education such as master's degrees and above.

- Nationality

The analysis revealed that 92.4% are Emirati, 5.7% are from GCC countries and 1.9% are from other nationalities.

- Years of experience in smartphone use

It is noticeable that the majority of respondents have three to five years of experience with smartphone use (42.4%), followed by 35.7% with more than five years' experience and 16.7% with one to two years' experience, and 5.2% with less than a year.

5.3.5 Descriptive statistics and data screening of the main study

5.3.5.1 Descriptive statistics of construct items

This section provides a descriptive summary of participants general view towards the proposed framework constructs. Negative words in the items were reversed using reverse coding option. Appendix G-1 displays detailed information about the Mean, SD, the Frequency and Percentage Distribution for each item measuring the dependent or independent constructs.

Exploring the data revealed that participants were generally positive towards the constructs forming the proposed research framework. Participants were positive towards TAM constructs in general. The analysis revealed that mobile digital library application was generally easy to use with a mean ranged between 4.10 and 4.36 for *Perceived ease of use* items. The analysis also showed that participants found the application useful as the mean for *Perceived usefulness* items ranged between 4.12 and 4.33. The percentage of their positive attitude towards *Perceived usefulness* items ranged between 83.8% and 90.5%. Participants were also very positive towards *Behavioural intention* items with a percentage ranged between 70.9% and 90.5% and a mean between 4.12 and 4.25.

Participants formed a positive view towards the *Distinctiveness/Prestige* construct. The mean ranged between 3.03 and 3.84. Participants also showed positive views towards their *English literacy* with a mean ranged between 3.30 and 3.85. The mean for *Mobile self-efficacy* items ranged between 3.44 and 4.16 indicating a positive view towards that construct. Participants were also positive towards *Perceived trust* construct with a mean ranged between 3.91 and 4.19 and percentage ranged between 64.4% and 85.3%. The mean for assistance scale revealed participants' positive view towards assistance construct. It ranged between 3.56 and 3.87. The *Social influence* scale revealed participants' positive views towards *Social influence* construct. The mean for *Social influence* items ranged between 3.43 and 4.10. The mean for *Mobility*

items ranged between 4.16 and 4.32 and the mean for *Navigation* items ranged between 4.05 and 4.08 showing participants positive view towards *Mobility* and *Navigation*. The mean for *Terminology* items and *Screen design* items also showed participants' positive view towards such constructs with a mean ranged between 3.90 and 4.02 for *Terminology* construct and 3.88 and 3.97 for *Screen design* construct.

However, the responses towards the scale of *Mobile and web experience* ranged from some towards extensive experience. The mean ranged between 2.86 and 4.02. Participants views towards relevance construct also ranged from neutral towards positive with a mean ranged between 2.88 and 4.02.

5.3.5.2 Data screening

Data screening and looking for errors is essential prior to the actual analysis (Pallant, 2010). Data should be examined statistically through SPSS for accuracy of data entry; detecting missing values, outliers and normality.

5.3.5.2.1 Missing data

Missing data means that valid values on one or more variables are not available for analysis (Hair et al., 2010). No missing data were discovered in this research presumably due to computer-based method of data collection.

5.3.5.2.2 Outliers

Outliers are "observations with a unique combination of the characteristics identifiable as distinctly different from the other observations" (Hair et al., 2010, p.64). Outliers might have a great effect on the correlation coefficient and regression (Hair et al., 2010). It is based on the researcher's decision about whether to maintain, recode or omit such outliers. This decision is

formed based on the characteristics of the outlier and the objectives of the analysis (Hair et al., 2010; Pallant, 2010). Both univariate and multivariate outliers have been used to detect outliers.

Univariate outliers: detects outliers for cases that usually fall out of the standard ranges (± 2.5) within each variable. The threshold standard value for a larger sample than 80 however, can reach up to 4. Univariate outliers are usually represented by box plot (Pallant, 2010).

Multivariate outliers on the other hand, consider the multidimensional assessment of each observation or a case across a set of variables. A multi assessment usually addressed by the Mahalanobi D^2 that measures each observation's distance in multidimensional space from the mean centre of all observations, providing a single value for each observation no matter how many variables are considered (Hair et al., 2010). Outliers can be detected through dividing the D^2 measure by the number of variables involved (D^2/df). If the value then, is 2.5 (for small samples) or 3 or 4 (for larger samples) can be considered possible outliers (Hair et al., 2010).
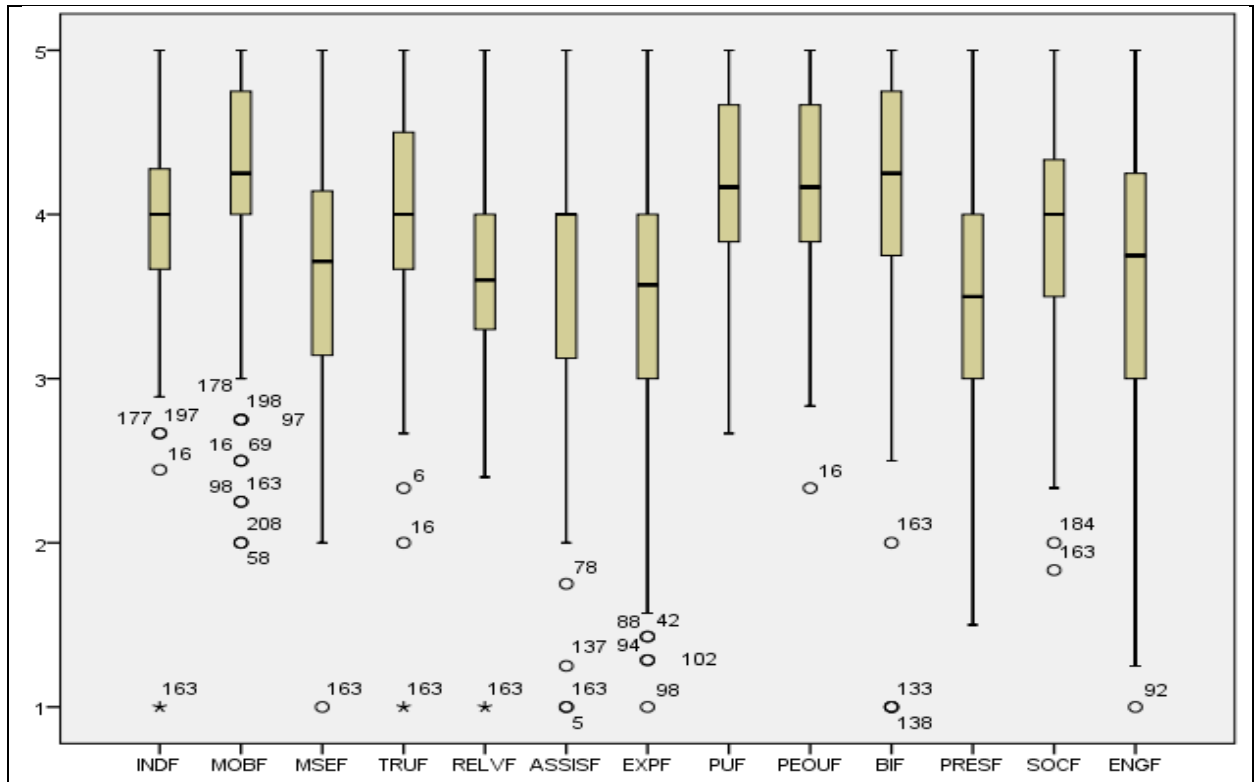
Figure 5.2: Univariate outliers

The univariate outliers represented by the box plot figure 5.2 showed 1 asterisk, indicating that one case was extreme outlier (more than 3 box-lengths from the edge of the box): case 163. This outlier has been compared against the multivariate outliers to reveal that case 163 should be removed, as shown in the following table. Hair et al. (2010) recommended that before discarding an outlier case it should be compared against multivariate diagnosis then make a decision to remove the outliers that appear across both outlier tests.

Table 5.7: Univariate and multivariate outliers results

Univariate outliers		Multivariate outliers		
Case with standard value ±4 Marked with asterisk		Case with a value of D^2 /df greater than 3 (df = 13)		
Case		Case	D^2	D^2/df
163	*	163	39.97813	3.075

5.3.5.2.3 Normality

Normality is "the degree to which the distribution of the sample data corresponds to a normal distribution" (Hair et al., 2010, p.63). Normality can be simply presented by normal Q-Q plot, Histogram, skewness and kurtosis, Shapiro-Wilks test or a modification of the Kolmogorov-Smirnov test that should be above 0.05 (Pallant, 2010).

The histogram and normal Q-Q plot shows that the data is normally distributed, as shown in Apeendix G-2 for each observation.

The statistical Kurtosis method measures the peakedness or flatness of a distribution when compared to a normal distribution. A positive value indicates a relatively peaked distribution and a negative value indicates a relatively flat distribution (Hair et al., 2010). Skewness on the other hand describes the balance of the distribution. It measures the symmetry of a distribution; in most instances the comparison is made to a normal distribution. A positively skewed distribution has relatively few large values and tails off to the right and a negatively skewed distribution has relatively few small values and tails off to the left. Skewness values falling outside the range of + 2.58 and − 2.58 indicate a substantially skewed distribution (Hair et al., 2010).

In this research, Skewness and Kurtosis test confirms the normality of distribution for all observed values falling within the range (±2.58) except for *Behavioural intention* (BI) that was somewhat Kurotitc (peaked) = 2.95 (see table 5.8). Shapiro-Wilks test and Kolmogorov-

Smirnov on the contrary suggested that the data is not normally distributed (see table 5.9 and 5.9).

Table 5.8: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
INDF	210	2	5	3.98	.549	-.080	.168	-.137	.334
MOBF	210	2	5	4.21	.633	-.790	.168	.835	.334
MSEF	210	2	5	3.67	.736	-.149	.168	-.629	.334
TRUF	210	2	5	4.02	.645	-.153	.168	-.472	.334
RELVF	210	2	5	3.73	.573	.211	.168	-.453	.334
ASSISF	210	1	5	3.73	.737	-.457	.168	.560	.334
PEOUF	210	2	5	4.20	.558	-.269	.168	-.225	.334
BIF	210	1	5	4.13	.737	-1.144	.168	2.959	.334
PRESF	210	2	5	3.50	.720	-.185	.168	-.219	.334
SOCF	210	2	5	3.91	.618	-.246	.168	-.278	.334
ENGF	210	1	5	3.66	.902	-.570	.168	-.197	.334
EXPF	210	1	5	3.50	.842	-.578	.168	.201	.334
PUF	210	3	5	4.23	.567	-.367	.168	-.495	.334
Valid N (listwise)	210								

Table 5.9: Tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
IND	.112	210	.000	.969	210	.000
MOB	.144	210	.000	.913	210	.000
MSEF	.095	210	.000	.978	210	.002
TRUF	.097	210	.000	.954	210	.000
RELVF	.089	210	.000	.973	210	.001
ASSISF	.157	210	.000	.955	210	.000
EXPF	.111	210	.000	.967	210	.000
PUF	.095	210	.000	.947	210	.000
PEOUF	.110	210	.000	.948	210	.000
BIF	.150	210	.000	.882	210	.000
PRESF	.099	210	.000	.979	210	.003
SOCF	.097	210	.000	.976	210	.001
ENGF	.126	210	.000	.954	210	.000

a. Lilliefors Significance Correction

A non-significant result that is above 0.05 indicates a normal distribution. However, all variables showed significant value. Pallant (2010) explained that Shapiro-Wilks test, Kolmogorov-Smirnov test, even Skewness and kurtosis tests are sensitive to the sample number. He recommended inspecting normality through the shape of the distribution that can be presented by Histogram and Q-Q Plot. Based on the Q-Q plot results, Histogram and Skewness and Kurtosis test data of this research assumed normal.

5.3.5.2.4 Linearity

Linearity assumes that the relationship between two variables is linear so all multivariate techniques such as multiple regression, factor analysis and SEM, are linear (Pallant, 2010). Linear models can be predicted with values that fall in a straight line in a scatter plot or by the correlation coefficient (Pearson r) (Pallant, 2010; Hair, 2010).

Correlation analysis is a useful technique for investigating a strength and direction of interactions between two variables. In this research, Pearson correlations were measured to determine the correlations between the thirteen variables: *Perceived usefulness*, *Perceived ease of use*, *Behavioural intention*, *Prestige*, *Social influence*, *English literacy*, *Mobility*, *Mobile self-efficacy*, *Mobile and web experience*, *Trust*, *Relevance*, *Assistance and Interface design.*

As shown in the following table, all the associated pairs of variables were found to be statistically positive and significant at either 0.01 or 0.05 level except the following ten pairs which found to be uncorrelated: *Perceived usefulness-Mobile and web experience*, *Behavioural intention-Mobile and web experience*, *prestige-Mobile and web experience*, *Social influence-Mobile and web experience*, *English literacy-Behavioural intention*, *English literacy-Prestige*, *Mobile self-efficacy-Mobile and web experience*, *Mobile self-efficacy-English literacy*, *Assistance- Behavioural intention and finally Assistance-Prestige*. Therefore, correlations between 68 of the 78 bivariate correlations were significant and ranged from

0.164 (p < .05) to 0.710 (p < .001), indicating a mixture of weak to strong relationships amongst the variables and a linear relationship between most variables. According to Sekaran and Bougie (2010), the correlation coefficient value (r) range from 0.10 to 0.29 is considered weak, from 0.30 to 0.49 is considered medium and from 0.50 to 1.0 is considered strong. However, according to Field (2005), correlation coefficient should not exceed 0.8 to avoid multicollinearity.

Table 5.10: Pearson correlations

		EXPF	PUF	PEOUF	BIF	PRESF	SOCF	ENGF	MSEF	TRUF	RELVF	ASSISF	MOBF	INDF
EXPF	Pearson Correlation	1	.093	.303**	.009	-.003	.127	.374**	-.033	.219**	.167*	.226**	.296**	.354**
	Sig. (2-tailed)		.178	.000	.896	.968	.067	.000	.637	.001	.015	.001	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
PUF	Pearson Correlation	.093	1	.710**	.353**	.405**	.592**	.191**	.297**	.530**	.423**	.164*	.532**	.457**
	Sig. (2-tailed)	.178		.000	.000	.000	.000	.006	.000	.000	.000	.018	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
PEOUF	Pearson Correlation	.303**	.710**	1	.357**	.382**	.601**	.311**	.240**	.584**	.450**	.196**	.622**	.559**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000	.000	.000	.004	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
BIF	Pearson Correlation	.009	.353**	.357**	1	.243**	.307**	.086	.144*	.357**	.385**	.031	.282**	.222**
	Sig. (2-tailed)	.896	.000	.000		.000	.000	.212	.037	.000	.000	.656	.000	.001
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
PRESF	Pearson Correlation	-.003	.405**	.382**	.243**	1	.481**	.026	.353**	.513**	.436**	.096	.324**	.337**
	Sig. (2-tailed)	.968	.000	.000	.000		.000	.705	.000	.000	.000	.166	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
SOCF	Pearson Correlation	.127	.592**	.601**	.307**	.481**	1	.240**	.429**	.643**	.447**	.191**	.504**	.497**
	Sig. (2-tailed)	.067	.000	.000	.000	.000		.000	.000	.000	.000	.006	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
ENGF	Pearson Correlation	.374**	.191**	.311**	.086	.026	.240**	1	.013	.218**	.203**	.225**	.295**	.304**
	Sig. (2-tailed)	.000	.006	.000	.212	.705	.000		.851	.002	.003	.001	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
MSEF	Pearson Correlation	-.033	.297**	.240**	.144*	.353**	.429**	.013	1	.427**	.331**	.316**	.276**	.283**

		EXPF	PUF	PEOUF	BIF	PRESF	SOCF	ENGF	MSEF	TRUF	RELVF	ASSISF	MOBF	INDF
	Sig. (2-tailed)	.637	.000	.000	.037	.000	.000	.851		.000	.000	.000	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
	Pearson Correlation	.219**	.530**	.584**	.357**	.513**	.643**	.218**	.427**	1	.598**	.268**	.536**	.664**
TRUF	Sig. (2-tailed)	.001	.000	.000	.000	.000	.000	.002	.000		.000	.000	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
	Pearson Correlation	.167*	.423**	.450**	.385**	.436**	.447**	.203**	.331**	.598**	1	.344**	.481**	.606**
RELVF	Sig. (2-tailed)	.015	.000	.000	.000	.000	.000	.003	.000	.000		.000	.000	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
	Pearson Correlation	.226**	.164*	.196**	.031	.096	.191**	.225**	.316**	.268**	.344**	1	.229**	.434**
ASSISF	Sig. (2-tailed)	.001	.018	.004	.656	.166	.006	.001	.000	.000	.000		.001	.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
	Pearson Correlation	.296**	.532**	.622**	.282**	.324**	.504**	.295**	.276**	.536**	.481**	.229**	1	.506**
MOBF	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001		.000
	N	210	210	210	210	210	210	210	210	210	210	210	210	210
	Pearson Correlation	.354**	.457**	.559**	.222**	.337**	.497**	.304**	.283**	.664**	.606**	.434**	.506**	1
INDF	Sig. (2-tailed)	.000	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000	
	N	210	210	210	210	210	210	210	210	210	210	210	210	210

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

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

⭕ uncorrelated pairs

5.3.5.2.5 Multicollinearity

Tolerance is an indicator of how much of the variability of the specified independent is not explained by the other independent variable in the model and is calculated using the formula: 1-R square for each variable. If this value is very small (less than .10) it indicates that the multiple correlation with other variables is very high, suggesting possible multicollinearity. VIF (Variance inflation factor) indicates whether an independent variable has a strong linear relationship with other variables. If the value of VIF is larger than 10 or less than 0.1, it indicates that the variables have multicollinearity (Pallant, 2010).

The results show no tolerance value of less than .10 and all VIF values were less than 10 and above 0.1. This indicates that there is no multicollinearity concern in this research, as shown in the following table.

Table 5.11: Collinearity

Model	Collinearity Statistics	
	Tolerance	VIF
(Constant)		
EXP1	0.179	5.573
EXP2	0.174	5.74
EXP3	0.208	4.801
EXP4	0.218	4.577
EXP5	0.405	2.47
EXP6	0.362	2.763
EXP7	0.323	3.099
pu1	0.297	3.367
pu2	0.199	5.036
pu3	0.228	4.388
pu4	0.276	3.628
pu5	0.241	4.155
pu6	0.27	3.703
peou1	0.238	4.203
peou2	0.253	3.947
peou3	0.246	4.072
peou4	0.261	3.832

Model	Collinearity Statistics	
	Tolerance	VIF
peou5	0.279	3.581
peou6	0.273	3.657
BI1	0.148	6.747
BI2	0.128	7.794
BI3	0.271	3.688
PRES1	0.247	4.044
PRES2	0.237	4.221
PRES3	0.376	2.662
PRES4	0.497	2.014
SOC1	0.434	2.303
SOC2	0.264	3.784
SOC3	0.28	3.575
SOC11	0.204	4.902
SOC22	0.214	4.67
SOC33	0.23	4.34
ENG1	0.237	4.214
ENGL2	0.401	2.494
ENGL3	0.228	4.389
ENGL4	0.255	3.922
MOB1	0.267	3.75
MOB2	0.187	5.348
MOB3	0.188	5.328
MOB4	0.425	2.355
mse1	0.386	2.59
mse2	0.266	3.764
mse3	0.235	4.264
mse4	0.254	3.941
mse5	0.236	4.232
mse6	0.377	2.653
mse7	0.34	2.945
TRU1	0.19	5.275
TRU2	0.235	4.262
TRU3	0.203	4.938
TRU4	0.197	5.07
TRU5	0.261	3.838
TRU6	0.192	5.205
RELV1	0.236	4.231

Model	Collinearity Statistics	
	Tolerance	VIF
RELV2	0.21	4.77
RELV3	0.262	3.822
RELV4	0.287	3.482
RELV5	0.376	2.661
ASSIS1	0.316	3.168
ASSIS2	0.21	4.773
ASSIS3	0.305	3.283
ASSIS4	0.278	3.596
NAV1	0.172	5.82
NAV2	0.228	4.393
NAV3	0.251	3.987
TER1	0.226	4.424
TER2	0.27	3.71
TER3	0.235	4.249
SCR1	0.334	2.99
SCR2	0.366	2.733
SCR3	0.317	3.155

5.3.5.2.6 Homoscedasticity of variance

Homoscedasticity refers to the assumption that dependent variables exhibit equal levels of variance across the range of the predictor variables. When data are grouped, homoscedasticity is known as homogeneity of variance (Tabachnick and Fidell, 2007). Analysis of residuals best illustrates this point (Hair et al., 2010). The most common test for that is Levene test. It is used to assess whether the variances of a single metric variable is being tested are equal across any number of groups. The significance value should exceed 0.05 to validate the homogeneity (Tabachnick and Fidell, 2007). Levene's test revealed that the dependent variables have equal levels of variance across the range of the predictor variables. The variances are equal between the two groups with a significant value above 0.05 to assure homogeneity, as shown below.

Table 5.12: Tests of homogeneity of variance

	Levene Statistic	df1	df2	Sig.
EXPF	.999	1	208	.319
PUF	2.242	1	208	.136
PEOUF	.115	1	208	.735
BIF	.287	1	208	.593
PRESF	1.012	1	208	.316
SOCF	.292	1	208	.590
ENGF	.702	1	208	.403
MSEF	.453	1	208	.501
TRUF	1.380	1	208	.241
RELVF	.075	1	208	.784
ASSISF	2.016	1	208	.157
MOBF	.008	1	208	.930
INDF	2.724	1	208	.100

Data screening revealed that there is no missing data, the data is normally distributed, linear, has no multicollinearity and homogeneous. It also showed an extreme outlier that was removed from the study to decrease the original sample from 211 to 210 participants.

5.3.6 Factor analysis

Exploratory Factor analysis was conducted to identify the indicators and factors considering the each construct separately. The collected data is statistically analysed by using factor analysis derived from principal component analysis and Varimax orthogonal rotation. The items were allocated to a particular construct in case their factor loadings are exceeding 50% each. Hair et al. (2010) specified factor loadings suitable for each sample size see table 5.13 below.

Table 5.13: Guidelines for identifying significant factor loadings based on sample size

Factor loading	Sample size needed for significance
.30	350
.35	250
.40	200
.45	150
.50	120
.55	100
.60	85
.65	70
.70	60
.75	50

(Hair et al., 2010, p.117)

Although the sample of this research can consider 40% factor loading, factor analysis showed a number of cross loadings. Based on that 50% factor loading was considered.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value should be .6 or above and Bartlett's Test of Sphericity value should be .05 or smaller to verify that data set is suitable for factor analysis. The KMO value in this research is .855 and Bartlett's test is significant (p = .000), therefore factor analysis is appropriate, as shown in table 5.14.

Table 5.14: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.855
Bartlett's Test of Sphericity	Approx. Chi-Square	11267.697
	df	2556
	Sig.	.000

It is noticeable that the dependant variable (*Behavioural intention*) was maintained. Item 2 and 3 under *Perceived ease of use* and items 1 and 5 under *Perceived usefulness* were removed due to low factor loading (< .05). As for the independent variables, *Mobile and web experience*, *Assistance* and *English literacy* were maintained. However, there were some variables which

had been removed from the model because their low loading ($<$ .05): item 1, 2 under *Social influence*; item 2 in Trust; item 1 in *Mobile self-efficacy*; item 5 in *Relevance*; and item 4 in *Mobility*. Other items had been combined together such as *Terminology* items, *Navigation* 1 and 2 and *Screen design* 3 (named as *INTERFACE DESIGN*). Items 1 and 2 were loading separately as one factor and *Prestige* was divided into two different factors with two items under each. For the purpose of analysing data in SEM, prestige with four items will be maintained and *Screen* items that loaded separately will not be considered in the analysis. Factor analysis result is presented in terms of factor loading and explained variance in table 5.15.

Table 5.15: Factor loading for each construct

Constructs and Items	% Exp. Var.	Factor Loading
• PERCEIVED EASE OF USE	4.28%	
PEOU1 Perceived ease of use 1		0.628
PEOU4 Perceived ease of use 4		0.584
PEOU5 Perceived ease of use 5		0.616
PEOU6 Perceived ease of use 6		0.691
• BEHAVIOURAL INTENTION	3.52%	
BI1 Behavioural intention 1		0.872
BI2 Behavioural intention 2		0.884
BI3 Behavioural intention 3		0.833
BI4 Behavioural intention 4		0.862
• PERCEIVED USEFULNESS	2.49%	
PU2 Perceived usefulness 2		0.748
PU3 Perceived usefulness 3		0.814
PU4 Perceived usefulness 4		0.688
PU6 Perceived usefulness 6		0.505
• SOCIAL INFLUENCE	3.05%	
SOC3 Social influence 3		0.653
SOC11 Social influence 11		0.604
SOC22 Social influence 22		0.686
SOC33 Social influence 33		0.768

Constructs and Items	% Exp. Var.	Factor Loading
• MOBILE AND WEB EXPERIENCE	8.06%	
EXP1 Mobile and web experience 1		0.81
EXP2 Mobile and web experience 2		0.824
EXP3 Mobile and web experience 3		0.822
EXP4 Mobile and web experience 4		0.793
EXP5 Mobile and web experience 5		0.591
EXP6 Mobile and web experience 6		0.64
EXP7 Mobile and web experience 7		0.766
• TRUST	26.83%	
TRU1 Trust 1		0.695
TRU3 Trust 3		0.661
TRU4 Trust 4		0.667
TRU5 Trust 5		0.6
TRU6 Trust 6		0.555
• MOBILE SELF-EFFICACY	3.64%	
MSE2 Mobile self-efficacy 2		0.721
MSE3 Mobile self-efficacy 3		0.763
MSE4 Mobile self-efficacy 4		0.78
MSE5 Mobile self-efficacy 5		0.763
MSE6 Mobile self-efficacy 6		0.608
MSE7 Mobile self-efficacy 7		0.681
• RELAVANCE	2.26%	
RELV1 Relevance 1		0.685
RELV2 Relevance 2		0.56
RELV3 Relevance 3		0.692
RELV4 Relevance 4		0.604
• INTERFACE DESIGN	5.72%	
TER3 Terminology 3		0.739
TER2 Terminology2		0.676
TER1 Terminology1		0.629
SCR3 Screen 3		0.553
NAV1 Navigation 1		0.547
NAV2 Navigation 2		0.503
• MOBILITY	1.89%	
MOB1 Mobility 1		0.528
MOB2 Mobility 2		0.798
MOB3 Mobility 3		0.7
• ASISSTANCE	2.35%	
ASSIS1 Assistance 1		0.664
ASSIS2 Assistance 2		0.802

Constructs and Items	% Exp. Var.	Factor Loading
ASSIS3 Assistance 3		0.829
ASSIS4 Assistance 4		0.822
• ENGLISH LITERACY	2.05%	
ENG1 English literacy 1		0.806
ENG2 English literacy 2		0.793
ENG3 English literacy 3		0.74
ENG4 English literacy 4		0.806
• PRESTIGE	1.60%	
PRE1 Prestige 1		0.637
PRE2 Prestige 2		0.68
• PRESTIGE 2	1.86%	
PRE3 Prestige 3		0.566
PRE4 Prestige 4		0.777
• SCREEN	1.45%	
SCRE1 Screen 1		0.699
SCRE2 Screen 2		0.526

5.3.7 Structural equation modelling analysis (AMOS)

As mentioned in the methodology chapter, SEM analysis and AMOS 20 software was used for model testing. SEM process consists of two phases recommended by Anderson and Gerbing (1988): developing a measurement model using CFA and structural model SEM. This analysis began with the measurement model to determine the degree to which the indicators refer to the same construct (Anderson and Gerbing, 1988), then the structural model for hypotheses testing was constructed to find the interrelations among latent constructs and observable variables in the proposed model (Schreiber et al., 2006).

5.3.7.1 The measurement model (CFA)

Measurement model involves testing the reliability of the observed variables and determining factor loadings or the interrelationship between indicators among the latent constructs. This process involves modification indexes (dropping a variable or adding a path) to drive the best indicators or latent variables before testing a structural model (Schreiber et al., 2006).

CFA in this thesis was run for the whole model consisting of 13 latent constructs: *Interface design* (IND), *Library assistance* (ASSIS), *English* (ENG), *Relevance* (RELV), *Social influence* (SOC), *Mobility* (MOB), *Prestige* (PRE), *Mobile self-efficacy* (MSE), *Trust* (TRU), *Mobile and web experience* (EXP), *Perceived ease of use* (PEOU), *Perceived usefulness* (PU) and *Behavioural intention* (BI) (see figure 5.3).
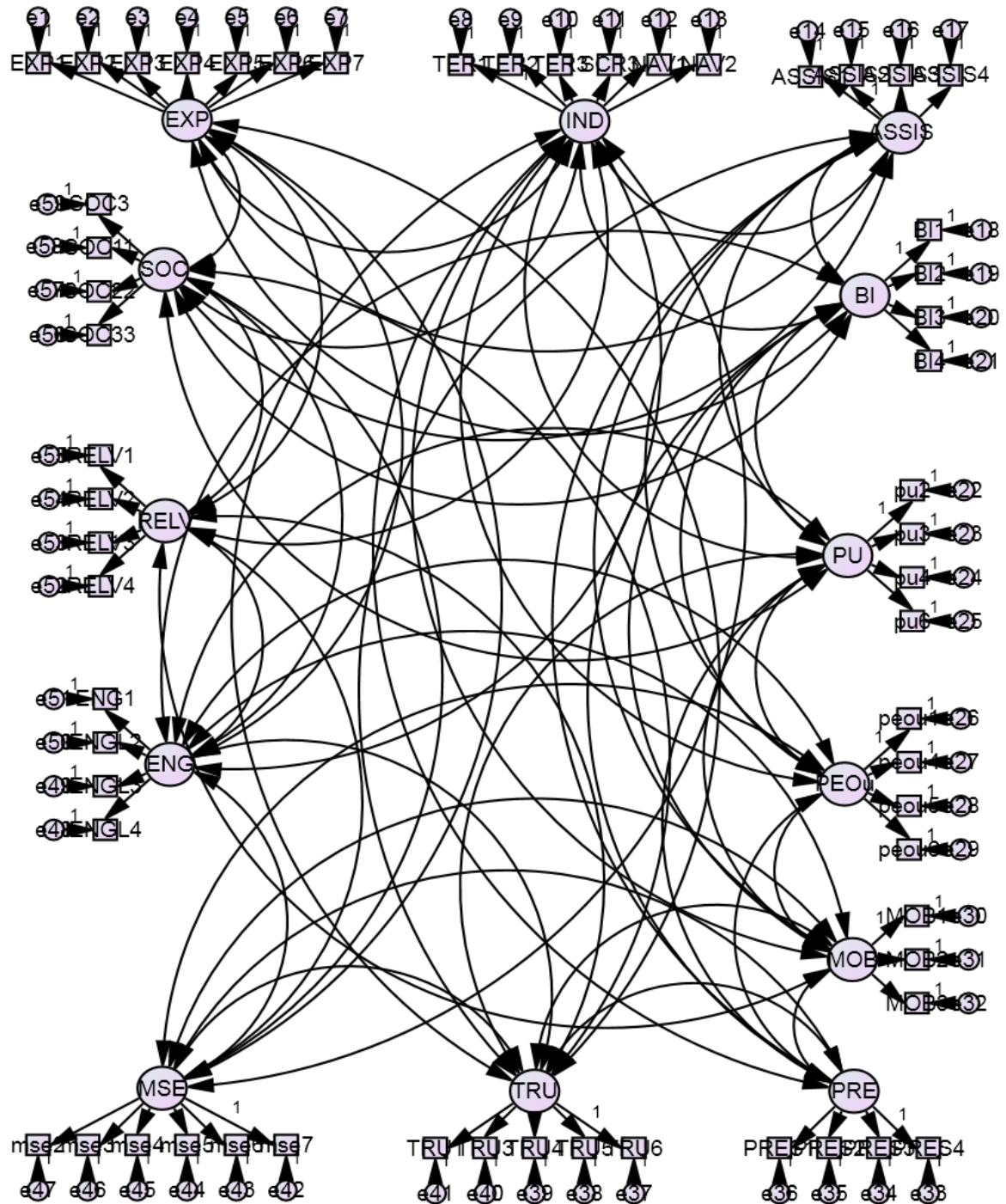
Figure 5.3: CFA model

5.3.7.2 Measurement model fit (CFA)

Measuring the model fit can be conducted based on three categorised: absolute fit, incremental fit and parsimonious fit indices (Hair et al., 1998). The absolute fit shows how well a previous model fits the sample data and which proposed model has the best fit (McDonald and Ho, 2002). This involves Chi-square (x^2), root mean square error of approximation (RMSEA), goodness-of-fit statistic (GFI) and the adjusted goodness-of-fit statistic (AGFI), root mean square residual (RMR) and standardized root mean square residual (SRMR).

Incremental fit indices on the other hand, does not rely on comparison with a baseline model but instead measures the model fit with no comparison at all (Joreskog and Sorborn, 1993). This involves normed-fit index (NFI) and comparative fit index (CFI).

Parsimonious fit depends on the sample data and usually used for complex models (Mulaik et al., 1989). It involves parsimony goodness-of-fit index (PGFI) and the parsimonious normed fit index (PNFI).

The measurement used to assess model fit for each construct in this thesis was based on chi square (x^2), normed chi square (x^2/df), GFI, AGFI, standardized RMR, RMSEA, NFI, CFI and PNFI (see table 5.16).

Table 5.16: Type of fitness

Category	Name of index	Index full name	Level of acceptance	Source
Absolute fit	x^2	Chi square	x^2, df, p > 0.05	Hair et al. (1998)
	x^2/df	Normed chi square	x^2/df < 5 preferably < 3.0	Tabachnik and Fidell (2007)
	GFI	Goodness-of-fit Index	Ranges from 0-1 GFI≥0.90 superior fit	Barbara and Byrne (2001); Joreskog and Sorbom (1993)
	AGFI	Adjusted Goodness-of-fit test	Ranges from 0-1 AGFI≥0.80 superior fit	Barbara and Byrne (2001); Wang, Lin and Laurn (2006)
	RMR	Standardized root mean square residual	Ranges from 0-1 RMR≤0.08	Barbara and Byrne (2001); Bentler (1995)
	RMSEA	Root mean square	RMSEA≤0.05 perfect	Hu and Bentler

Category	Name of index	Index full name	Level of acceptance	Source
		Error approximation	.08 reasonable .08-1 mediocre fit	(1999) Barbara and Byrne (2001)
Incremental fit	NFI	Normed Fit Index	Ranges from 0-1 NFI$\geq$0.90	Bentler and Bonett (1980)
	CFI	Comparative Fit Index	Ranges from 0-1 CFI$\geq$0.90	Hu and Bentler (1999)
Parsimonious fit	PNFI	Parsimonious Normal Fit	> 0.60	Hair et al. (2010)

The first run of the model revealed the following results [χ^2 = 3182.354; df = 1574; χ^2/df = 2.022; GFI = .676; AGFI = .636; CFI = .801; RMR = .061; RMSEA = .070, NFI = .676; PNFI = .621]. The complete results are shown in Appendix H. These results indicated a mediocre fit that can be improved. The following section illustrates the process of improving the model fit.

5.3.7.3 Reliability and validity

The next step is to evaluate the psychometric properties of the measurement model: reliability, convergent validity and discriminant validity.

Reliability measures the degree to which a set of indicators of a latent construct is internally consistent and how highly the indicators are interrelated with each other. It assures that all indicators for a construct measure the same thing (Hair et al., 2010). To test the reliability and analyse the internal consistency of the constructs, both Cronbach's α and Composite reliability were calculated. The cut-off value Cronbach's α should exceed 0.7 (Nunnally, 1978) while Composite reliability (CR) should be above 0.6 (Hair et al., 2010). Cronbach's α can be calculated in SPSS separately while (CR) depends on computing the squared sum of factor loadings (Li) for each construct and the sum of the error variance terms for a construct (ei):

$$CR = \frac{(\sum_{i=1}^{n} Li)^2}{(\sum_{i=1}^{n} Li)^2 + (\sum_{i=1}^{n} ei)}$$

Reliability was first calculated using Cronbach's α (See table 5.18). The model reliability coefficient is .937, which exceeds the 0.7 cut-off value of Nunnally (1978). The following table shows that Cronbach's α ranged between .671 and .920. All constructs in this study demonstrated acceptable reliability except *Prestige* = .671. However, deleting (PRES4) will enhance the reliability. (PRES4) will be maintained for now and compared against composite reliability.

Table 5.17: Cronbach's α reliability

Construct	No. of items	Cronbach's α	Reliability type
Perceived usefulness (PU)	4	.829	High
Perceived ease of use (PEOU)	4	.848	High
Behavioural intention (BI)	4	.920	Excellent
Prestige (PRE)	4	.671 if (PRE4) deleted .739	High
Social influence (SOC)	4	.852	High
English literacy (ENG)	4	.817	High
Mobility (MOB)	4	.751	High
Mobile self-efficacy (MSE)	6	.862	High
Trust (TRU)	6	.901	Excellent
Relevance (REL)	4	.862	High
Assistance (ASSIS)	4	.856	High
Interface design (IND)	6	.872	High
Mobile and web search Experience (EXP)	7	.889	High

Convergent validity assesses the extent to which different indicators for the measure refer to the same conceptual construct (Agarwal and Prasad, 1998). It can be measured by examining the Average Variance Extracted (AVE) that can be calculated through factor loadings and squared standardized factor loadings (squared multiple correlations) from the CFA. AVE should be 0.5 or higher; > square root of factor correlation; and > MSV the discriminant validity (Hair et al., 2010)

$$\text{AVE} = \frac{\sum_{i=1}^{n} Li^2}{n}$$

The (Li) represents factor loading and the (i) is the number of items (Hair et al., 2010).

Discriminant validity of a measure assesses if the measure is adequately distinguishable from related constructs (Agarwal and Prasad, 1998) so it investigates whether a construct is truly distinct from other constructs (Hair et al., 2010). It can be calculated by comparing AVE with the square of the correlations estimate between two constructs (MSV). The MSV should be less than AVE and less than the Average Shared Square Variance (ASV) that explains to what extent a variable can be explained in another variable. Discriminant validity: MSV < AVE, ASV < AVE. Checking the composite reliability showed no concerns. All constructs were above 0.7. On the other hand validity showed some convergent and discriminant validity concerns related to *Prestige* construct (table 5.18).

Table 5.18: Reliability and validity of variables

	CR	AVE	MSV	ASV	ASSIS	EXP	SOC	RELV	ENG	MSE	TRU	IND	BI	PU	PEOU	MOB	PRE
ASSIS	0.857	0.600	0.256	0.075	0.775												
EXP	0.896	0.560	0.158	0.070	0.231	0.748											
SOC	0.858	0.602	0.454	0.227	0.206	0.164	0.776										
RELV	0.862	0.610	0.555	0.236	0.308	0.270	0.515	0.781									
ENG	0.835	0.565	0.171	0.103	0.336	0.398	0.363	0.414	0.752								
MSE	0.863	0.516	0.171	0.071	0.327	-0.094	0.367	0.249	0.022	0.718							
TRU	0.893	0.627	0.555	0.282	0.298	0.234	0.674	0.745	0.305	0.414	0.792						
IND	0.874	0.540	0.521	0.255	0.506	0.390	0.532	0.722	0.405	0.243	0.709	0.735					
BI	0.921	0.746	0.176	0.075	0.036	-0.023	0.316	0.419	0.143	0.122	0.378	0.253	0.864				
PU	0.837	0.565	0.392	0.178	0.204	0.029	0.571	0.445	0.260	0.326	0.523	0.472	0.362	0.751			
PEOu	0.849	0.584	0.423	0.244	0.189	0.375	0.622	0.523	0.403	0.147	0.595	0.613	0.375	0.626	0.764		
MOB	0.827	0.617	0.423	0.176	0.236	0.397	0.436	0.480	0.381	0.184	0.520	0.518	0.272	0.417	0.650	0.785	
PRE	0.703	0.416	0.425	0.159	0.127	0.116	0.614	0.464	0.089	0.357	0.652	0.439	0.180	0.445	0.468	0.293	0.645

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Table 5.18 shows both convergent and discriminant validity concerns, indicating that the variables correlate more highly with variables outside their parent factor than with the variables within their parent factor (i.e. the latent factor is better explained by some other variables from a different factor than by its own observed variables) (Hair et al., 2010).

Discriminant validity:

- The square root of the AVE for PRE is less than one the absolute value of the correlations with another factor.
- The AVE for PRE is less than the MSV.

Convergent validity: - The AVE for PRE is less than the cut-off 0.50.

To enhance the model fit and fix the convergent validity and discriminant concerns, the model went through a number of refinement steps (Byrne, 2001; Hair et al., 2006):

- Standardized regression weights (SRW) (items with low loadings) less than 0.5 were dropped from the model (PRE4).
- Square multiple correlations (SMCs) < .5 were dropped from the model (MOB1, EXP6, EXP5, MSE7, MSE6, ENG2, PRE3, PRE4, PU6, EXP7)
- Standardized residual covariance (S.R.C) > |±2.58| were dropped from the model (PEOU5, PU6, PU4, ENG2, PRE3, EXP7, EXP5, MSE6, NAV2)
- Modification indexes (MI) that reveal high covariance between measurement errors accompanied by high regression weights between these errors' construct were candidates for deletion (see table 5.19).

Table 5.19: Covariance errors and regression weights

Errors	MI-covariance	Path	MI-regression weight
e20 < -- > e21	37.603	BI3-BI4	12.348
			11.484
e12 < -- > e13	25.998	NAV1-NAV2	8.088
			10.791
e8 < -- > e13	22.451	TER1-NAV2	9.344
			6.479

- The modification indexes also revealed high cross-loadings that were also deleted from the model. (TER2, PU4, PRE4, ASSIS1, SOC11, MSE5, EXP1, RELV4, TRU1, TRU4, TRU6).

Dropping these items improved both the validity and CFA model fit [χ^2 = 924.062; df = 517; χ^2/df = 1.787; GFI = .811; AGFI = .756; CFI = .902; RMR = .039; RMSEA = .061, NFI = .854; PNFI = .663]. Table 5.20 illustrates the difference between the model fit of the first run and the second run.

Table 5.20: Comparison of model fit between first and second run

	χ^2	df	χ^2/df	GFI	AGFI	CFI	RMR	RMSEA	NFI	PNFI
Standards	n.a	n.a	< 5 or < 3	0-1 ≥0.90	0-1 ≥0.80	0-1 ≥0.90	0-1 ≤0.08	≤0.05 80-.10	0-1 ≥0.90	> 0.60
1st run	3182.354	1574	2.022	.676	.636	.801	.061	.070	.676	.621
2nd run	924.062	517	1.787	.811	.756	.902	.039	.061	.854	.663

5.3.8 Structural equation model (SEM)

Finally after checking and modifying both the confirmatory model fit and construct validity, structural relationships between constructs can be measured and hypotheses can be tested (Hair et al., 2010).

Based on the same criteria used to assess the CFA model fit, the SEM model revealed a minor changes in the model fit [χ^2 = 949.620; df = 532; χ^2/df = 1.785; GFI = .805; AGFI = .756; CFI = .900; RMR = .041; RMSEA = .061, NFI = .802; PNFI = .677]. Based on that, hypothesis testing can be conducted. The proposed SEM model (with no covariance between latent constructs just for better resolution) is shown in Figure 5.4.
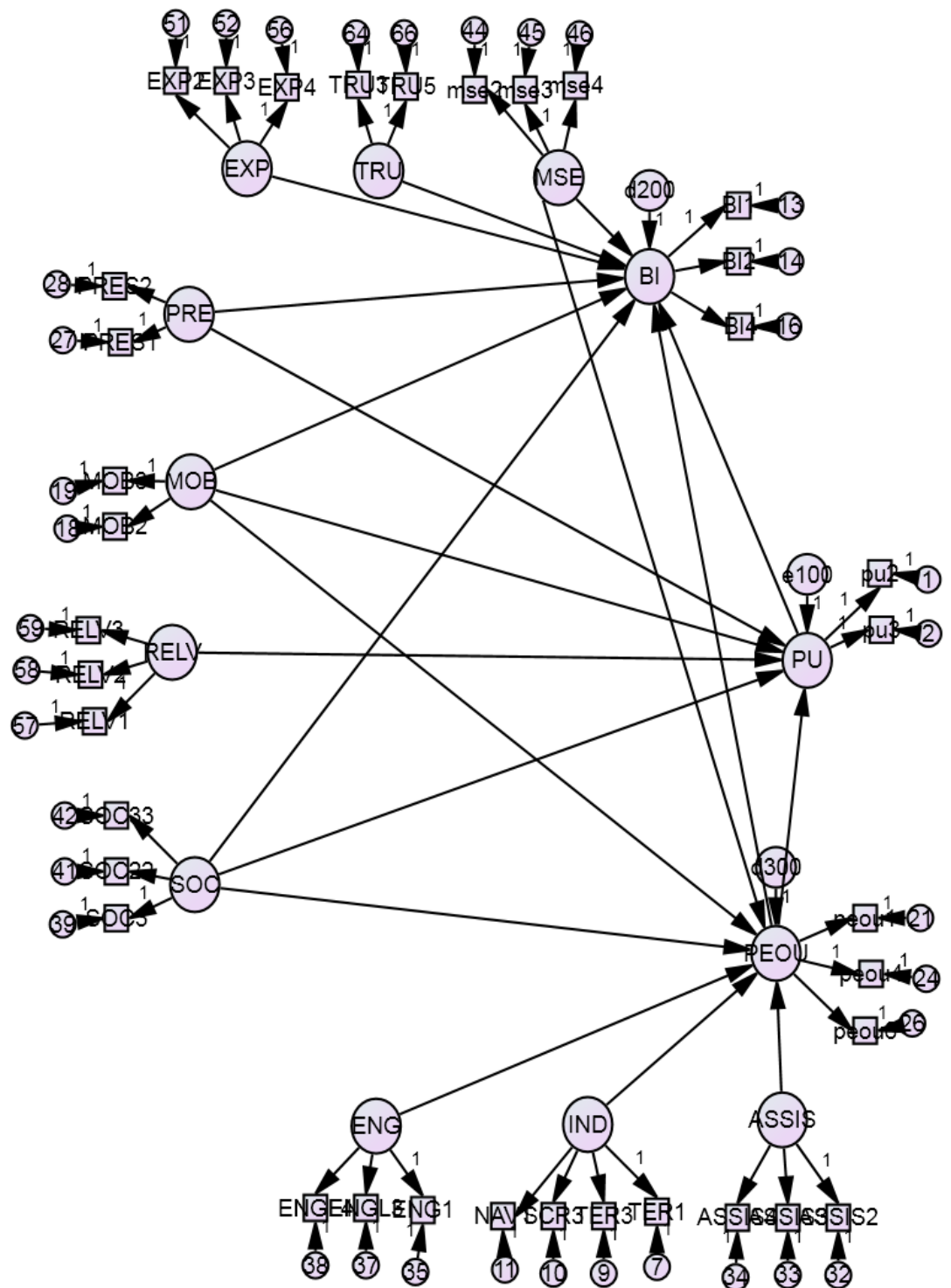
Figure 5.4: SEM model

5.4 Results

Hypotheses were tested based on factor loadings (regression weights). When CR or t-test is equals or higher than 1.96 for an estimate (regression weight), then the parameter coefficient value is statistically significant at the .05 level (Hair et al., 2010). The critical ratio or t-test was obtained by dividing the regression weigh estimate by the estimate of its standard error (S.E). Furthermore standardized factor loadings (β) were used to assess whether the significant hypotheses has a positive influence (Hair et al., 2010). Table 5.21 illustrated the results found in the model. The highlighted sections represent the significant and supported hypotheses.

Table 5.21: Factor loadings (regression weights and standardized regression weights)

H.N	Path			Estimate	S.E.	C.R.(t-value)	P	β Estimate	Label
H1	BI	< ---	PU	.233	.106	2.198	.028	.206	S
H2	BI	< ---	PEOU	.341	.170	2.004	.045	.264	S
H3	PU	< ---	PEOU	.421	.154	2.731	.006	.368	S
H4	BI	< ---	MOB	.119	.114	1.044	.296	.111	N.S
H5	PU	< ---	MOB	-.182	.100	-1.822	.068	-.191	N.S
H6	PEOU	< ---	MOB	.227	.070	3.253	.001	.273	S
H7	PEOU	< ---	ASSIS	.119	.057	2.067	.039	.158	S
H8	PEOU	< ---	IND	.369	.088	4.173	***	.427	S
H9	PU	< ---	RELV	.128	.103	1.244	.214	.125	N.S
H10	BI	< ---	SOC	.076	.137	.554	.550	.069	N.S
H11	PEOU	< ---	SOC	.243	.075	3.249	.001	.283	S
H12	PU	< ---	SOC	.217	.121	1.786	.074	.220	N.S
H13	BI	< ---	PRE	.232	.099	2.345	.019	.261	S
H14	PU	< ---	PRE	-.084	.081	-1.038	.299	-.106	N.S
H15	BI	< ---	TRU	.295	.134	2.209	.027	.280	S
H17	BI	< ---	EXP	.141	.068	2.090	.037	.176	S
H18	BI	< ---	MSE	-.039	.055	-.708	.479	-.058	N.S
H19	PEOU	< ---	MSE	-.022	.037	-.605	.545	-.043	N.S
H20	PEOU	< ---	ENG	.038	.049	.778	.436	.057	N.S
H.N (Hypotheses Number), S (supported hypotheses), N.S (Not supported) *** (p-value < .001)									

The strongest relationship was found between *Interface design* and *Perceived ease of use*. It was positive and significant with β = .427, critical ratio or t-value = 4.173 and p-value < .001. Following that, *Social influence* and *Mobility* were both positively and significantly affecting the *Perceived ease of use* with β = .283 and .273 respectively, critical ratio =

3.249 and 3.253 and p-value = .001 respectively. *Perceived ease of use* was also positively and significantly affecting *Perceived usefulness* with β = .368, t = 2.731 and p-value = .006.

The relationship between *Prestige* and *Behavioural intention* was positively significant with β = .261, t-value = 2.345 and p-value = .019. The relationship between *Trust* and *Behavioural intention* was positive and significant with β = .280, t-value = 2.209 and p-value = .027. The relationship between *Perceived usefulness* and *Behavioural intention* was also positive and significant with β = .206, t = 2.198 and p-value = .028. The relationship between *Mobile and web experience* and *Behavioural intention* was significant with a positive effect. The β value was .176 and critical ratio was 2.090 and p = .037.

The relationship between *Assistance* and *Perceived ease of use* was also found to be significant and positive. The β value was .158, the critical ratio was 2.067 (more than 1.96) and p-value was 0.39 < .05. Finally, the relationship between *Perceived ease of use* and *Behavioural intention* was positive and significant with β = .264, t = 2.004 and p-value = .045.

The relationship between *Mobility*, *Relevance*, *Social influence*, *Prestige and Perceived usefulness* however were not significant with critical ratio = -1.822, 1.244, 1.786, -1.038 respectively (below 1.96) and p-value more than the cut-off .05.

The relationship between *Mobility*, *Social influence*, *Mobile self-efficacy* and *Behavioural intention* were also not significant with t-value = 1.044, .555, -.708 respectively and p-value = .296, .550, .479.

Similarly, the relationship between *Mobile self-efficacy* and *Perceived ease of use* was not significant with critical ratio = -.605 and p-value = .545. In addition, the relationship between *English literacy* and *Perceived ease of use* found non-significant with critical ratio = .778 and p-value = .436 exceeding the cut-off .05

Data has been split into two groups: males and females to test (H16): gender is a moderator that has a significant effect on the relationship between *Perceived trust* and *Behavioural intention* to use mobile digital library application. The following table shows no difference

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between males and females regarding trust. Figure 5.5 shows the final model with supported and not supported hypotheses.

Table 5.22: Factor loadings (regression weights)

H.N	Path			Estimate	S.E.	C.R.	P	Label
H16	(M) BI	< ---	TRU	.142	.118	1.201	.230	N.S
H16	(F) BI	< ---	TRU	.265	.184	1.438	.150	N.S
H.N (hypotheses number), N.S (not supported hypotheses)								

(Solid lines represent supported hypotheses – dotted lines represent unsupported hypotheses)
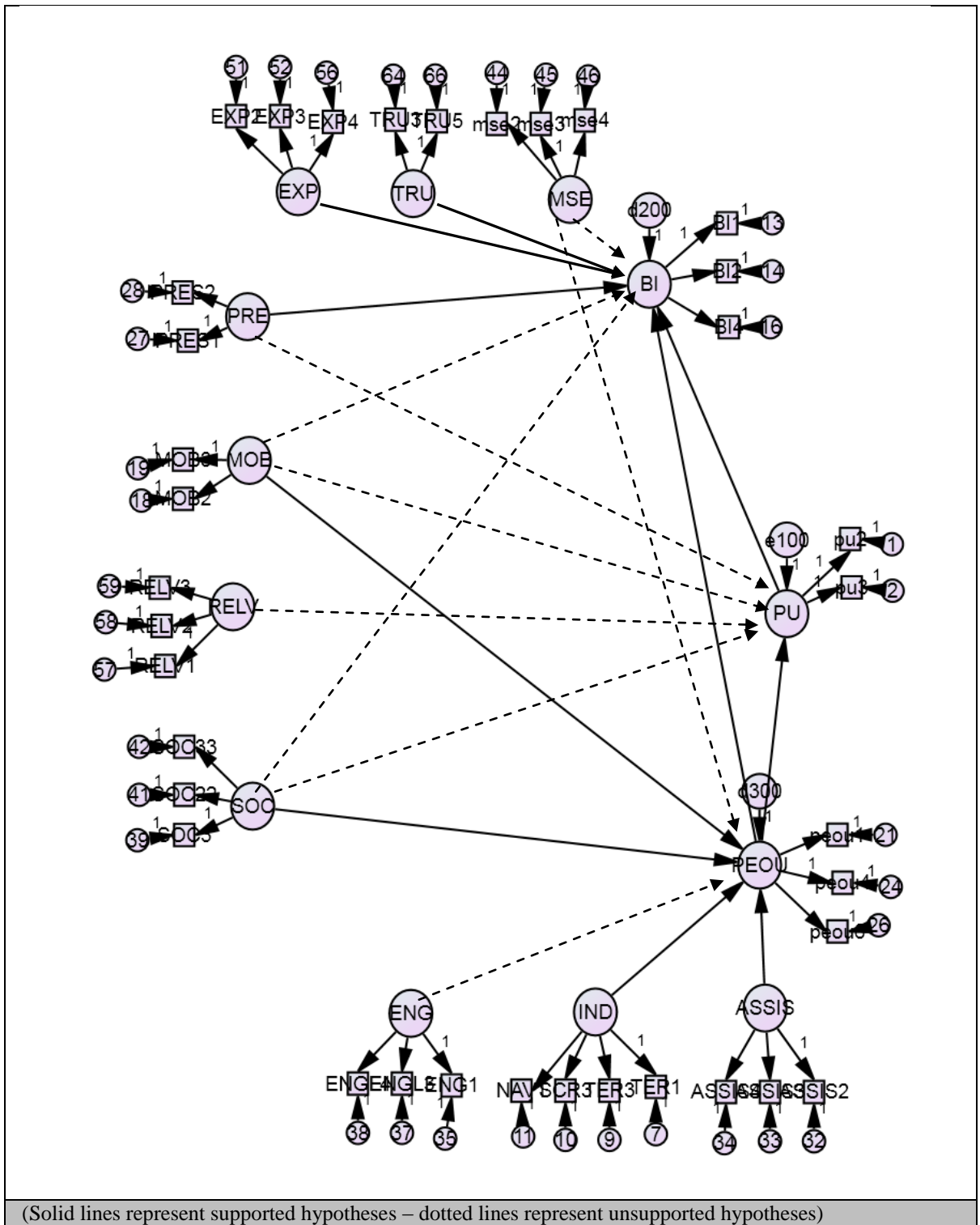
Figure 5.5: Final SEM model

The analysis revealed that *Behavioural intention* is influenced by *Trust*, *Mobile and web experience*, *Prestige*, *Perceived ease of use* and *Perceived usefulness*. The coefficient of

determination (R^2) was 0.264, indicating that 26.4% of the variance in *Behavioural intention* can be explained by those independent constructs. The analysis also showed that the coefficient of determination (R^2) for *Perceived usefulness* was 0.342, indicating that 34.2% of the variance in *Perceived usefulness* can be explained by *Perceived ease of use*. *Perceived ease of use* on the other hand was influenced by *Mobility*, *Social influence*, *Interface design* and *Assistance*. The coefficient of determination (R^2) for *Perceived ease of use* was 0.624, demonstrating that 62.4% of the variance in *Perceived ease of use* can be explained by those independent constructs.

5.5 Summary

This chapter illustrated the process of conducting the usability test and analysing data obtained to modify the mobile digital library prototype to reach its final state. This prototype was sent to all students of Zayed University accompanied with online questionnaire to help gathering quantitative data. Analysing this quantitative data using SEM fulfilled the aim of this chapter, namely to validate the proposed framework and test the hypotheses generated in the exploratory phase.

Using SPSS allowed for describing data, in terms of discovering outliers and declaring constructs' reliability, data normality, linearity, homogeneity and lack of multicollinearity. Data was modified using CFA to make sure it is reliable and valid and the model has goodness of fit. After modifying the CFA, structural relationships between 13 constructs were tested to verify hypotheses. Ten of the twenty hypotheses were found to significantly affect *Behavioural intention* (i.e. intention to use mobile digital library) either directly or indirectly through *Perceived ease of use* and *Perceived usefulness*. The following table summarizes the hypotheses results. The next chapter provides detailed discussion of the results obtained in relation to previous study findings to address the main research question and explain hypotheses.

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Table 5.23: Summary of hypotheses results

H1	Perceived usefulness – Behavioural intention	Supported
H2	Perceived ease of use – Behavioural intention	Supported
H3	Perceived ease of use – Perceived usefulness	Supported
H4	Mobility – Behavioural intention	Not supported
H5	Mobility – Perceived usefulness	Not supported
H6	Mobility – Perceived ease of use	Supported
H7	Library assistance – Perceived ease of use	Supported
H8	Interface design – Perceived ease of use	Supported
H9	Relevance - Perceived usefulness	Not supported
H10	Social influence- Behavioural intention	Not supported
H11	Social influence – Perceived ease of use	Supported
H12	Social influence – Perceived usefulness	Not supported
H13	Prestige – Behavioural intention	Supported
H14	Prestige- Perceived usefulness	Not supported
H15	trust – Behavioural intention	Supported
H16	Gender moderator – Perceived trust and Behavioural intention	Not supported
H17	Mobile and web experience – Behavioural intention	Supported
H18	Mobile self- efficacy- Behavioural intention	Not supported
H19	Mobile self-efficacy- Perceived ease of use	Not supported
H20	English literacy – Perceived ease of use	Not supported

Chapter 6: Discussion

6.1 Introduction

This thesis seeks to overcome the limitations of previous studies by focusing on the adoption of mobile digital libraries that little research considered and by concentrating on the adoption in the developing world, particularly the GCC countries, using the case of the UAE. Answering the main question of what factors affect users' intention to use mobile digital libraries in the developing world context will help to address the gap identified in the literature.

As mentioned earlier in the literature, most studies relied on TAM to explain the adoption and acceptance, while few studies focused on the three general categories of interface characteristics, personal characteristics and system characteristics that affect the intention either directly or through *Perceived usefulness* and *Perceived ease of use*. The components of these characteristics were not clearly decided. Additionally, studies that focused on these components relied heavily on quantitative approach which restricts the possibility to discover the components of these factors or find out new factors that might affect the adoption of mobile digital libraries.

In this thesis, a theoretical framework for understanding the mobile digital library adoption has been formulated and empirically tested based on mixing qualitative and quantitative methods. In a qualitative exploratory phase, a focus group study was conducted to explore the components of the three categories (interface characteristics, personal characteristics and system characteristics), to refine the preliminary framework and generate new constructs and hypotheses. Following that, an explanatory or quantitative testing phase was conducted for the sake of validating the generated framework from the exploratory phase. Both qualitative and quantitative findings from the two phases will be discussed in this chapter in relation to literature theories and models to support the findings.

6.2 Qualitative vs. quantitative findings

The results obtained from the exploratory study and the qualitative data provided an important initial contribution in this thesis. *Mobility* and *Distinctiveness* emerged as new constructs that have never been discussed in a digital library context before. The components or the definition of a number of other constructs were also modified based on participants' responses such as *Library assistance*, Interface characteristics, *Computing experience and self-efficacy* to suit the new mobile digital library context. Moreover, the analysis of the qualitative data obtained from focus groups revealed that not all proposed constructs and relationships from the literature were supported in a mobile digital library context (e.g. *System accessibility* and *Domain knowledge* were not supported).

Constructs and relationships which emerged in the exploratory phase were tested later on in an explanatory or testing phase. Statistical testing was conducted for the sake of validating the refined theoretical framework and testing hypotheses raised in the exploratory phase. Some of these hypotheses or relationships were supported while others found not significant. Three constructs (*Relevance*, *Mobile self-efficacy* and *English literacy*) were also removed from the final model for non-significant effect. The following sections provide detailed information about the results of each relationship. They begin by validating TAM the base model of mobile digital library framework, and then the external factors and their relationship with TAM constructs are discussed.

6.3 Validation of TAM

TAM, as mentioned in chapter 2, assumes that *Perceived ease of use* and *Perceived usefulness* are the main determinants of *Behavioural intention* to use new information systems (Davis, 1989). *Perceived ease of use* is the extent to which a person believes that using a system will be free of effort (Davis, 1989), while *Perceived usefulness* is the degree to which a person believes that using a system will enhance his/her job performance (Davis, 1989). The initial descriptive statistics demonstrated the importance of TAM constructs. Generally, participants were very positive towards intention to use mobile digital library application with an average ranges between 3.98 and 4.25. They intend to

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continue using the mobile library application and increase that use in the future. Participants were also very positive towards the ease of use the application with an average ranged between 4.10 and 4.36. They thought that learning to operate the application and becoming adept in its use would be easy; it is perceived (and indeed designed) to be an easy and flexible application with which to interact. Similarly, participants were very positive towards the usefulness of the application, with an average score of between 4.12 and 4.33. They felt that the application would improve their performance and increase their learning productivity.

Although the original TAM explained 40-50% of the variance in the *Behavioural intention* (Venkatesh and Davis, 2000; Wu et al., 2011), in the UAE context only 26.4% of the variance was explained by this variable. The major variance was explained by *Perceived ease of use* (62.4%), followed by *Perceived usefulness* (34.2%) as the two main determinants of *Behavioural intention* in TAM. Jeong (2011) and Thong, Hong and Tam (2002) in the context of library acceptance found that *Perceived usefulness* (43.9%; 50.5%) and *Perceived ease of use* (40.8%; 64.4%) explain more variance than the *Behavioural intention* (36.9%; 34.8%). Kim, Choi and Han (2009) in the context of mobile services acceptance also found that *Perceived usefulness* explains more variance (31%) than *Behavioural intention* (27%). Even among TAM2 model it was found that *Perceived usefulness* explained more variance (60%) than the *Behavioural intention* (52%) (Venkatesh and Davis, 2000). Therefore, the results of this thesis are consistent with prior research that validated TAM in the digital library context and mobile services.

6.3.1 Perceived usefulness (PU) and Behavioural intention (BI)

Perceived usefulness was found to affect *Behavioural intention* in multiple IS application areas, including mobile digital libraries (Goh, 2011; Goh and Liew, 2009). Focus group results suggested the importance of that relationship in a mobile digital library context. Participants clearly mentioned that they will use the mobile digital library application because it is useful, facilitates their work and solves so many issues. Similarly, quantitative results validated the significance of this relationship. The relationship between *Perceived usefulness* and *Behavioural intention* was positive and significant with $\beta = .206$, $t = 2.198$

and p-value = .028. Therefore the result in the mobile digital library context was consistent with TAM.

6.3.2 Perceived ease of use (PEOU) and Behavioural intention (BI)

A number of prior studies including studies in the mobile digital library context found that *Perceived ease of use* affects both the *Behavioural intention* and *Perceived usefulness* (Goh, 2011; Goh and Liew, 2009). Focus group results supported that relationship in a mobile digital library context. Participants' were concerned about the ease of the application. They mentioned if it is not easy, they will not use it. The statistical analysis also supported that relationship. The relationship between *Perceived ease of use* and *Behavioural intention* was positive and significant with $\beta = .264$, $t = 2.004$ and p-value = .045. However, this relationship was found as the weakest relationship among TAM constructs and among the entire constructs of mobile digital library framework. This finding is consistent with that of Davis (1989), namely that *Perceived usefulness* was more strongly linked to usage than *Perceived ease of use*. He explained that users are usually attracted to an application because of the functions it performs for them and then they considered how easy or hard it is for them to get the system perform these functions.

6.3.3 Perceived ease of use (PEOU) and Perceived usefulness (PU)

Prior studies in the mobile digital library context also found that *Perceived ease of use* affects *Perceived usefulness* (Goh, 2011; Goh and Liew, 2009). Focus group results supported that relationship. Participants mentioned that by making the application easy to use, it will better facilitate their work and serves their needs. Validating the results quantitatively, revealed that the relationship between *Perceived ease of use* and *Perceived usefulness* is the strongest among TAM relationships. The quantitative results in this thesis showed that *Perceived ease of use* was positively and significantly affecting *Perceived usefulness* with $\beta = .368$, $t = 2.731$ and p-value = .006. *Perceived ease of use* has less impact on the intention directly than indirectly through *Perceived usefulness*, supporting Kim, Mirsumonov and Lee's (2010) results in a mobile service context and Goh and Liew

(2009) in mobile digital library context. The easier the mobile digital library application, the less effort needed to operate it.

6.4 External factors

TAM, as discussed in chapter 2, allows the addition of external factors. To explain *Behavioural intention* to use the mobile digital library application, a number of external factors falling in the three general categories (interface characteristics, personal characteristics and system characteristics) formed the preliminary framework to explain the adoption of mobile digital libraries. Mixing qualitative and quantitative methods helped refining that framework and validating the relationships proposed. The following subsections discuss the constructs that were found to have a significant impact on *Behavioural intention* through *Perceived ease of use*, followed by constructs that showed significant effect on the intention directly as no constructs affecting *Perceived usefulness* were found.

6.4.1 Factors affecting Perceived ease of use (PEOU)

6.4.1.1 Interface characteristics *(Interface design-IND)*

Interface characteristics or *Interface design* is the medium between the system and the user and the platform for user action. It consists of terminology, screen design and navigation (Thong, Hong and Tam, 2002). In this thesis, *Interface characteristics* are believed to enhance the usability of mobile digital library application and affect students' acceptance of such system. Focus group results in this thesis supported previous studies (Jeong, 2011; Thong, Hong and Tam, 2002), and pointed out students' major interest in Interface characteristics. However, focus group results contributed in adjusting the components of Interface characteristics in a mobile digital library context. It proposed that Interface characteristics involves a broader *Interface design* concept that includes not only terminology, screen design and navigation but also customization, screen size and the use of images and shortcuts. Supporting prior studies in the context of digital libraries

acceptance, focus group results suggested a relationship between *Interface design* and *Perceived ease of use* (Jeong, 2011; Thong, Hong and Tam, 2002).

Interface characteristics was found to affect *Perceived ease of use* of digital library system (Jeong, 2011; Ramayah, 2006; Thong, Hong and Tam, 2002), was validated and supported in a mobile digital library framework. The descriptive statistics revealed a very positive view towards *Interface design* with a mean ranging between 3.88 and 4.08. The participants felt that the application is easy to navigate; the terms are understandable and easy; and the screen layout and fonts are clear and consistent. The very positive view of participants towards *Interface design* (between 73.8% and 80.5%) in this research proves that the user-centred design process was an effective method.

Interestingly, the quantitative results in this thesis showed that *Interface design* had the strongest relationship with *Perceived ease of use*. The relationship was found to be positive and significant with β = .427, critical ratio = 4.173 and p-value < .001, indicating that in the context of mobile digital library, users' perception of the ease of the application is highly influenced by the *Interface design*. The first thing that would affect their perception of the ease of mobile digital library application is the presentation of the system and how usable and user-friendly it is. Library users would be looking for an application that has clear terminology with no technical jargons to match their needs. They would be looking for an attractive screen that consists of images and short navigation steps. They want a proper screen design that allows for customization and shortcuts.

6.4.1.2 Personal characteristics (Social influence-SOC)

Social influence refers to the pressure from social networks to make or not to make certain behavioural decisions (Lu, Yao and Yu, 2005). *Social influence* was one of the personal characteristics discussed in digital library (Kim, 2010b; Miller and Khera, 2010), mobile service (Lu et al., 2008) and in mobile learning acceptance contexts (Park, Nam and Cha, 2012), yet not in a mobile digital library context. *Social influence* in this thesis was predicted to affect students' *Behavioural intention* toward the mobile digital library application. As predicted, focus group results highlighted the importance of the social network and their influence on students' behavioural decision towards a new context,

mobile digital library. Students showed an initiation of consulting their friends and teachers about the mobile digital library application. They also mentioned that they would influence their friends and push them to use such app.

Consistent with prior studies in the context of internet use, mobile commerce and e-services (Bahatti, 2007; Fusilier and Durlabhji, 2005; Liao, Chen and Yen, 2007), focus group results in this thesis proposed a direct possible relationship between *Social influence* and *Behavioural intention* to use mobile digital library service. It also suggested an indirect relationship between *Social influence* and the intention through *Perceived usefulness*, similar to prior studies in the context of mobile commerce, e-services and e-learning (Bahatti, 2007; Lee, 2006; Liao, Chen and Yen, 2007). Finally, it suggested that *Social influence* would affect *Perceived ease of use*, similar to the contexts of e-library, mobile services and mobile learning (Kim 2010b; Lu et al., 2008; Park, Nam and Cha, 2012).

Contrary to the hypotheses raised in the focus group, the quantitative results in this thesis revealed that the direct relationship with the *Behavioural intention* and the indirect relationship with *Perceived usefulness* were not significant in this research, consistent with the findings of Lu et al. (2008) and Lu, Yao and Yu (2005) in a mobile service context. The non significance effect of these relationships might be related to the use of generic measure - if split into peer and superior social influence might provide different effect. *Social influence* was found to affect the intention only through *Perceived ease of use*, supporting previous results in a digital library context (Kim 2010b). As predicted, the relationship between *Social influence* and *Perceived ease of use* was among the strongest relationships (β = .283, critical ratio = 3.249 and p-value = .001). The descriptive statistics also revealed participants' positive view towards the *Social influence* with an average ranged between 3.43 and 4.10. Therefore, users' friends and teachers would affect their perception of how easy the mobile digital library application is to use.

6.4.1.3 System characteristics (Mobility-MOB)

Mobility is one of the new constructs that emerged from the focus group study and contributed to the significance of the results of this thesis. The *Mobility* construct has never been discussed in a digital library context before. *Mobility*, which refers to the ability to

connect anywhere, anytime (Kargin, Basoglu and Daim, 2009), was a highly important issue raised by all focus groups, so it was expected to affect the *Behavioural intention* to use mobile digital library.

Prior studies found that *Mobility* affects the *Behavioural intention* directly in the context of mobile services (Schierz, Schilke and Wirtz, 2010) and indirectly through *Perceived usefulness* in the context of mobile services, m-learning (Huang, Lin and Chuang, 2007; Kargin, Basoglu and Daim, 2009), and through *Perceived ease of use* of mobile services (Kim, Mirusmonov and Lee, 2010). Focus group results proposed the same direct and indirect relationships; however, the quantitative study supported only the relationship between *Mobility* and *Perceived ease of use*. The relationship between *Mobility* and *Perceived ease of use* was highly supported with β = .273 critical ratio = 3.253 and p-value = .001. Based on that, the *Mobility* of smartphones in the mobile digital library context makes it easy for students to use library services anytime, anywhere. This highly significant relationship was expected as the initial descriptive statistics indicated a highly positive view towards *Mobility*. Participants' positive view ranged between 4.08 and 4.32. They were positive towards coordinating their daily tasks, especially library-related tasks, on an anytime, anywhere basis.

6.4.1.4 System characteristics (Library assistance-ASSIS)

Library assistance refers to the extent to which librarians were helpful when assistance was needed (Park et al., 2009). As predicted, focus group results revealed that participants are in need for *Library assistance*. However, the results suggested that *Library assistance* involves personal assistance from librarians and teachers along with technical support. Students expected assistance in using the app and finding resources on the app from librarians and teachers.

Prior studies found that *Library assistance* affects both *Perceived ease of use* (Kim, 2010b; Park et al., 2009) and *Perceived usefulness* of e-library use (Park et al., 2009). However, focus group results indicated a possible relationship only between *Library assistance* and *Perceived ease of use*. This relationship was validated and supported in a mobile digital library context. The relationship between *Assistance* and *Perceived ease of use* was found

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to be positively significant (β value .158, critical ratio 2.067 [more than 1.96] and p-value < .05). Students were positive towards the availability of assistance (mean 3.56 to 3.79). Assistance and technical support would make the mobile digital library easier to use.

6.4.2 Factors affecting Behavioural intention (BI)

6.4.2.1 Personal characteristics (Distinctiveness/Prestige-PRE)

Distinctiveness/prestige was among the new constructs which emerged from the focus group and contributed to the significance of this study. *Prestige* refers to students' belief that the mobile digital library system will improve their status. *Prestige* has not been discussed in a library setting, and the focus group study allowed for exploring such a construct. Students mentioned that they would use the mobile digital library application *because* it is a new system that they have not heard about before.

Image, a similar construct identified in previous mobile service use studies, was found to directly affect the *Behavioural intention* (Hong, Tam and Kim, 2006) and through *Perceived usefulness* (Kargin, Basoglu and Daim, 2009). The focus group results proposed similar relationships for *Prestige*. However, the quantitative results showed that *Prestige* affects only *Behavioural intention* to use mobile digital library directly. The relationship between *Prestige* and *Behavioural intention* was found to be positively significant, with β = .261, t-value = 2.345 and p-value = .019. This indicates that users think that the use of mobile digital library would raise their profile/status. *Prestige* is an important factor that would affect students' *Behavioural intention* to use mobile digital library.

6.4.2.2 Personal characteristics (Trust-TRU)

Trust means users' belief or faith in the degree to which a particular mobile application has no security or privacy threats (Gao, Krogsite and Gransaether, 2008). Focus group results pointed out the importance of *Perceived trust* yet broaden that concept to include judgments about security, reliability and credibility. Interestingly, focus group results also suggested a difference between male and female students when it comes to their perception of security of their accounts and mobile payments.

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Prior studies found that *Perceived trust* affects intention to use mobile services and mobile learning directly (Gao, Moe and Grogsite, 2010; Roine, 2011) and through *Perceived ease of use* (Lu et al., 2008). *Trust* has also been found to affect *Perceived usefulness* in the context of mobile services and digital libraries (Lu et al., 2008; Miller and Khera, 2010). Focus group results however proposed that *Perceived trust* affects *Behavioural intention* directly and that gender affects users' judgments of security. The quantitative results supported the importance of *Perceived trust* construct as students were positive towards it (mean between 3.91 and 4.19).

The relationship between *Perceived trust* and *Behavioural intention* was positive and significant with $\beta = .280$, t-value = 2.209 and p-value = .027. This relationship indicates that students are concerned about the security of their accounts, the reliability of the information provided in the application and the credibility of the developer. *Perceived trust* is an important factor to positively influence students' *Behavioural intention* to use mobile digital library application. The quantitative analysis however showed no difference between female and male students. This might be related to the relatively small sample size (n = 210) and the dominance of female participants (n = 132).

6.4.2.3 Personal characteristics (Mobile and web search experience-EXP)

Mobile and web experience emerged in the focus group and is an adapted version of computer experience proposed in the literature (Thong, Hong and Tam, 2002). Focus group results revealed that users with no smartphone background were against the idea of using library services through smartphones; while experienced users felt it is inevitable matter in the future that everyone will be using smartphones.

Focus group results indicated that *Mobile and web search experience* was expected to be a barrier to adoption. In the digital library context, Thong, Hong and Tam (2002) and Park et al. (2009) found that the relationship between experience and *Perceived ease of use* was significant; while Ramayah (2006b) and Miller and Khera (2010) found this relationship not-significant. The adapted version from focus group results however, proposed a new relationship that may not be discovered otherwise. *Mobile and web search experience* would affect *Behavioural intention* to use mobile digital library system directly. The

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relationship between *Mobile and web experience* and *Behavioural intention* was found significant with a positive effect. The β value was .176 and critical ratio was 2.090 and p = .037. This result supports the focus group results that *Mobile and web search experience* is a barrier to adoption. The more users' level of *Mobile and web search experience* increases, the greater its impact on their *Behavioural intention*.

6.5 Non-significant factors

6.5.1 System characteristics (Relevance, RELV)

Relevance in the context of digital libraries refers to the extent to which the library provides resources that match student needs (Thong, Hong and Tam, 2002). *Relevance* based on focus group results is dynamic and context dependent. Different functions would be relevant in different contexts of use.

Previous studies found that *Relevance* affect both *Perceived usefulness* and *Perceived ease of use* of library services and mobile services (Kargin Basoglu and Daim, 2009; Phan et al., 2010; Thong, Hong and Tam, 2002). Focus group results supported the proposition of previous studies that it might have an effect on the *Perceived usefulness* only. The initial descriptive statistics showed that students were neutral or positive towards *Relevance* construct with an average between 2.88 and 4.02. They think that the mobile library application provides up-to-date information and enough resources that relate well to their needs. Quantitative results however showed that *Relevance* has no significant impact on *Perceived usefulness*. The relationship between *Relevance* and *Perceived usefulness* was not significant, with critical ratio = 1.244 (below 1.96) and p-value more than the cut-off .05. The non-significant relationship was also found in digital libraries context (Vaidyanthan, Sabbaghi and Bargellini, 2005). They explained that users employ different criteria in making their own evaluation of *Relevance*.

6.5.2 Personal characteristics (Mobile self-efficacy, MSE)

Self-efficacy refers to an individual judgment of his/her capability to use a computer (Compeau and Higgins, 1995). *Mobile self-efficacy*, derived from self-efficacy, is a

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narrower concept which emerged from the focus group results. Participants mentioned that their generation is all about technology, which facilitates the use of mobile digital library application.

Prior studies found that self-efficacy affects the intention directly in the context of mobile services (Wang, Lin and Luarn, 2006) and indirectly through *Perceived usefulness* and *Perceived ease of use* in the context of mobile digital libraries (Goh, 2011; Goh and Liew, 2009). Focus group results suggested a direct relationship between *Mobile self-efficacy, Behavioural intention* and *Perceived ease of use*. The initial descriptive statistics revealed students positive view towards their self-efficacy with an average between 3.44 and 4.16. Their responses indicated that they were sure about their capability of mobile digital library application usage, and that they can use the application without the need for manuals or someone to show them how to use it.

Surprisingly, both direct relationships with the *Behavioural intention* and *Perceived ease of use* were found to be insignificant in the quantitative validation process. The relationship between *Mobile self-efficacy* and *Behavioural intention* was not significant, with t value = -.708 and p-value = .479. The relationship between *Mobile self-efficacy* and *Perceived ease of use* was also not significant with critical ratio = -.605 and p-value = .545. The insignificancy of this relationship is probably due to the students who participated in this study already being literate and proficient in smartphone use. Nov and Ye (2009), who found the same non-significant result, explained that users might believe the system is easy, but they cautioned that this is not necessarily associated with their confidence in their ability to use it properly. Furthermore, Jeong et al. (2011) explained that giving demonstration sessions may give a feeling of self-efficacy. This thesis provided participants with a tutorial video of the mobile digital library features and services and provided them with the opportunity to interact with an active prototype that might gave them a sense of self-efficacy and negate the effect of *Mobile self-efficacy* construct.

6.5.3 Personal characteristics (English literacy, ENG)

Prior studies found that English language skill is a barrier to using digital library systems (Byrne, 2003) or the internet in general (Du, 1999). Since this research was conducted in

one of the developing countries where Arabic is the first language, English language was proposed to be a barrier of mobile digital library use. The necessity of English language skills in order to understand the system (Park et al., 2009) was supported in the focus group. Users clearly mentioned that they would like to have the chance to have both Arabic and English language on the mobile digital library application. They also mentioned that they were concerned about first-year students who are generally less advanced in English language.

A prior study found that English skills affect the intention through *Perceived ease of use* and *Perceived usefulness* of e-library use (Park et al., 2009). Focus group results revealed a possible relationship between *English literacy* and *Perceived ease of use* only. Quantitatively, this relationship was not supported. The relationship between *English literacy* and *Perceived ease of use* was found to be insignificant, with critical ratio = .778 and p-value = .436, exceeding the cut-off .05. This corroborates the findings of Miller and Khera (2010), who also found this relationship to be insignificant in a digital library context. In this thesis, the prototype sent to students offered both English and Arabic versions, which may negate the effect of *English literacy*. The non-significant relationship between *English literacy* and *Perceived ease of use* might also be related to the high literacy of students. The initial descriptive statistics revealed that students were positive and comfortable about their English skills and the use of mobile applications in English (the average ranged between 3.30 and 3.85). In GCC countries and the UAE in particular, students start to study English language from the elementary education level. Mentioning the need for both languages in the application might only relate to students' matter of choice. Using applications in their mother language might make them more comfortable but not necessarily affecting their intention of use.

6.6 Summary

This chapter discussed and interpreted the qualitative and quantitative findings of this thesis in detail. The use of mixed-method approach for data collection and analysis contributed to a better understanding and a clearer and more comprehensive interpretation of findings about factors affecting *Behavioural intention* to use mobile digital library in

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developing countries. The qualitative focus group study or the exploratory phase helped in refining the theoretical framework and proposing new constructs and hypotheses. The quantitative analysis of online questionnaire conducted in the testing phase helped in validating the proposed framework and testing the hypotheses raised in the exploratory phase. To some extent, there was consistency between the qualitative and quantitative findings. As expected, a number of differences between qualitative assumptions and quantitative statistical results emerged; however, it should be noted that the former are based on a small sample and are insufficient for most generalization purposes.

In general, the results offer better understanding of factors affecting intention to use mobile digital libraries in the developing world. In the next chapter, a summary of the key findings of this research is presented, highlighting the contribution of this thesis in relation to theory, practice and methodology. It also provides information about potential limitations and suggests future directions of this research.

Chapter 7: Conclusion

7.1 Introduction

This chapter reports the overall summary and conclusion of this thesis. It presents how the aim and objectives of this research, discussed in chapter 1, were fulfilled. It begins with a summary of each chapter comprising this thesis accompanied by the research findings pertinent to the research objectives. The contributions of this research to theory, methodology and practice are then outlined. Finally, it identifies the research limitations and suggests areas for future research.

7.2 Research summary (motivations, aim and objectives)

This thesis is organized in seven chapters to fill the knowledge gap found by reviewing the literature and to meet the aim and objectives of this thesis. A summary of the rationale and steps of conducting previous six chapters will be presented in this section along with a discussion of the findings.

Chapter 1 introduced the field of mobile digital library and the motivation of conducting this research. It explained that providing library services through smartphones might enhance the image of libraries and meet users' needs. Students are increasingly using smartphones to access online services suggesting that they may also be willing to use library services through such innovation. However, the literature revealed that factors that may affect users' intention to use mobile digital library were not identified. Besides, the mobile digital library implementation was limited and restricted to developed countries. Even the process of the implementation was not based on users' perspectives. Based on that, there was a demand to understand what might affect students' decisions whether to use such service or not. This thesis aimed to provide a framework to better understand the factors that may affect students' intention to use mobile digital library service in one of the developing countries, the UAE.

To fulfil objective 1, to understand the current state of the art in the adoption of mobile digital libraries and to set a background theory for conducting this research, **chapter 2**

reviewed literature concerning related theories and areas such as intention to use digital libraries, mobile services in general and mobile services in higher education to understand limits of the current knowledge; thus it identified gaps in the literature that this study sought to address.

By reviewing theories and models from related areas, a preliminary framework for mobile digital library adoption was formed based on TAM, the most validated model in IS and mobile digital library related fields. A number of mutual external factors that have been validated in all related areas were added to the original TAM. Interface characteristics, personal characteristics and system characteristics were considered in the preliminary framework development to cover the limitations found in the literature that concentrated on one type of the characteristics at a time. This chapter achieved objective 3, which focused on developing an initial framework for mobile digital library adoption.

Chapter 3 established the basis of the methodological aspects of this research. It justified the selection of the positivist approach as the general philosophical assumption upon which this research was constructed, and justified the rationale for the selection of survey strategy and mixed-methods approach. The process of collecting and analysing data was organized into an exploratory phase, a pre-testing phase and a testing or confirmatory phase. Furthermore, this chapter provided detailed information about the convenience and quota sampling techniques used in this research. This chapter also followed the reliability and validity criteria that contributed to the quality of this research. Finally, this chapter provided an overall plan of data collection and analysis methods, computer tools that helped in the analysis of data collected and the expected outcomes of such analysis.

Chapter 4 discussed the exploratory phase of this research. The exploratory phase is a strategy that helped in filling the literature gap which relied heavily on quantitative methods. Exploratory studies allows for discovering new factors that quantitative methods fail to achieve. Since the adoption of mobile digital library is a new area about which little is known, the exploratory phase was found to be the most suitable strategy to collect data. The exploratory phase of this research involved two studies: focus group and card sorting. During the focus group study participants were exposed to an initial mobile digital library prototype that was designed based on the literature and contributed to meeting objective 2,

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which focused on designing an initial mobile digital library prototype to use as stimulus in the focus group for generating users' views and opinions about mobile digital library features to encourage adoption. By exposing the participants to the initial prototype, their needs in relation to library services were discovered and used for refining the prototype. The prototype and services were further refined by card sorting method as services were organized based on their communality to participants. The focus group study also allowed for generating hypotheses and refining the preliminary framework proposed from the literature. In other words, it allowed for meeting objective 3, namely deriving an initial theoretical model/framework to explain mobile digital library adoption.

Chapter 5 was divided into two main parts to fulfil the two remaining objectives. To complete objective 4, a pretesting phase was conducted to further refine and test the prototype to reach its final status. This prototype was used as a probe in the next quantitative testing phase using survey. The data was collected through online survey and analysed using SEM. This part of **chapter 5** involved an in-depth statistical testing to the generated hypotheses and helped in refining the previous framework generated from the exploratory phase leading to meet objective 5.

Chapter 6 involved an in-depth discussion about the research qualitative and quantitative findings and linked them to the literature theories and models to support the findings.

Table 7.1 illustrates how the objectives proposed in chapter 1 were accomplished in this thesis.

Table 7.1: Accomplishment of research objectives

Research objectives	Accomplishment
Understand the current state of the art in the adoption of mobile digital libraries.	Achieved in **chapter 2** through a comprehensive literature review of related areas to mobile digital library adoption
Design an initial mobile digital library prototype to use as stimulus for generating user views on desirable mobile library features to encourage adoption.	Achieved in **chapter 4** by investigating the important services recommended in the literature; browsing library websites and looking for mutual services; and based on the factors that proposed to affect the adoption of mobile digital libraries.
Derive an initial theoretical model/framework to explain mobile digital library adoption.	Achieved in **chapter 2** by expanding TAM and selecting mutual external factors from related areas to mobile digital library adoption. This framework was then refined in **chapter 4** by conducting focus group study.
Refine the mobile digital library	Achieved in **chapter 4** and **chapter 5**. The prototype went

prototype to use as a probe in a quantitative study.	through a number of phases to reach its final stage. It was refined by findings found in the focus group study, card sorting and usability testing.
Empirically test framework on mobile digital library adoption.	Achieved in **chapter 5** by sending an online survey to students accompanied with the final prototype. Data collected was then analysed using SEM to validate and test the mobile digital library adoption framework.
Draw theoretical and practical conclusions from the empirical results.	Achieved in **chapter 7**.

7.3 Significance of research

The significance of this research to theory, methodology and practice is explained in detail in the following subsections.

7.3.1 Contribution to theory

This research contributed to the understanding of factors affecting mobile digital library adoption in the developing world in general and in GCC countries and the UAE in particular. Reviewing the literature revealed that there is a lack of a comprehensive framework that explains students' intention to use mobile digital libraries. This research succeeded in developing and validating a theoretical framework to help in understanding students' intention. It filled the literature gap by focusing on and validating the importance of three categories: interface characteristics, system characteristics and personal characteristics. It stressed the importance of TAM and factors that were validated in prior studies such as *Social influence*, *Library assistance*, *Trust* and the components of *Interface design* (terminology, navigation and screen design). It also managed to explore and emphasise the importance of new factors and factors that were not discussed in a digital library context such as *Mobility*, *Mobile and web experience* and *Distinctiveness/Prestige*. Accordingly, this research managed to discover new relationships that were not previously considered in the digital library adoption such as: the relationship between *Mobility* and *Perceived ease of use; Mobile and web experience* and *Behaviour intention; and Distinctiveness/Prestige and Behaviour intention* (Figure 7.1 presents the theoretical framework for mobile digital library acceptance)
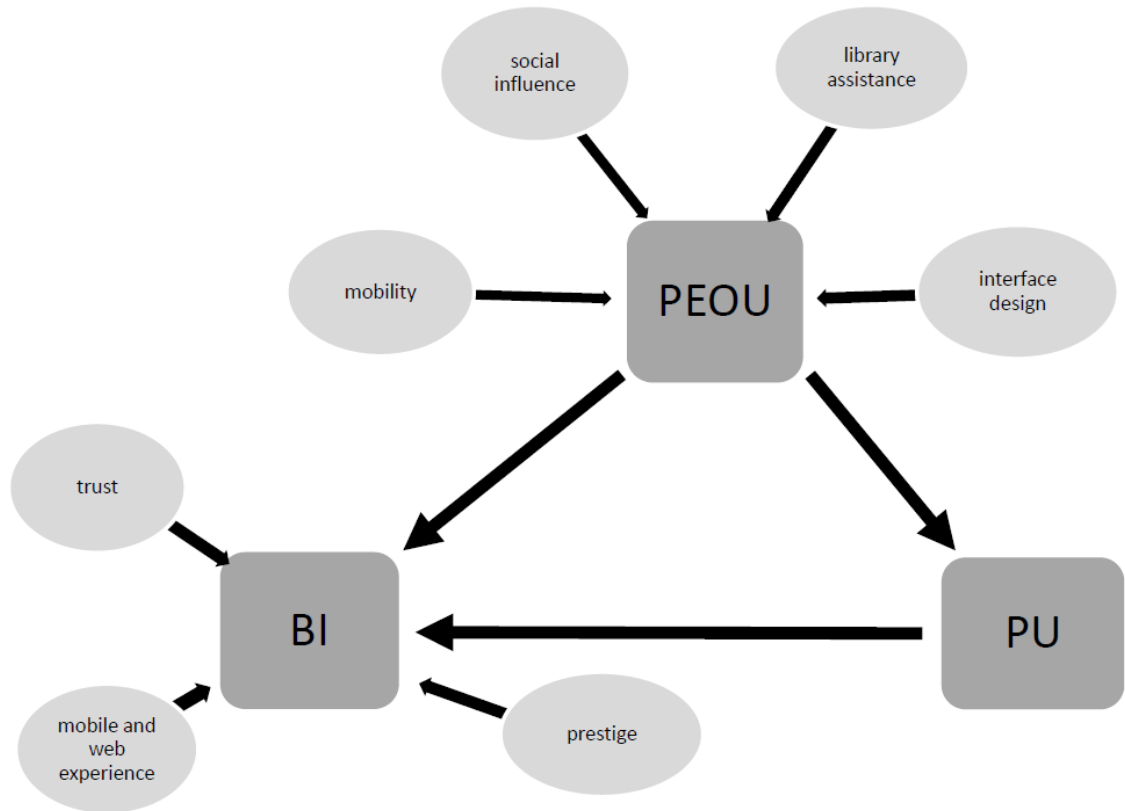
Figure 7. 1: Mobile digital library acceptance framework

TAM has been validated in a number of fields, including mobile digital library adoption, and has been used to explain the adoption of library services through small screen devices but not through smartphones. The new smartphones provide a number of features that are not available in small screen devices/traditional mobile phones, hence they are capable of providing more library services. TAM in this thesis succeeded to explain the adoption of mobile digital libraries that deliver their services through smartphones. TAM also has been validated mostly in the developed world, comprising another gap in the knowledge. This thesis filled that gap by validating TAM in mobile digital library context in one of the developing countries, the UAE, which is also an important contribution due to the unique features of the GCC with regard to technology acceptance and mobile phone usage, as well as applying survey items previously applied in East and South-East Asia but not to the GCC and assaying the reliability of those items for this context.

7.3.2 Contribution to methodology

This thesis, unlike other studies in the area of digital library adoption and mobile adoption in higher education, considered studying the adoption before implementation by referring to a developed prototype. This way of research contributed to the methodology by studying the adoption before implementing the model, exposing participants to a prototype to save money and effort and to incorporate the needs and opinions of end users in the final model. Thus this study was user-centred from its inception, unlike the majority of research in this area. Potential library users' views were considered in all stages of this research, which represents a form of empirical testing rather than the opinions and expert (i.e. service providers') experience resorted to by previous studies.

The mobile digital library prototype developed and tested in this thesis thus manifested several substantial methodological contributions. Although Davis and Venkatesh (2004) mentioned that the adoption can be measured without designing a prototype, it is believed that people would give more reliable responses to an active program that does not require imagining. The mobile digital library is a new area, and little awareness of such services were expected from participants. Based on that, the mobile digital library prototype worked as a stimulus in the qualitative focus group and helped generating views. After refining the prototype and testing it in several phases it was used as a probe in the quantitative part of this study. Students had the chance to see a version of mobile digital library and give more accurate feedback about their possible adoption then.

One of the significant contributions of this thesis is the use of mixed-methods, starting with the exploratory phase and qualitative methods. Qualitative focus group method was the first methodological approach used to explore new factors and refine the framework generated from the literature. As mobile digital library is a new area, quantitative data alone limits the exploration of new constructs that might affect adoption by users.

Prior library acceptance studies found terminology, navigation and screen design to be important factors affecting students' intention, yet they did not consider looking at these factors in detail. Thong, Hong and Tam (2002) mentioned that technical terms and jargon should be avoided, and the best way of avoiding them is by conducting focus groups (i.e.

consulting end users to identify such barriers). In this thesis, focus group method, card sorting and usability testing of the mobile digital library prototype allowed for uncovering the most common terms, navigation steps and the best screen design that are amenable to users' needs.

SEM analysis and the use of AMOS program to analyse data related to GCC countries and digital library applications delivered via smartphones is a new context that contributes to the methodological value of this study. The results of this quantitative analysis also revealed that some indicators had to be deleted or merged with other indicators in a GCC context which differ from those used in the original scales, as discussed in chapter 5.

7.3.3 Contribution to practice

The framework developed and validated in this thesis provided insight into interface, individual and system characteristics that affect students' intention to use mobile digital library. These findings contribute to IS field and offer researchers who are interested in mobile digital libraries a foundation to further studies. Based on the findings of this research, the following recommendations are provided to improve the library image and help developers, system designers and library authorities to build a mobile digital library application that suits users' needs and urge them to adopt such service.

- The usefulness and ease of mobile digital library application are factors that students were concerned about. System designers need to develop a useful and easy to use mobile digital library application to succeed among students. Students' perception of the ease of use and usefulness are influenced by a number of external factors that also need to be considered in the design.

- The framework showed that students focus was mostly on the interface design and the user-friendliness of the system. Designers should consider using specific terms that relates to students and arrange the screen in certain ways that includes pictures and less text. Databases and articles can be included in the design only if it is going to be provided into tablets platforms. Customization is another important issue to students, so that option should be considered in the design. Developers also need to

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design a shallow structure system that does not require intensive navigation steps and provides shortcuts.

- The importance of interface design was met by providing a recommended architecture for mobile digital library as it was shown to be rated highly in terms of this dimension, indicating that it has a generally high impact on the adoption intention of the intended user group.

- Since social norms were found to highly affect students' perceived ease of use mobile digital libraries, this factor should be considered not only in the design but also in providing advertisements about the system. System designers can add "share" service, RSS feeds and social networks with which students are already familiar (e.g. Facebook and YouTube) to publicize library services and allow students to consult their social networks, thus promoting the use and the ease of the system. Library authorities can also explain the importance of this system to teachers and perhaps show them how it works as teachers can also affect students' perception of the ease of using the mobile digital library.

- Mobility was also found to highly affect students' adoption of mobile digital library via Perceived ease of use. Students would like to be able to use the application anytime, anywhere, both within and outside the library. For instance, designers can add a map in the application that shows the location of the book or add the option of printing remotely to save students' time. In order to cover the mobility factor, library authorities should consider providing Wi-Fi connection throughout university campuses and allow students to be connected outside the library, especially as students mentioned that sometimes they need to check something quickly for class purposes.

- The results showed that students require library assistance from librarians and teachers, and they expect technical support. Thus, the designers of the application and librarians should consider including a service for asking librarians, help service, or tutorials that show how to use the application and its services.

- Designers should also consider that students would think that the application would give them a sense of distinctiveness; in order to attract students to adopt the application, it should include unique services that they cannot otherwise access,

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although this could raise obvious ethical implications if any existing services were denied to students for the purposes of compelling them to use a mobile application. Thus new services and functionalities offered on the mobile platform (as enumerated in this thesis and by previous researchers) distinct from traditional library services could be considered exclusive to this platform, without parallel novelties being introduced in traditional platforms.

- The application designers and librarians should also focus on building an application that protects the privacy of students' accounts and states clearly that the university library is responsible for designing this application. Students also seem to be hesitant to use mobile payment to cover library fines, so it is early to consider such services in the application. If considered, they should be simple and should not require bank account details or credit card information. For example, a student library account could be established wherein students deposit cash, preferably in the library building, and they can then authorise the payment of fines from this account via their smartphones; given that most universities require deposits of some kind and withhold degrees upon graduation until all outstanding fees, including library fines, are paid; this would seem to be an eminently sensible option for the introduction of online university payments, which would render the library a pioneer of advanced technological solutions in most university contexts.

- Librarians can provide tutorials or workshops to train students who lack mobile or web search experience to improve their skills and therefore have intention to use mobile digital library application.

7.4 Research limitations and future directions

This is one of the first studies that focused on the adoption to use mobile digital libraries. It is believed that the adoption factors would be the same in other GCC countries since library services are almost the same in every university. Still, the framework that has been produced in this thesis to explain factors affecting intention to use mobile digital library application can be replicated in the future in other public universities in GCC countries to generalize the results among GCC public universities. This research focused on collecting data from a single university in the UAE. It would be unwise to transpose results obtained

from the UAE wholesale on other countries (even within the GCC) without deep consideration of the contextual factors.

Although most libraries provide the same services, the framework can be also tested among private universities. Participants of this research were from a public university only. Students in the private universities are usually required to pay for certain services, including library services, so the factors that affect their adoption of mobile digital library application might differ from those of students in public universities. Cost might be one of the factors affecting their adoption of use.

A number of factors emerged in the focus group were not feasible to include as part of the empirical testing. Future research can develop a scale for 'quality of work', 'system coverage' and 'experimentation' and investigate their effect on intention to use mobile digital libraries. The analysis of the focus group revealed that these are important factors that might affect the adoption of mobile digital libraries. Participants were interested into an application that would improve the quality of their working life by saving their time and expenses. Respondents were also concerned about the facilitating conditions that ensure the availability of mobile and internet coverage. They mentioned that the unavailability of wireless connections might prevent them from using the mobile application outside the university. Experimenting with new technology also seems to be a reason for students' adoption. A number of students were willing to experiment with the application first before deciding to use it or judge their capability of use. The overall variance in Behaviour intention explained by the framework is relatively low. Future inclusion of these additional factors might allow explanation of a greater proposition of the variance.

Future research can explore further the differences between male and female students, especially with regard to the trust issues that revealed clear gender differences in the exploratory phase but not in the testing phase. The majority of participants in this research were female students; different results might be obtained if equal samples were obtained from both genders (or single-sex samples were used). Future research can also explore further the effect of social influence on the perceived usefulness and behaviour intention by splitting the general measure into peers and superior social influence.

Ideally, sampling is usually random, to allow for equal chances of participation. However, the sampling method in the thesis was based on convenience and quota sampling technique, not on random sampling, which limits the generalizability of the findings. However, this way of sampling was the only possible technique for several reasons motioned in the methodology chapter (for example the sampling frame or the total number of students was not defined).

This thesis also focused on adoption, because of the novelty of mobile digital library and the paucity if research concerning it. Future research subsequent to the implementation of pioneering systems offering this service can study users' acceptance and satisfaction after use and investigate their continuous use (e.g. by longitudinal study of adoption). Measuring users' acceptance after implementation will also enable future system enhancement, the overall promotion of user satisfaction, better library service provision and improved educational outcomes.

7.5 Conclusion

In conclusion, this research contributed to knowledge, methodology and practice. The aim of this research was to design a framework for mobile digital library adoption that was achieved by a mixed-method approach over a number of phases. The adoption of mobile digital libraries is a new area that lacks a comprehensive theoretical framework to explain behavioural intention to use. The final mobile digital library framework developed in this thesis was based on the original TAM and consisted of seven latent constructs categorized into interface, system and personal characteristics covering the literature gap. Libraries wishing to implement a mobile digital library service should start doing so by considering the factors affecting the adoption of a mobile digital library. The framework also contributed in understanding factors affecting the adoption of mobile digital libraries in the developing world, especially in the GCC and UAE contexts. By focusing on a user-centred design method, important interface design architectural knowledge was obtained. The mobile library adoption framework will assist libraries in designing a proper mobile digital library that suits users' needs. In addition, this framework will facilitate the process of designing and implementing a mobile library service.

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Appendices

Appendix A: Study findings on behavioural intention (adoption and acceptance)

Study	Author	Year	Findings		Area
			Sig	Non-sig	
Relationship PEOU → BI					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)	√		Digital library
Interface characteristics, perceived ease of use and intention to use an online library in Malaysia	Ramayah	(2006a)	√		Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)		√	Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)	√		Digital library
Gender role and the use of university library website resources: a social cognitive theory perspective	Kim	(2010a)	√		Digital library
The adoption of university library website resources: a multigroup analysis	Kim	(2010b)		√	Digital library
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library
Factors driving the adoption of mobile learning: an empirical study	Liu, Li, and Carlsson	(2010)		√	Mobile services in higher education
Student characteristics and variables that determine mobile learning adoption: an initial study	Callum	(2009)	√		Mobile services in higher education

Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)		√	Mobile services in higher education
User behaviours toward mobile data services: the role of perceived fee and prior experience	Kim, Choi, and Han	(2009)		√	Mobile services
Intentions to use mobile services: antecedents and cross-service comparisons	Nysveen, Pedersen, and Thorbjornen	(2005a)	√		Mobile services
Explaining intention to use mobile chat services: moderating effects of gender	Nysveen, Pedersen, and Thorbjornen	(2005b)		√	Mobile services (mobile chat)
Mobile data service fuels the desire for uniqueness	Hong, Tam, and Kim	(2006)	√		Mobile services
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)	√		Mobile wireless services
Personal innovativeness, social influences and adoption of wireless internet services via mobile technology	Lu, Yao, and Yu	(2005)	√		Mobile wireless services
What drives mobile commerce? An empirical evaluation of the revised technology acceptance model	Wu and Wang	(2005)		√	Mobile service (mobile commerce)
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)	√		Mobile service (mobile payment)
Does mobile payment technology Mnet attract potential consumers? The case of Kuwait	Rouibah	(2007)	√ (inexp.)	√ (exp.)	Mobile service (mobile payment)
Dimensions of self-efficacy in the study of smartphone acceptance	Chen, Chen, and Yen	(2011)	√		Mobile dervice
Predicting consumer intention to use mobile services	Wang, Lin, and Luarn	(2006)	√		Mobile dervice
Design and evaluation of personalized mobile tourist system	Roine	(2011)	√		Mobile service (mobile tourism)
An empirical test of the mobile services acceptance model	Gao, Moe, and Krogsite	(2010)	√		Mobile service in higher education
Mobile collaborative learning system	Kuadey	(2010)	√		Mobile service in higher education
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library

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Study	Author	Year	Findings		Area
			Sig	Non-sig	
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)	√		Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)	√		Digital library
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library
Gender role and the use of university library website resources: a social cognitive theory perspective	Kim	(2010a)		√	Digital library
The adoption of university library website resources: a multigroup analysis	Kim	(2010b)	√		Digital library
On the success factors of mobile learning	Ju, Sriprapainpog, and Minh	(2007)	√		Mobile services in higher education
Elucidating user behaviour of mobile learning: a perspective of the extended technology acceptance model	Huang, Lin, and Chuang	(2007)	√		Mobile services in higher education
Factors driving the adoption of mobile learning: an empirical study	Liu, Li, and Carlsson	(2010)	√		Mobile services in higher education
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)		√	Mobile services in higher education
Towards an understanding of the behavioural intention to use 3G mobile value-added services	Kuo and Yen	(2009)		√	Mobile services
User behaviours toward mobile data services: the role of perceived fee and prior experience	Kim, Choi, and Han	(2008)	√		Mobile services
Intentions to use mobile services: antecedents and cross-service comparisons	Nysveen, Pedersen, and Thorbjornen	(2005a)	√		Mobile services
Explaining intention to use mobile chat services: moderating effects of gender	Nysveen, Pedersen, and Thorbjornen	(2005b)	√		Mobile services (mobile chat)
Mobile data service fuels the desire for uniqueness	Hong, Tam, and Kim	(2006)	√		Mobile services

Study	Author	Year	Findings		Area
			Sig	Non-sig	
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)	√		Mobile wireless services
Personal innovativeness, social influences and adoption of wireless internet services via mobile technology	Lu, Yao, and Yu	(2005)	√		Mobile wireless services
What drives mobile commerce? An empirical evaluation of the revised technology acceptance model	Wu and Wang	(2005)	√		Mobile service (mobile commerce)
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)	√		Mobile service (mobile payment)
Does mobile payment technology Mnet attract potential consumers? The case of Kuwait	Rouibah	(2007)	√		Mobile service (mobile payment)
Dimensions of self-efficacy in the study of smartphone acceptance	Chen, Chen, and Yen	(2011)	√		Mobile service
Predicting consumer intention to use mobile services	Wang, Lin, and Luarn	(2006)	√		Mobile service
Design and evaluation of personalized mobile tourist system	Roine	(2011)	√		Mobile service (mobile tourism)
An empirical test of the mobile services acceptance model	Gao, Moe, and Krogsite,	(2010)	√(-)		Mobile service in higher education
Mobile collaborative learning system	Kuadey	(2010)	√		Mobile service in higher education
Relationship PEOU → PU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Impact of interface characteristics on digital libraries usage	Lee et al.	(2005)	√		Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)	√		Digital library

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Study	Author	Year	Findings		Area
			Sig	Non-sig	
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library
Gender role and the use of university library website resources: a social cognitive theory perspective	Kim	(2010a)	√		Digital library
The adoption of university library website resources: a multigroup analysis	Kim	(2010b)	√		Digital library
On the success factors of mobile learning	Ju, Sriprapainpog, and Minh	(2007)	√		Mobile services in higher education
Elucidating user behaviour of mobile learning: a perspective of the extended technology acceptance model	Huang, Lin, and Chuang	(2007)	√		Mobile services in higher education
Factors driving the adoption of mobile learning: an empirical study	Liu, Li, and Carlsson	(2010)		√	Mobile services in higher education
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)	√		Mobile services in higher education
Towards an understanding of the behavioural intention to use 3G mobile value-added services	Kuo and Yen	(2009)	√		Mobile services
User behaviours toward mobile data services: the role of perceived fee and prior experience	Kim, Choi, and Han	(2008)		√	Mobile services
Intentions to use mobile services: antecedents and cross-service comparisons	Nysveen, Pedersen, and Thorbjornen	(2005a)	√		Mobile services
Explaining intention to use mobile chat services: moderating effects of gender	Nysveen, Pedersen, and Thorbjornen	(2005b)	√		Mobile services (mobile chat)
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)	√		Mobile wireless services
Personal innovativeness, social influences and adoption of wireless internet services via mobile technology	Lu, Yao, and Yu	(2005)	√		Mobile wireless services
What drives mobile commerce? An empirical evaluation of the revised technology acceptance model	Wu and Wang	(2005)	√		Mobile service (mobile commerce)

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Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Understanding consumer acceptance of mobile payment services: an empirical analysis	Schierz, Schilke, and Wirtz	(2010)	√		Mobile service (mobile payment)
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)	√		Mobile service (mobile payment)
Does mobile payment technology Mnet attract potential consumers? The case of Kuwait	Rouibah	(2007)		√	Mobile service (mobile payment)
Dimensions of self-efficacy in the study of smartphone acceptance	Chen, Chen, and Yen	(2011)	√		Mobile service
Predicting consumer intention to use mobile services	Wang, Lin, and Luarn	(2006)	√		Mobile service
Adoption factors of mobile services	Kargin, Basoglu, and Daim	(2009)	√		Mobile services
Design and evaluation of personalized mobile tourist system	Roine	(2011)	√		Mobile service (mobile tourism)
An empirical test of the mobile services acceptance model	Gao, Moe, and Krogsite	(2010)	√		Mobile service in higher education
Mobile collaborative learning system	Kuadey	(2010)	√		Mobile service in higher education
Relationship TERM → PEOU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)		√	Digital library
Interface characteristics, perceived ease of use and intention to use an online library in Malaysia	Ramayah	(2006a)	√		Digital library
Doing e-research with e-library: determinants of perceived ease of use	Ramayah	(2006b)	√		Digital library
Impact of interface characteristics on digital libraries usage	Lee et al.	(2005)	√		Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)	√		Digital library

Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)	√		Digital library
Relationship SCREEN → PEOU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)	√		Digital library
Interface characteristics, perceived ease of use and intention to use an online library in Malaysia	Ramayah	(2006a)	√		Digital library
Doing e-research with e-library: determinants of perceived ease of use	Ramayah	(2006b)	√		Digital library
Impact of interface characteristics on digital libraries usage	Lee et al.	(2005)		√	Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)	√		Digital library
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)	√		Digital library
Users' personality and perceived ease of use of digital libraries: the case for resistance to change	Nov and Ye	(2008)	√		Digital library
Relationship SCREEN → PU					
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)	√		Digital library
Relationship NAVIG → PEOU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library

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Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Interface characteristics, perceived ease of use and intention to use an online library in Malaysia	Ramayah	(2006a)	√		Digital library
Doing e-research with e-library: determinants of perceived ease of use	Ramayah	(2006b)	√		Digital library
Impact of interface characteristics on digital libraries usage	Lee et al.	(2005)		√	Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)	√		Digital library
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)	√		Digital library
Relationship DKN → PEOU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)	√		Digital library
Doing e-research with e-library: determinants of perceived ease of use	Ramayah	(2006b)	√		Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)	√		Digital library
Relationship DKN → PU					
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library

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Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Relationship CEXP → PEOU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
Doing e-research with e-library: determinants of perceived ease of use	Ramayah	(2006b)		√	Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)		√	Digital library
Relationship SEF → PEOU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
Doing e-research with e-library: determinants of perceived ease of use	Ramayah	(2006b)		√	Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)		√	Digital library
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)		√	Digital library
Users' personality and perceived ease of use of digital libraries: the case for resistance to change	Nov and Ye	(2008)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library
Gender role and the use of university library website resources: a social cognitive theory perspective	Kim	(2010a)	√		Digital library
On the success factors of mobile learning	Ju, Sriprapainpog, and Minh	(2007)	√		Mobile services in higher education

Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)	√		Mobile services in higher education
Dimensions of self-efficacy in the study of smartphone acceptance	Chen, Chen, and Yen	(2011)	√		Mobile service
SMS-based library catalogue system: a preliminary investigation of user acceptance	Goh and Liew	(2009)	(-)√		Mobile digital library (SMS)
Exploring gender differences in SMS-based mobile library search system adoption	Goh and Liew	(2011)	√		Mobile digital library (SMS)
Relationship SEF → PU					
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)	√		Mobile services in higher education
SMS-based library catalogue system: a preliminary investigation of user acceptance	Goh and Liew	(2009)	(-)√		Mobile digital library (SMS)
Exploring gender differences in SMS-based mobile library search system adoption	Goh and Liew	(2011)	(-)√		Mobile digital library (SMS)
Relationship SEF → BI					
Predicting consumer intention to use mobile services	Wang, Lin, and Luarn	(2006)	√		Mobile service
Relationship RELV → PEOU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
Doing e-research with e-library: determinants of perceived ease of use	Ramayah	(2006b)	√		Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Users' personality and perceived ease of use of digital libraries: the case for resistance to change	Nov and Ye	(2008)	√		Digital library

Study	Author	Year	Findings		Area
			Sig	Non-sig	
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)		√	Mobile services in higher education
Relationship RELV → PU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)		√	Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
An investigation of user perceptions and behavioural intentions towards the e-library	Jeong	(2011)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)	√		Mobile services in higher education
Relationship CONT → PU					
Adoption factors of mobile services	Kargin, Basoglu, and Daim	(2009)	√		Mobile services
Relationship SACC → PEOU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)	√		Digital library
Doing e-research with e-library: determinants of perceived ease of use	Ramayah	(2006b)	√		Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library

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Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)	√		Mobile services in higher education
Relationship SACC → PU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, Tam	(2002)		√	Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)		√	Digital library
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)		√	Mobile services in higher education
Relationship ASSIS → PEOU					
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)		√	Digital library
The adoption of university library website resources: a multigroup analysis	Kim	(2010b)	√		Digital library
Relationship ASSIS → PU					
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Relationship ENGL → PEOU					
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)		√	Digital library

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Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Relationship ENGL → PU					
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Relationship SN → PEOU					
The adoption of university library website resources: a multigroup analysis	Kim	(2010b)	√		Digital library
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)		√	Mobile services in higher education
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)		√	Mobile wireless services
Personal innovativeness, social influences and adoption of wireless internet services via mobile technology	Lu, Yao, and Yu	(2005)	√		Mobile wireless services
Relationship SN → PU					
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library
Gender role and the use of university library website resources: a social cognitive theory perspective	Kim	(2010a)	√		Digital library
The adoption of university library website resources: a multigroup analysis	Kim	(2010b)	√		Digital library
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)	√		Mobile services in higher education
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)		√	Mobile wireless services
Personal innovativeness, social influences and adoption of wireless internet services via mobile technology	Lu, Yao, and Yu	(2005)	√		Mobile wireless services

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Study	Author	Year	Findings		Area
			Sig	Non-sig	
An acceptance model of wireless mobile data services in China: combining TAM with consumer behaviour model	Tan and Qi	(2009)	√		Mobile wireless servicers
Does mobile payment technology Mnet attract potential consumers? The case of Kuwait	Rouibah	(2007)	√		Mobile service (mobile payment)
Relationship SN → BI					
The adoption of university library website resources: a multigroup analysis	Kim	(2010b)	√		Digital library
University students' behavioural intention to use mobile learning: evaluating the technology acceptance model	Park, Nam, and Cha	(2012)	√		Mobile services in higher education
Intentions to use mobile services: antecedents and cross-service comparisons	Nysveen, Pedersen, and Thorbjornen	(2005a)	√		Mobile services
Explaining intention to use mobile chat services: moderating effects of gender	Nysveen, Pedersen, and Thorbjornen	(2005b)	√		Mobile services (mobile chat)
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)	√ (-)		Mobile wireless services
Personal innovativeness, social influences and adoption of wireless internet services via mobile technology	Lu, Yao, and Yu	(2005)		√	Mobile wireless services
An acceptance model of wireless mobile data services in China: combining TAM with consumer behaviour model	Tan and Qi	(2009)	√		Mobile wireless servicers
Driving consumer acceptance of mobile marketing: a theoretical framework and empirical study	Bauer et al.	(2005)	√		Mobile service (marketing)
Relationship MOB → PEOU					
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)	√		Mobile service (mobile payment)
Relationship MOB → PU					
Elucidating user behaviour of mobile learning: a perspective of the extended technology acceptance model	Huang, Lin, and Chuang	(2007)	√		Mobile services in higher education

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Study	Author	Year	Findings		Area
			Sig	Non-sig	
Understanding consumer acceptance of mobile payment services: an empirical analysis	Schierz, Schilke, and Wirtz	(2010)	√		Mobile service (mobile payment)
Adoption factors of mobile services	Kargin, Basoglu, and Daim	(2009)	√		Mobile services
Relationship MOB → BI					
Understanding consumer acceptance of mobile payment services: an empirical analysis	Schierz, Schilke, and Wirtz	(2010)	√		Mobile service (mobile payment)
Relationship IMAGE → PU					
Adoption factors of mobile services	Kargin, Basoglu, and Daim	(2009)	√		Mobile services
Relationship IMAGE → BI					
Mobile data service fuels the desire for uniqueness	Hong, Tam, and Kim	(2006)	√		Mobile services
Relationship TRUST → PEOU					
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)	√		Mobile wireless services
Relationship TRUST → PU					
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)	√		Mobile wireless services
Relationship TRUST → BI					
Determinants of accepting wireless mobile data services in China	Lu et al.	(2008)	√		Mobile wireless services
Does mobile payment technology Mnet attract potential consumers? The case of Kuwait	Rouibah	(2007)	√		Mobile service (mobile payment)

Study	Author	Year	Findings		Area
			Sig	Non-sig	
The influence of content and trust on consumers' intention to accept mobile advertisements	Westerlund, et al.	(2009)	√		Mobile service (mobile advertisements)
Design and evaluation of personalized mobile tourist system	Roine	(2011)	√		Mobile service (mobile tourism)
An empirical test of the mobile services acceptance model	Gao, Moe, and Krogsite	(2010)	√		Mobile service in higher education
Mobile collaborative learning system	Kuadey	(2010)	√		Mobile service in higher education
Relationship COMP → PEOU					
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)		√	Mobile service (mobile payment)
Relationship COMP → PU					
What drives mobile commerce? An empirical evaluation of the revised technology acceptance model	Wu and Wang	(2005)	√		Mobile service (mobile commerce)
Understanding consumer acceptance of mobile payment services: an empirical analysis	Schierz, Schilke, and Wirtz	(2010)	√		Mobile service (mobile payment)
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)		√	Mobile service (mobile payment)
Relationship CONTX → PEOU					
Design and evaluation of personalized mobile tourist system	Roine	(2011)	√		Mobile service (mobile tourism)
An empirical test of the mobile services acceptance model	Gao, Moe, and Krogsite	(2010)	√		Mobile service in higher education
Mobile collaborative learning system	Kuadey	(2010)	√		Mobile service in higher education

Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Relationship CONTX → PU					
Design and evaluation of personalized mobile tourist system	Roine	(2011)	√		Mobile service (mobile tourism)
An empirical test of the mobile services acceptance model	Gao, Moe, and Krogsite	(2010)	√		Mobile service in higher education
Mobile collaborative learning system	Kuadey	(2010)	√		Mobile service in higher education
Relationship VIS → PU					
Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences	Thong, Hong, and Tam	(2002)	√		Digital library
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)		√	Digital library
Digital library adoption and the technology acceptance model: a cross-country analysis	Miller and Khera	(2010)	√		Digital library
Relationship INT-PUB → PU					
User acceptance of digital library system in developing countries: an application of the technology acceptance model	Park et al.	(2009)	√		Digital library
Relationship RELIB → PU					
User acceptance of digital library: an empirical exploration of individual and system components	Vaidyanthan, Sabbaghi, and Bargellini	(2005)	√		Digital library
Relationship COM-ANX → PEOU					
Factors that influence the use of library resources by faculty members	Korobili, Tilikidou, and Delistavrou	(2006)	-√		Digital library

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Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Users' personality and perceived ease of use of digital libraries: the case for resistance to change	Nov and Ye	(2008)	√		Digital library
Relationship RTC → PEOU					
Users' personality and perceived ease of use of digital libraries: the case for resistance to change	Nov and Ye	(2008)	-√		Digital library
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)	-√		Digital library
Relationship RES-DEMON → PU					
Resistance to change and the adoption of digital libraries: an integrative model	Nov and Ye	(2009)	√		Digital library
Toward an understanding of web-based subscription database acceptance	Kim	(2006)	√		Digital library
Relationship MAND-USE → BI					
Why should I use university library website resources? Discipline differences	Kim	(2010c)	√		Digital library
Relationship INF-QUA → PU					
Understanding intention to use electronic information resources: a theoretical extension of the technology acceptance model	Tao	(2008)	√		Digital library
Relationship SYS-QUA → PEOU					
Understanding intention to use electronic information resources: a theoretical extension of the technology acceptance model	Tao	(2008)	√		Digital library

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Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Relationship P-RISK → PU					
What drives mobile commerce? An empirical evaluation of the revised technology acceptance model	Wu and Wang	(2005)	√		Mobile service (mobile commerce)
Relationship PIIT → BI					
An empirical test of the mobile services acceptance model	Gao, Moe, and Krogsite	(2010)	√		Mobile service
Determinants of accepting wireless mobile data services in china	Lu et al.	(2008)	√		Mobile wireless service
Factors driving the adoption of m-learning: an empirical study	Liu, Li, and Carlsson	(2010)	√		Mobile service in higher education
Mobile service acceptance model	Gao, Krogsite, and Grasaether	(2008)	√		Mobile service in higher education
Mobile collaborative learning system	Kuadey	(2010)		√	Mobile service in higher education
Relationship PIIT → PEOU					
Toward an understanding of the behavioural intention to use 3G mobile value-added services	Kuo and Yen	(2009)	√		Mobile service
Adoption factors of mobile services	Kargin, Basoglu, and Daim	(2009)	√		Mobile service
Personal innovativeness, social influences and adoption of wireless internet services via mobile technology	Lu, Yao, and Yu	(2005)	√		Mobile wireless services
Determinants of accepting wireless mobile data services in china	Lu et al.	(2008)	√		Mobile wireless service
An acceptance model of wireless mobile data services in China: combining TAM with consumer behaviour	Tan and Qi	(2009)		√	Mobile wireless service
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)	√(late)	√(early)	Mobile service (mobile payment)
Factors driving the adoption of m-learning: an empirical study	Liu, Li, and Carlsson	(2010)	√		Mobile service in higher education

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Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Relationship PIIT → PU					
Toward an understanding of the behavioural intention to use 3G mobile value-added services	Kuo and Yen	(2009)		√	Mobile service
Personal innovativeness, social influences and adoption of wireless internet services via mobile technology	Lu, Yao, and Yu	(2005)	√		Mobile wireless services
An acceptance model of wireless mobile data services in China: combining TAM with consumer behaviour	Tan and Qi	(2009)	√		Mobile wireless service
Factors driving the adoption of m-learning: an empirical study	Liu, Li, and Carlsson	(2010)	√		Mobile service in higher education
Relationship COST → PU					
Toward an understanding of the behavioural intention to use 3G mobile value-added services	Kuo and Yen	(2009)	(-)√		Mobile service
Mobile data service fuels the desire for uniqueness	Hong, Tam, and Kim	(2006)	√		Mobile service
Relationship COST → BI					
Predicting consumer intention to use mobile service	Wang, Lin, Luarn	(2006)	√		Mobile service
User behaviour toward mobile data services: the role of perceived fee and prior experience	Kim, Choi, and Han	(2009)	(-)√		Mobile service
An acceptance model of wireless mobile data services in China: combining TAM with consumer behaviour	Tan and Qi	(2009)			Mobile wireless service
What drives mobile commerce? An empirical evaluation of the revised technology acceptance model	Wu and Wang	(2005)	(-)√		Mobile service (mobile commerce)
Relationship CRED → BI					
Predicting consumer intention to use mobile service	Wang, Lin, Luarn	(2006)	√		Mobile service

Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Relationship P-ENJOY → PU					
User behaviour toward mobile data services: the role of perceived fee and prior experience	Kim, Choi, and Han	(2009)	√		Mobile service
Adoption factors of mobile services	Kargin, Basoglu, and Daim	(2009)	√		Mobile service
Does mobile payment technology Mnet attract potential consumers? The case of Kuwait	Rouibah	(2007)	√		Mobile service (mobile payment)
Relationship P-ENJOY → BI					
Intentions to use mobile services: antecedents and cross-service comparisons	Nysveen, Pedersen, and Thorbjornsen	(2005a)	√		Mobile service
Mobile data service fuels the desire for uniqueness	Hong, Tam, and Kim	(2006)	√		Mobile service
Does mobile payment technology Mnet attract potential consumers? The case of kuwait	Rouibah	(2007)	√		Mobile service (mobile payment)
A study of behavioural intention for 3G mobile internet technology: preliminary research on mobile learning	Phuangthong and Malisawan	(2005)	√		Mobile service in higher education
Relationship P-ENJOY → ATT					
A study of behavioural intention for 3G mobile internet technology: preliminary research on mobile learning	Phuangthong and Malisawan	(2005)	√		Mobile service in higher education
Elucidating user behaviour of mobile learning: a perspective of the extended technology	Huang, and Chuang	(2007)	√		Mobile service in higher education
Relationship P-EXPRE → BI					
Intentions to use mobile services: antecedents and cross-service comparisons	Nysveen, Pederson, thorbjornsen,	(2005a)	√		Mobile service
Relationship SYS-FUNC → PU					
Determinants of accepting wireless mobile data services in china	Lu et al.	(2008)	√		Mobile wireless service

_____

Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Relationship SYS-FUNC → PEOU					
Determinants of accepting wireless mobile data services in china	Lu et al.	(2008)	√		Mobile wireless service
Relationship PERSON → PU					
Adoption factors of mobile services	Kargin, Basoglu, and Daim	(2009)	√		Mobile service
Relationship SERV-QUA → PU					
Research on the factors of affecting the mobile learning	Ye, Li, and Geng	(2010)	√		Mobile service in higher education
Relationship FAC-COND → PU					
Determinants of accepting wireless mobile data services in china	Lu et al.	(2008)	√		Mobile wireless service
Relationship P-CUR → BI					
An acceptance model of wireless mobile data services in China: combining TAM with consumer behaviour	Tan and Qi	(2009)	√		Mobile wireless service
Relationship PRIV → PU					
Does mobile payment technology Mnet attract potential consumers? The case of Kuwait	Rouibah	(2007)		√	Mobile service (mobile payment)
Relationship OUT-QUA → PU					
Toward an understanding of web-based subscription database acceptance	Kim	(2006)		√	Digital library
Relationship REACH → PEOU					
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)	√(late+ early)		Mobile service (mobile payment)

Study	Author	Year	Findings		Area
			Sig	**Non-sig**	
Relationship REACH → PU					
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)	√(late)	√(early)	Mobile service (mobile payment)
Relationship MOTIV → BI					
Student characteristics and variables that determine mobile learning adoption: an initial study	Callum	(2009)		√	Mobile service in higher education
Relationship COVENV → PU					
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)	√(late)	√(early)	Mobile service (mobile payment)
Relationship COVENV → PEOU					
An empirical examination of factors influencing the intention to use mobile payment	Kim, Mirusmonov, and Lee	(2010)		√(early+late)	Mobile service (mobile payment)

Perceived ease of use (PEOU); Perceived usefulness (PU); Behavioural intention (BI); Terminology (TERM); Screen design (SCREEN); Navigation (NAVIG); *Domain knowledge* (DKN); Computer experience (CEXP); Self-efficacy (SEF); Relevance (RELV); Content (CONT); System accessibility (SACC); Library Assistance (ASSI); English literacy (ENGL); Social norm (SN); Mobility (MOB); Image (IMAGE); Trust (TRUST); Compatibility (COMP); Context (CONTX); Visibility (VIS); Interest in publishing (INT-PUB); Reliability (RELIB); Computer anxiety (COM-ANX); Resistance to change (RTC); Result demonstrability (RES-DEMON); Mandatory use (MAN-USE); Information quality (INF-QUA); System quality (SYS-QUA); Perceived risk (P-RISK) ; Personal initiatives to information technology (PIIT); Cost (COST); Credibility (CRED); Perceived enjoyment (P-ENJOY); Perceived expressiveness (P-EXPRES); System functionality (SYS-FUNC); Personality (PERSON); Service quality (SERV-QUA); Facilitating conditions (FAC-COND); Perceived curiosity (P-CUR); Privacy (PRIV); Output quality (OUT-QUA); Reachability (REACH); Motivation (MOTIV); Convenience (CONVEN).

Appendix B: Ethical approval forms

School of Information Systems, Computing and Mathematics
David Gilbert, Head of School, Professor of Computing
Jasna Kuljis, Head of Information Systems and Computing, Professor of Computing
Tony Rawlins, Head of Mathematical Science, Professor of Mathematics

Brunel
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Telephone: +44(0) 1895 274000
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Emails:
Yongmin.Li@brunel.ac.uk
Annette.Payne@brunel.ac.uk
Lampros.Stergioulas@brunel.ac.uk
Zidong.Wang@brunel.ac.uk

Date: 16th April 2012
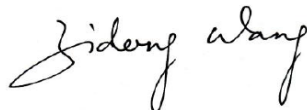
STATEMENT OF ETHICS APPROVAL

Proposer: Sumayyah Hassan AL-Faresi

Title: Mobile digital library

The school's research ethics committee has considered the proposal recently submitted by you. Acting under delegated authority, the committee is satisfied that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that you will adhere to the terms agreed with participants and to inform the committee of any change of plans in relations to the information provided in the application form.

Yours sincerely,

Professor Zidong Wang
Chair of the Research Ethics Committee
SISCM

_____

Research Ethics Committee (REC)
Proof of Ethical Clearance

Chair of the Research Ethics Committee
Zayed University

Ms. Sumayyah
PhD Candidate
Brunel University
United Kingdom

Date	06 June. 2012
Ethics Application Number	**ZU12-033-F**
Research Title	mobile digital library
Submitted Form	☒ Full Application for Ethical Clearance ☐ Exemption from Full Application
Valid until	05 May. 2014

Dear Ms. Sumayyah,

Thank you for submitting the above mentioned research proposal to the Research Ethics Committee at Zayed University. The following submitted documents were reviewed:

1. Survey tool both in English and Arabic
2. Focus group questions
3. Usability test

The project was discussed in the Research Ethics Committee's meeting held on 28th May 2012, and I am pleased to advise you that that the Committee has granted

☒ Full Ethical Clearance	☐ Exemption from Full Ethical Clearance

The following Committee members and Office of Research representatives were present at the meeting when your study was discussed:

Dr Mercedes Sheen (chair), Assistant Professor, College of Sustainability Sciences and Humanities, Natural Science and Public Health
Dr Michael Allen, Assistant Provost for Faculty Affairs and Research, (Ex-officio, Office of Research)
Dr Mohammed Lahkim, Director, Institute for Community Engagement
Dr Andrew Marrington, Assistant Professor, College of Information Technology
Dr Milan Pagon, Professor, College of Business
Shurooq AL Hashimi, Graduate Development Program Associate (Recorder, Office of Research)

Notes from the Committee	None

Approval is given on the understanding that the Principal Investigator reports the following to the Office of Research at Zayed University:

- Any amendments or significant change that occur in connection to the study which may alter the ethical consideration, such as
  * any serious or unexpected adverse events, and
  * any unforeseen events that might affect the continued ethical acceptability of the project

- Any proposed changes to the research protocol or the conduct of the research
- Premature suspension or termination of the study
- Arrangements for publication or dissemination the research including any feedback to participants
- Progress Report on annual basis
- Final Report within 3 months after termination or completion of the study

On behalf of the Committee, I am wishing you a productive and successful accomplishment of this research study.

Sincerely,

Dr Mercedes Sheen , Ph.D.
Chair, Research Ethics Committee
Zayed University

_____

_____

Appendix C: Hierarchy of selected services for 1st prototype with rationale

The initial prototype services		
Services	Literature Reason	Factor Reason
1. Reference services: Searching catalogue My account/ student profile Library opining hours Notifications (SMS) Ask a librarian New Books	The most wanted services by students were reference/circulation-related services (Wilson and McCarthy, 2010). SMS notification is one of the most popular mobile library services (Mills, 2009).	- *Relevance* - *Library assistance* - *Experience*
2. Current awareness/RSS	The most wanted services by students were reference/circulation-related services (Wilson and McCarthy, 2010).	- *Domain knowledge*
3. Quick Response Codes (QR): Booking group study rooms library homepage	QR codes will replace pen and paper use. Students developed a habit of photographing signs and books to save information for later use (Vila, Calvez and Campos, 2010; Mills, 2009).	- Screen design
4. Library instructions and information literacy sessions (Youtube)	The most wanted services by students were reference/circulation-related services (Wilson and McCarthy, 2010).	- *Library assistance*
5. About the library: Description Map Contact us	The most wanted services by students were reference/circulation-related services (Wilson and McCarthy, 2010).	- *System accessibility*
6. Facebook	People are most likely to check social networks first to get information (Silverman, 2001). Being reached by librarians through social networking sites is totally acceptable by a large number of students (Connell, 2009). Students prefer asking their reference and research questions through Facebook and e-mail more than face-to-face (Connell, 2009).	- *Trust* - *Social influence*
7. Go to web: Zayed University British Library	The most wanted services by students were reference/circulation-related services (Wilson and McCarthy, 2010).	*-Domain knowledge*

_____

Appendix D: Focus group consent form and demographic information

Consent to Participate in Focus Group

You have been asked to participate in a focus group. The purpose of the group is to try and understand users' needs with regards to mobile library services. The information learned in the focus groups will be used to design a mobile library application intended to match users' needs.

We anticipate no harm to participants as a result of participation and participants may decline answer any question or withdraw without penalty. Although the focus group will be tape recorded, your responses will remain anonymous and no names will be mentioned in the report. There is no right or wrong answers to the focus group questions. We want to hear many different viewpoints and would like to hear from everyone. We hope you can be honest even when your responses may not be in agreement with the rest of the group. In respect for each other, we ask that only one individual speak at a time in the group and that responses made by all participants be kept confidential.

I hereby grant full permission to Sumayyah AL-Faresi to take notes and record the focus group discussion

I understand this information and agree to participate fully under the conditions

Stated above:

Signed:_____ Date:_____

Contact information

Researcher: Sumayyah.alfaresi@brunel.ac.uk

ZU research office: research@zu.ac.ae

Tel: 025993569

_____

موافقة خطية لإجراء حلقة بحث

لقد تم اختيارك لعمل بحث حول موضوع (المكتبة المحمولة/Mobile library) والتي يقصد بها استخدام المتكبة عبر هاتفك المحمول، وذلك لفهم احتياجات مستخدم المكتبة والمساهمة في تصميم برنامج خاص لتوفير خدمات المكتبة على الهاتف المحمول. الغرض من هذه الحلقة الحصول على آراء مختلفة حول الموضوع من جميع المشاركين.

ملاحظات

- هذا البحث لا يحمل في طياته أي أذى أو خطر محتمل للمشاركين.
- لك الحق بالمشاركة او عدم المشاركة في هذه الحلقة ، ولك الحق بالانسحاب من البحث في أي وقت أو الامتناع عن اجابة أي سؤال دون شروط.
- للإحاطة بالعلم سيتم تسجيل هذه الحلقة (تسجيل صوتي) لن يستمع إليه إلا الباحث (سمية الفارسي) كما أن أسماء الشخصيات المشاركة لن تذكر في البحث وستبقى سرية.

أوافق على المشاركة في هذه الحلقة

توقيع:----------------   تاريخ:--------------------

لمراسلة

الباحث:Sumayyah.alfaresi@brunel.ac.uk

مكتب البحوث: research@zu.ac.ae

هاتف رقم: 025993569

_____

Mobile Digital Library Acceptance   *Sumayyah AL-Faresi*

_____

Demographic Information Questionnaire

(Please note, your information will not be sold or given to outside entities. It is for internal use only. If you have any concerns or complaints regarding this project please contact research@zu.ac.ae)

1. Name:_____

2. Education level:

   Bachelor Student   Master Student   Doctoral Student

3. Grade Level:

   First year   Second Year   Third Year   Fourth Year

4. School/major:

   _____

5. Age Group:

   18-22   23-29   30-36   37-43   44-50   over 50

6. Gender:

   Female   Male

7. How often do you use the internet?
   Daily   Weekly   Monthly   Occasionally   Never

8. Experience in mobile services:

   0-1 year   2-5 years   More than 5 years

9. Nationality:

   _____

**Do you wish to participate in Card sorting methods? if yes please mention your e-mail
_____

_____

Mobile Digital Library Acceptance   *Sumayyah AL-Faresi*

المعلومات الشخصية

(المعلومات المذكورة في هذا الاختبار لن تستخدم إلا للبحث العلمي. اذا كانت لديك شكوى او سؤال

متعلق في هذا البحث يمكنك الاتصال بمركز البحوث research@zu.ac.ae)

1. الإسم: _____
2. المستوى التعليمي: طالب بكالريوس   طالب ماجستير   طالب دكتوراة
3. طالب في السنة: الأولى   الثانية   الثالثة   الرابعة
4. الكلية: _____
5. العمر: 18-22   23-29   30-36   37-43   44-50   أكبر من 50
6. الجنس: ذكر   أنثى
7. استخدامك للإنترنت: يوميا   أسبوعيا   شهريا   بعض الأحيان   لا أستخدمه
8. سنوات الخبرة باستخدام الهاتف المحمول: 0-1 سنة   2-5 سنه   أكثر من 5 سنوات
9. الجنسية: _____

**يرجى ذكر ايميلك او بريدك الالكتروني اذا كنت تود المشاركة في البحث القادم

_____

Mobile Digital Library Acceptance   *Sumayyah AL-Faresi*

_____

Appendix D-1: Focus group questions

Opening question: tell us your name and what you most enjoy doing when you're not studying?

Introductory question: when you hear the words mobile digital library service, what comes to mind?

Transition question: Can you think of a situation where you need to have mobile library service?

Key questions:

1. Is there a particular library service that you would like to have on your mobile? What is your greatest need? Take a moment and write these down on a piece of paper. When you're finished, we will share these with each other.
2. Which one item is most important to you
3. If you were in charge, what kind of changes would you make?
4. If this application received an award, what would it be for?
5. What would you tell a best friend about this application?
6. Assume this application could talk what would it say about itself?
7. If you could change five things about this application, what would you change and what's the main reason that these things need changing?
8. Can you tell me five positive things about this application, no matter how small that positive thing is?

Ending questions:

9. If you were responsible for marketing this application, what key point would you stress in the ad campaign?
10. What do you need to know about this application in order to accept it or reject it?

_____

أسئلة حلقة بحث

1. عرفنا بنفسك وما الذي تحب القيام به اثناء وقت فراغك؟
2. عندما تسمع المكتبة المحمولة أو (mobile digital library) ما الذي يخطر ببالك؟
3. هل يمكنك التفكير بموقف تحتاج به الى المكتبة المحمولة؟
4. هل هناك خدمة مكتبية معينة تحتاجها على هاتفك المحمول؟ فكر واكتب هذه الخدمات على ورقة لنناقشها سويا بعد انتهائك؟
5. اي من هذه الخدمات هي الأهم بنظرك؟ ضع علامة على السبورة توضح ذلك
6. اذا كنت المسؤول عن هذا البرنامج ما هي التغييرات التي ستجريها؟
7. اذا كان هذا البرنامج يستحق جائزة فلأي سبب؟
8. ماذا ستخبر صديقك عن هذا البرنامج؟
9. تخيل ان بامكان هذا البرنامج الكلام ماذا سيخبر عن نفسه؟
10. اذا كان بامكانك تغيير 5 أشياء ماذا ستغير؟
11. اذكر اي امر ايجابي في هذا البرنامج؟
12. اذا كنت المسؤول عن تسويق هذا البرنامج ما هي الكلمات التي ستستخدمها في الاعلان؟
13. ما الذي تحتاج لمعرفته عن هذا البرنامج لتتقبله او ترفضه؟

Appendix D-2: Respondent profiles

Participant no.	Age Group	College	Gender	Level in education	Name	Education category	Internet use	Years of smartphone expertise
1	37-43	Education	Female	Not Applicable	Aliaa	postgraduate	Daily	2-5 years
2	30-36	Business	Female	Not Applicable	Nora	postgraduate	Daily	2-5 years
3	37-43	Science	Female	Not Applicable	Shaikha a	postgraduate	Daily	0-1 year
4	23-29	Science	Female	Not Applicable	Sara	postgraduate	Daily	2-5 years
5	23-29	Business	Female	Not Applicable	Fatima H	postgraduate	Daily	2-5 years
6	30-36	Business	Female	Not Applicable	Khulood	postgraduate	Daily	more than 5 years
7	30-36	Social science	Female	Not Applicable	Maitha M	postgraduate	Daily	more than 5 years
8	30-36	Business	Female	Not Applicable	Aisha	postgraduate	Daily	more than 5 years
9	37-43	Education	Female	Not Applicable	Anan	postgraduate	Daily	2-5 years
10	23-29	Social science	Male	Not Applicable	Adel	postgraduate	Daily	2-5 years
11	23-29	Art	Male	Not Applicable	Hamdan	postgraduate	Daily	0-1 year
12	30-36	Business	Male	Not Applicable	Hussain	postgraduate	Daily	more than 5 years
13	30-36	Business	Male	Not Applicable	Sultan	postgraduate	Daily	more than 5 years
14	23-29	Science	Male	Not Applicable	Abd Alaziz	postgraduate	Daily	more than 5 years
15	23-29	Education	Male	Not Applicable	Rashid	postgraduate	Daily	more than 5 years
16	23-29	Education	Female	Not Applicable	Shaikha	postgraduate	Daily	0-1 year
17	23-29	Business	Female	Not Applicable	Shaymaa	postgraduate	Daily	2-5 years
18	30-36	Social science	Female	Not Applicable	Fatima M	postgraduate	Daily	more than 5 years
19	37-43	Education	Female	Not Applicable	Maitha J	postgraduate	weekly	more than 5 years
20	30-36	Art	Female	Not Applicable	Khawla	postgraduate	Daily	more than 5 years
21	18-22	Science	Female	1st year	Anwar	Undergraduate	Daily	more than 5 years
22	18-22	Education	Female	2nd year	Fatima A	Undergraduate	Daily	more than 5 years
23	18-22	Art	Female	1st year	Maryam	Undergraduate	Daily	more than 5 years
24	18-22	Science	Female	1st year	Latifa	Undergraduate	Daily	2-5 years
25	18-22	Education	Female	3rd year	Marwa	Undergraduate	Daily	more than 5 years
26	18-22	Business	Female	3rd year	Yasmeen	Undergraduate	Daily	2-5 years

Participant no.	Age Group	College	Gender	Level in education	Name	Education category	Internet use	Years of smartphone expertise
27	18-22	Art	Female	4th year	Ghada	Undergraduate	Daily	2-5 years
28	18-22	Science	Female	3rd year	Manal	Undergraduate	Daily	2-5 years
29	18-22	General	Female	1st year	Noor	Undergraduate	Daily	2-5 years
30	18-22	General	Female	1st year	Madeya	Undergraduate	Daily	2-5 years
31	18-22	Education	Female	2nd year	Nadia	Undergraduate	Daily	2-5 years
32	18-22	Social science	Female	2nd year	Sara A	Undergraduate	Daily	0-1 year
33	18-22	General	Male	1st year	Mohammed S	Undergraduate	Daily	2-5 years
34	18-22	Social science	Male	1st year	Salih	Undergraduate	Daily	0-1 year
35	18-22	Business	Male	2nd year	Jassem H	Undergraduate	Daily	2-5 years
36	18-22	General	Male	1st year	Abd Allah	Undergraduate	Daily	2-5 years
37	18-22	General	Male	1st year	Zeyad	Undergraduate	Daily	2-5 years
38	18-22	General	Male	1st year	Mahmood	Undergraduate	Daily	2-5 years
39	18-22	Science	Male	1st year	Ibrahim	Undergraduate	Daily	more than 5 years
40	18-22	Art	Male	2nd year	Khamees	Undergraduate	Daily	0-1 year
41	18-22	Education	Male	3rd year	Saeed	Undergraduate	Daily	0-1 year
42	18-22	Social science	Male	3rd year	Jassem A	Undergraduate	Daily	2-5 years
43	18-22	Business	Male	4th year	Mohammed M	Undergraduate	Daily	2-5 years
44	18-22	Education	Male	3rd year	Ahmed	Undergraduate	Daily	more than 5 years
45	44-50	Not Applicable	Male	Not Applicable	Kenneth	Librarian	Daily	2-5 years
46	37-43	Not Applicable	Female	Not Applicable	Heidi	Librarian	Daily	more than 5 years
47	30-36	Not Applicable	Female	Not Applicable	Sarah	Librarian	Daily	more than 5 years
48	23-29	Not Applicable	Female	Not Applicable	Khulood M	Librarian	Daily	more than 5 years
49	more than 50	Not Applicable	Female	Not Applicable	luciana	Librarian	Daily	more than 5 years

_____

Appendix E: Consent form for card sorting

<u>CONSENT AND WAIVER</u>

TO WHOM IT MAY CONCERN:

I hereby grant full permission to Sumayyah AL-Faresi to take notes of my comments during the card sorting method to help in the design of **Mobile Digital library application**.

I understand that card sorting notes, my name, and e-mail address will **not** be shared with external third parties in compliance with Brunel University Privacy Policy

I understand that I can freely withdraw from the study at any time.

This consent and waiver will not be made the basis of a future claim of any kind against the Brunel University and any of its agencies.

Name of Research Participant: _____

Signature: _____

Date: _____

Appendix E-1: A Diagram of the full application architecture
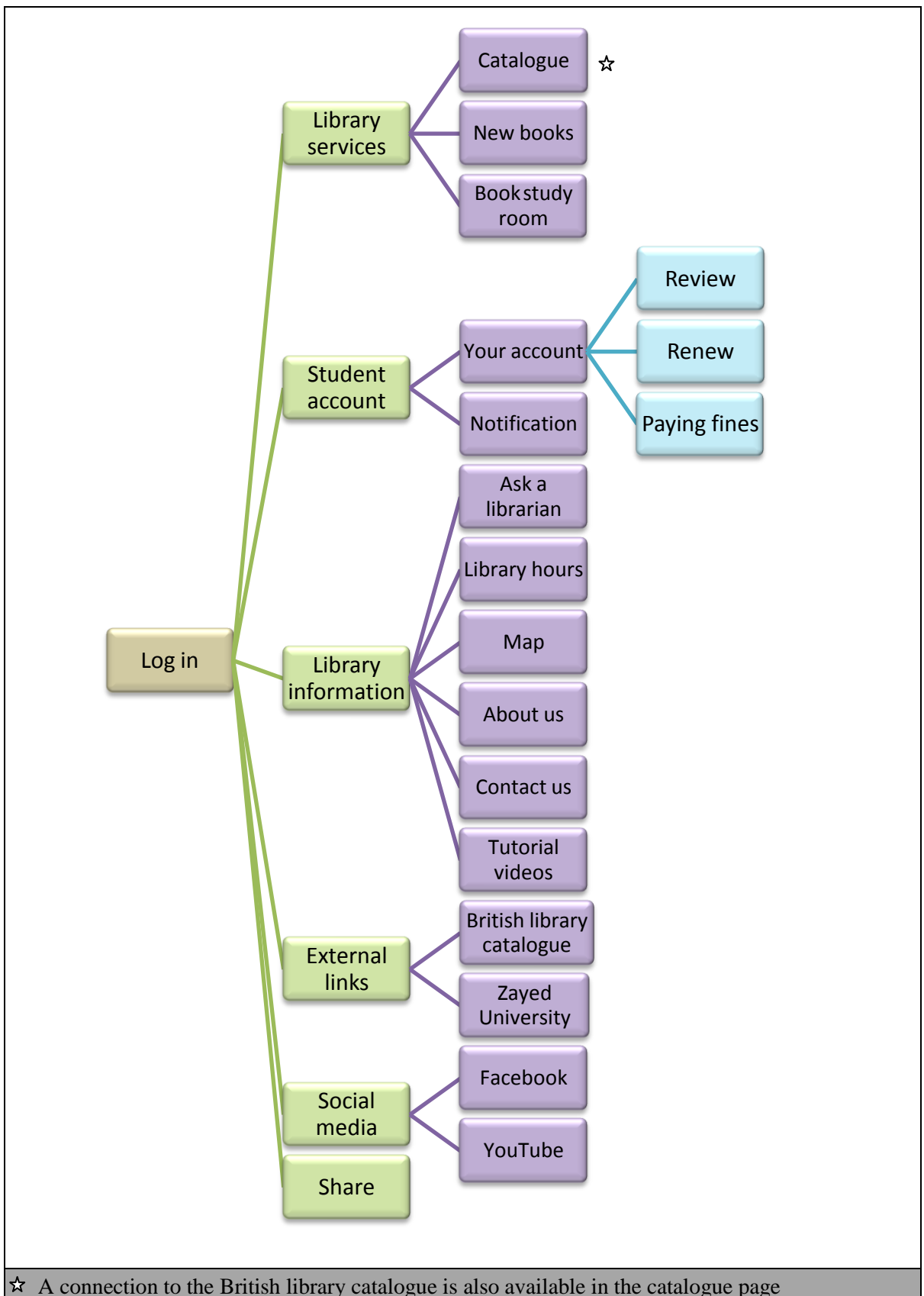
☆ A connection to the British library catalogue is also available in the catalogue page

APPENDIX F: Consent form for Usability testing

<u>CONSENT AND WAIVER</u>

TO WHOM IT MAY CONCERN:

I hereby grant full permission to Sumayyah AL-Faresi to take notes of my comments during the usability test for **Mobile Digital library application**.

I agree to my interview being recorded.

I understand that I may be quoted directly in this research, without reference to my name.

I understand that usability notes, my name, address, phone number and e-mail address will **not** be shared with external third parties in compliance with Brunel University Privacy Policy

I understand that I can freely withdraw from the study at any time.

This consent and waiver will not be made the basis of a future claim of any kind against the Brunel University and any of its agencies.

Name of Research Participant: _____

Signature: _____

Date: _____

Appendix F-1: Usability test questions

Mobile digital library application Usability Test

It takes only five users to uncover 80 percent of high-level usability problems. Jakob Nielsen

The purpose of our test sessions will be to gauge the usability and ease of navigation of the Mobile library application for specific target audiences, namely undergraduate students and graduate students.

We will test the application with 5-10 individuals pulled from the defined audience groups. We will administer an entrance and exit survey before and after each test and ask users to sign a release form giving their permission for taking notes and quoting their comments to be used for data-gathering purposes. Users will be asked to complete tasks read aloud to them by the facilitator.

Our goals will be to determine what is or is not working successfully on the application from the users' perspective.

Description of Methodology

Think-Aloud Protocol

We will employ a task-based think-aloud protocol, in which we will ask users to communicate their thought processes verbally while they work. We will ask them to vocalize what path they take to find information, what questions they have and what surprises or confuses them as they go through the application.

Specific Computer/Software used for this Test:

PC:

Operating System:

Smartphone:

Webcam:

Demographic Information Questionnaire

*(Please note, your information will **not** be sold or given to outside entities).*

1. Name:_____

2. Education level:

   Bachelor   Master   Doctoral

3. Grade Level:

   First year   Second year   Third year   Fourth year

4. Major:_____

5. Age Group:

   16-22   23-29   30-36   37-43   44-50   over 50

6. Gender:

   Female   Male

7. How often do you use the internet?
   Daily   Weekly   Monthly   Occasionally   Never

8. What do you usually do on the internet? *(e.g., email, use reference materials such as encyclopedias and dictionaries, read news, curriculum activities, games, entertainment etc.)*

   _____

   _____

   _____

9. Experience in mobile services:

   0-1 year   2-5 years   More than 5 years

10. Nationality: _____

- May we contact you about your input at a later date?
  If so, please provide your e-mail address. _____

_____

Task-based questions

The goal of this test is to evaluate the usability of mobile library application. I will ask you a series of questions and would like you to think out loud while you look for the answer. Some questions are easy and some are more difficult. Do not worry if you cannot find the answer every time. Please remember that we are testing the effectiveness of the application design and this is not a test of you. The whole test should take less than an hour. Thank you.

Please rank from 1 to 5 regarding the ease of use of the application, 1 being the easiest and 5 being the most difficult.

1. **Does the library own the book (Management: an introduction) by (Boddy, David)?**
   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

2. **You realize that you forgot to return a library book on time and you will have to return it in few days after the due date. Where on mobile app you can renew your book?**
   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

3. **You are at home working on a paper and you would like to ask a librarian for help. Where would you look for information on how to contact a librarian for help?**
   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

4. **Your instructor told you that you can get extra credit for attending lectures and events on libraries. Is the library holding any new special events?**
   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

5. **Your study group is planning to meet at 2pm in the library next Saturday. Is the library open at that time?**
   1   2   3   4   5

   Easy to use   Difficult to use

_____

Your comment: _____

_____

6. **You need the book (Millennium) by (Steve Englehart) for a class project, but you discover that our library does not have a copy. Where on the app would you go to check if another library has it?**

   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

7. **You want to reserve a library room to study in. where would you go on mobile app to reserve it?**

   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

8. **Does the library have a tutorial guide on how to change your library pin?**

   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

9. **You found the app useful and you would like to share it with a friend through e-mail, where would you go?**

   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

10. **You would like to tailor your overdue notices according to your preferences by SMS or/and e-mail before one week, two weeks, or even one day of time.**

    1   2   3   4   5

    Easy to use   Difficult to use

    Your comment: _____

    _____

_____

Please Let Us Know What You Think…

(Please note, any information you provide is for internal use only.)

Mobile digital library application Feedback

Please circle a number on the scale to indicate your reaction. Please write your comments to elaborate on your answers. I will go over your answers with you to make sure that I understand all of your responses. Thank you.

1. **Please rate the ease of use of the application.**

   1   2   3   4   5

   Easy to use   Difficult to use

   Your comment: _____

   _____

2. **What do you think about the organization of information on the application?**

   1   2   3   4   5

   Clear   Unclear

   Your comment: _____

   _____

3. **What do you think about the terminology used in the application?**

   1   2   3   4   5

   Clear   Unclear

   Your comment: _____

   _____

4. **Is the application visually attractive?**

   1   2   3   4   5

   Attractive   Unattractive

   Your comment: _____

   _____

5. **What is the best feature(s) of the application?**

   _____

   _____

   _____

6. **What is the worst feature(s) of the application?**

   _____

   _____

_____

_____

_____

7. What new content or features that you would like to see on the application?

_____

_____

_____

8. Can you recover from mistakes easily?

1   2   3   4   5

Easy   Difficult

Your comment: _____

_____

9. Your overall reaction to the application:

1   2   3   4   5

Satisfied   Unsatisfied

Your comment: _____

_____

10. Do you feel lost while using the site?

Yes_____   No_____

Your comment: _____

_____

11. Is the site easy to navigate?

Yes_____   No_____

Your comment: _____

_____

12. When you click a button on the application, do you expect that the click will lead you to correct answer?

Yes_____   No_____

Your comment: _____

_____

13. Do you have any other comments about the application?

_____

_____

Appendix F-2: Participants' demographic factors

Demographic Factors		Frequency	Percentage
Gender	Male	7	63.6
	Female	4	36.4
	Total	11	100
Age group	16-22	2	18.2
	23-29	4	36.4
	30-36	2	18.2
	37-43	2	18.2
	44-50	1	9.1
	Over 50	-	-
	Total	11	100
Major	Information system	4	36.4
	Computer science	3	27.3
	Marketing	2	18.2
	Economics	2	18.2
	Total	11	100
Education level	Bachelor degree	3	27.3
	Master degree	2	18.2
	Doctoral degree	6	54.5
	Total	11	100
Grade level	First year	3	27.3

	Second Year	5	45.5
	Third Year	2	18.2
	Fourth Year	1	9.1
	Total	11	100
Years of experience in smartphone use	0-1 year	-	-
	2-5 years	3	27.3
	More than 5 years	8	72.7
	Total	11	100
Nationality	Emirati	5	45.5
	GCC	3	27.3
	Other	3	27.3
	Total	11	100

Participants' individual answers in usability testing

Qs/st1	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	48.95	3	0	CT	1	Easy to find
Q2	21.46	3	0	CT	1	Perfect
Q3	6.03	2	0	CT	2	Move it to library services
Q4	44.17	0	3	FT	3	Confused. It should be under library information. It is updated news. Or you can call it events, activities, or updated news
Q5	5.05	2	0	CT	1	Excellent
Q6	8.68	2	0	CT	1	It is better to find it under the catalogue. The catalogue will give you choices to find it in

						different places. But if someone wants a certain book strait away they would like to have it separate category.
Q7	7.86	2	0	CT	1	As a suggestion. Booking a room is a service that you need straight away so if you add a category just for it, it would be better.
Q8	35.18	0	2	FT	5	Where is the guide line? I can't see it. it is difficult for me you need to put in a paragraph explaining the process then if they need further explanation they will turn to videos
Q9	1.12	1	0	CT	1	To share strait away
Q10	38.85 (37.71)	2	1	CT	3	I forgot that I am already registered
Total CA	8					
Total FA	2					
Qs/st2	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	41.8	3	0	CT	1	Very easy
Q2	14.13	3	0	CT	1	Very easy
Q3	19.35 (6.23)	2	3	CT	4	It wasn't easy. I expect to find it as a category by itself not under the library information
Q4	4.87	1	0	CT	1	It was easy to find but why don't you add maybe between brackets new news or events. Alerts is not very obvious
Q5	4.2	2	0	CT	1	Yes library information
Q6	4.75	2	0	CT	1	

Q7	7.9	2	0	CT	1	Maybe I am not sure. It might be under student account
Q8	34.88	1	8	FT	5	I couldn't find it. It is not obvious at all. It is better to be under student account
Q9	2.58	1	0	CT	1	
Q10	4.48	2	0	CT	1	
Total CA	10					
Total FA	1					
Qs/st3	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	18.60	3	0	CT	1	Easy obvious
Q2	9.31	3	0	CT	1	Easy
Q3	7.15	2	0	CT	2	
Q4	21.3 (3.15)	1	2	CT	1	"Alerts" doesn't represent events. It should be replaced with announcements
Q5	3.22	2	0	CT	1	Easy
Q6	11.56 (7.05)	2	2	CT	1	Better to add it under the catalogue
Q7	26.7 (8.34)	2	1	CT	2	It should be under library services. The account is only for renewals
Q8	33.16	0	3	FT	3	Hard to find
Q9	3.4	1	0	CT	1	
Q10	5.11	2	0	CT	1	clear
Total CA	9					

_____

Total FA	1					
Qs/st4	**TCT/sec**	**NCA**	**NRA**	**CT/FT**	**SR**	**COM**
Q1	30.48	3	0	CT	1	It is easy. Common sense
Q2	19.49 (12)	3	1	CT	1	Very easy
Q3	5.66	2	0	CT	1	Logically
Q4	3.02	1	0	CT	2	Not the right word "events" would be better but still it is easy to find. Alerts usually used when you have to return a book
Q5	3.43	2	0	CT	1	Easy
Q6	2.98	2	0	CT	1	Obvious under the external links
Q7	10.33 (4.64)	2	1	CT	3	Probably it is better to put it under the library services
Q8	11.11	2	0	CT	1	Easy to find
Q9	1.32	1	0	CT	1	Very easy to find
Q10	6.46	2	0	CT	1	Easy
Total CA	10					
Total FA	0					
Qs/st5	**TCT/sec**	**NCA**	**NRA**	**CT/FT**	**SR**	**COM**
Q1	31.74	3	0	CT	4	It is not very clear from the main screen that I should choose this one. It is better to be strait like search a book or find a book.

_____

Qs/st6	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q2	13.01	3	0	CT	1	
Q3	4.11	2	0	CT	1	
Q4	38.75	0	3	FT	4	I expect to find "news", "events" or "what's going on". I thought alert is something related to my own account
Q5	3.27	2	0	CT	1	This should be easy. Library information then library hours. yes
Q6	9.66	2	0	CT	1	
Q7	23.87	2	2	FT	5	Very strange. I expect it under library services
Q8	41.26	0	2	FT	4	It should be under student account. Sorry I thought I have to change my password. This is another thing. But I still think it should be under the library information because even the icon shows me that there is help. So I expect to find it there.
Q9	1.88	1	0	CT	1	Yes share.
Q10	6	2	0	CT	1	
Total CA	8					
Total FA	3					
Qs/st6	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	56.88	3	0	CT	1	Easy and simple to use
Q2	10.89	3	0	CT	1	
Q3	9.83	2	0	CT	1	
Q4	28.92	1	5	CT	3	It is not easy. if the tab just says events
Q5	5.22	2	0	CT	1	

Q6	6.34	2	0	CT	1	Maybe if it is on the same page of the catalogue would be better
Q7	8.41 (4.09)	2	1	CT	2	I think maybe under the library services would be better
Q8	6.17	2	0	CT	1	It is clear because YouTube is a type of social media
Q9	1.32	1	0	CT	1	
Q10	12.68	2	0	CT	1	
Total CA	10					
Total FA	0					

Qs/st7	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	17.59	3	0	CT	1	Very easy
Q2	10.51	3	0	CT	1	
Q3	11.42 (6.1)	2	1	CT	1	
Q4	7.83 (0.92)	1	1	CT	2	If we can change alerts to another word would be easier. Recent events maybe. Alert is equivalent to warning.
Q5	4.41	2	0	CT	1	It was quiet easy
Q6	10.92	2	0	CT	1	It is very obvious.
Q7	15.36 (4.23)	2	1	CT	3	Not in library services! It is much better if we move it with the services. It is easy to see all the services together
Q8	8.37	2	0	CT	1	It was easy tutorials is something related to media

Q9	1.8	1	0	CT	1	That is so obvious
Q10	29.23 (1.73)	2	2	CT	2	It is ok. But if you put it in link by itself. No it is ok to have it under student account
Total CA	10					
Total FA	0					
Qs/st8	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	35.7	3	0	CT	1	
Q2	24	3	0	CT	2	
Q3	7.09	2	0	CT	1	
Q4	17.63 (1.53)	1	2	CT	4	It wasn't easy. Instead of alerts. Because alerts could be anything. We can call it events or something like that
Q5	3.9	2	0	CT	1	I would name it opening hours
Q6	51.06 (5.80)	2	2	CT	3	I think better to link it with the catalogue
Q7	4.91	2	0	CT	1	
Q8	53.9 (1.53)	2	7	CT	5	Wow. To make it easier I suggest having a section for tutorials on how to use services. If it is only related to how to change the pin it could be under student accounts.
Q9	1.24	1	0	CT	1	
Q10	6.89	2	0	CT	1	Obvious
Total CA	10					
Total	0					

_____

FA						
Qs/st9	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	36.04	3	0	CT	1	It is quiet easy
Q2	8.51	3	0	CT	1	
Q3	10.68	2	0	CT	1	
Q4	51.9	1	4	FT	5	It is very hard to found. I think you should put it under library information and mention "special events"
Q5	4.48	2	0	CT	1	Easy
Q6	5.02	2	0	CT	1	
Q7	3.94	2	0	CT	1	
Q8	29.06	0	4	FT	5	Which one? This is difficult I think you should have button under library information called instruction showing you how to. YouTube does not really tell you what is happening there.
Q9	1.54	1	0	CT	1	
Q10	5.43	2	0	CT	1	
Total CA	9					
Total FA	2					
Qs/st10	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	48.07	3	0	CT	1	Very easy
Q2	15.39	3	0	CT	1	
Q3	5.93	2	0	CT	1	Probably library information but you might also think it might be under library services so

_____

					this is might be confusing.
Q4	34.01	0	3	FT	3	I might go through them all. It is not obvious. I assumed that alerts is what I set for my favourites. I think it might be under library services.
Q5	6.44	2	0	CT	1	This is quiet easy
Q6	5.29	2	0	CT	1	Very easy
Q7	30.3 (3.73)	2	2	CT	3	It is not obvious. But it is fine because you need to book under your name. so it should be under your account
Q8	48.96	0	4	FT	4	Where this service could be found? I do not think this is the right place. I think it should be under library information or library service.
Q9	16.58 (1.42)	1	2	CT	1	Oh sorry share I didn't see it. very easy
Q10	33.29 (6.83)	2	2	CT	2	It took me a while to find it because I was thinking where to place it.
Total CA	8					
Total FA	2					

Qs/st11	TCT/sec	NCA	NRA	CT/FT	SR	COM
Q1	81.05	3	0	CT	3	
Q2	18.04	3	0	CT	5	It can be either under library services or student account. It is a guess work. Maybe if you add in brackets the subcategories under each category.
Q3	3.46	2	0	CT	1	This one is easy

Q4	16.72 (7.79)	1	2	CT	4	Either library information or alerts! I think you can call it events and include it with library information
Q5	5.12	2	0	CT	1	That one is easy
Q6	4.68	2	0	CT	1	This is easy to do
Q7	34.29 (3.53)	2	1	CT	5	Putting it under my account might not be ideal. That would be difficult to get
Q8	79.62	1	2	FT	5	That should be under library information. social media is about how to connect with other people
Q9	2.5	1	0	CT	1	Simple. share
Q10	8.92	2	0	CT	1	That was easy
Total CA	10					
Total FA	1					
TCT/sec (Time of complete task), NCA (Number of correct answers), NRA (number of wrong answers), CT/FT (complete/failed to complete task), SR (steps required), COM (comments)						

The ease of completing each task

Tasks	N	Percentage (Very easy, easy)	Percentage (Moderate)	Percentage (difficult and very difficult)
search catalogue	11	81.80%	9.10%	9.10%
renew	11	81.80%	9.10%	9.10%
ask a librarian	11	72.7% 18.2%		9.10%
library news	11	18.2%	27.30%	27.3%

		18.2%		9.1%
library hours	11	100%		
interlibrary loan	11	90.90%	9.10%	
Book study room	11	36.4% 18.2%	27.30%	18.20%
Youtube tutorial	11	27.30%	9.10%	18.2% 45.5%
Share	11	100%		
Notification	11	72.7% 18.2%	9.10%	
N (Number of participants)				

_____

Appendix G: Questionnaire

Mobile Digital Library Acceptance

Dear students,

I am a Kuwaiti PhD student. I am currently conducting a study to measure users' acceptance of the idea of using the library services like (library catalogue, library hours, student account, renew books, etc.) through smartphone (e.g iphone, Black Berry Android, etc.).

Through this survey, I hope to learn more about what may interfere with your acceptance of mobile digital library services. I am interested in your feedback. I appreciate if you spare few minutes to fill out this survey.

**Please Watch the video first or download the prototype (app) and then answer the questionnaire !

log in: User1

Password: smart

iphone

https://itunes.apple.com/WebObjects/MZStore.woa/wa/viewSoftware?id = 736787310&mt = 8

Android

https://play.google.com/store/apps/details?id = smart.l&hl = en_GB

 Thank you for your time and effort

Sumayyah AL-Faresi, PhD. Candidate
Brunel University, Information System and Computing Department, UK.
Sumayyah.alfaresi@brunel.ac.uk

** If you have any complaints you can contact ZU reserch office at research@zu.ac.ae

1) Gender *

☐ Male

☐ Female

Mobile Digital Library Acceptance   *Sumayyah AL-Faresi*

_____

2) Age *

[   ]

3) Department *

[   ]

4) Education level *

☐ Bachelor Degree

☐ Master Degree

☐ PhD Degree

5) Nationality *

[   ]

6) How many years of experience do you have in using smartphones? *

☐ Less than 1 year

☐ 1-2 years

☐ 3-5 years

☐ More than 5 years

7) Please indicate your level of experience with the following technologies: *

	None	Very limited	Some experience	Quite a lot	Extensive
Smartphones	☐	☐	☐	☐	☐
Mobile applications	☐	☐	☐	☐	☐
E-mail via smartphones	☐	☐	☐	☐	☐
Internet or World Wide Web via smartphones	☐	☐	☐	☐	☐

library Database via internet	☐	☐	☐	☐	☐
Blackboard via internet	☐	☐	☐	☐	☐
Reading news or weather reports on the internet	☐	☐	☐	☐	☐

Comments:

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8) Using the mobile digital library application would help me to accomplish tasks more quickly *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

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9) Using the mobile library application would improve my performance in my study *

☐ Strongly Agree

☐   Agree

☐   Undecided

☐   Disagree

☐ Strongly Disagree

Comments:

☐

10) Using the mobile library application would increase my learning productivity *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

☐

11) Using the mobile library application would enhance my effectiveness in learning *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

12) **Using mobile digital library would make it easier to do my assignments** *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

13) **I would find mobile digital library useful in my study** *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

14) **Learning to operate the mobile digital library application would be easy for me** *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```


```

15) I find it easy to get the mobile digital library application to do what I want it to do *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

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```

16) My interaction with mobile digital library application would be clear and understandable *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

☐ _(empty text box)_

17) I find mobile digital library application flexible to interact with *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

☐ _(empty text box)_

18) It would be easy for me to become skilful at using the mobile digital library application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

☐ _(empty text box)_

19) I would find the mobile digital library application easy to use *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

20) Assuming that I have access to mobile digital library application… *

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I intend to continue using the application in the future	☐	☐	☐	☐	☐
I would continue using the application in the future	☐	☐	☐	☐	☐
I intend to increase my use of the application in the future	☐	☐	☐	☐	☐
I would regularly use the application in the future	☐	☐	☐	☐	☐

Comments:

21) **People who use mobile applications to gather information have a high profile. ***

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

22) **People who use library services on their mobile have a high profile. ***

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

23) **People who use the mobile applications to gather information have more prestige than those who do not.. ***

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```



```

24) People who use library services on their mobile have less prestige than those who do not *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

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```

25) People important to me think I should use mobile digital library application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

┌─────────────────────────────────┐
│   │
│   │
│   │
└─────────────────────────────────┘

26) It is expected that students like me use mobile digital library application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

┌─────────────────────────────────┐
│   │
│   │
│   │
└─────────────────────────────────┘

27) People I look up to expect me to use mobile digital library application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

┌─────────────────────────────────┐
│   │
│   │
│   │
└─────────────────────────────────┘

_____

28) People who are important to me would recommend using mobile digital application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

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```

29) People who are important to me would find using mobile digital library application beneficial *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```


```

30) People who are important to me would find using mobile digital library application a good idea *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```



```

31)   I feel comfortable reading articles in English *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```



```

32) My reading ability in English is very poor *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

33) I feel comfortable using mobile applications in English language
     *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

34) Generally, my English language is very good *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

35) I like to be able to keep in touch with the library everywhere I am
     *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```


```

36) I like to be able to coordinate my daily tasks no matter what time it is *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```


```

37)   I like to be able to coordinate my daily tasks everywhere I am *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

☐ (comment box)

38) I could imagine having multiple tasks at a time *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

☐ (comment box)

39) I could complete a task using mobile digital library application if there was no one around to tell me what to do *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

☐ (comment box)

40) I could complete a task using the mobile digital library application if I had only manuals for reference *

◻ Strongly Agree

◻ Agree

◻ Undecided

◻ Disagree

◻ Strongly Disagree

Comments:

```

```

41) I could complete a task using the mobile digital library application if someone else helped me get started *

◻ Strongly Agree

◻ Agree

◻ Undecided

◻ Disagree

◻ Strongly Disagree

Comments:

```

```

42) I could complete a task using the mobile digital library application if I had seen someone else using it before trying it my self *

◻ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```
```

43) I could complete a task using the mobile digital library application if I could call someone for help if I got stuck *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```
```

44) I could use the mobile digital library application if I had a lot of time to complete a task *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

45)

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

46) The mobile digital library application is trustworthy *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

47)   I trust in the benefits of this mobile digital library application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

[   ]

48) This mobile digital library application keeps its promises and commitments *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

[   ]

49) The mobile digital library application keeps students' best interest in mind *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

_____

☐ Strongly Disagree

Comments:

```



```

50) This mobile digital library application would do the job right *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```



```

51)   I trust this mobile digital library application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```



```

52) The mobile digital library application provides up-to-date information in my area(s) of interest *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

53) The services included in the mobile digital library application relate well to my needs *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

54) The information I find in the mobile digital library application are generally applicable to my area of interest *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```

```

55) The mobile digital library application has enough resources for my needs *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```

```

56) In general, the information from the mobile digital library application are not relevant to me *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

[ ]

57)   I can get help easily from a librarian *

[ ] Strongly Agree

[ ] Agree

[ ] Undecided

[ ] Disagree

[ ] Strongly Disagree

Comments:

[ ]

58) Librarians respond to my problem quickly *

[ ] Strongly Agree

[ ] Agree

[ ] Undecided

[ ] Disagree

[ ] Strongly Disagree

Comments:

[ ]

59) I find librarians knowledgeable to direct me where I can find information I need *

[ ] Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

---

60) I find librarians capable of directing me where I can find information *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

---

61) It is easy to navigate the mobile digital library application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```



```

62) **In the mobile digital library, I can easily navigate to where I want**
*

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```



```

63) The mobile digital library application's directions and navigations are clear *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```



```

64) I understand most of the terms that are used throughout the mobile digital library application *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

[   ]

65) The use of terms throughout the mobile digital library application is consistent *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

[   ]

66) The mobile digital library application provide terms that are easy to understand *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```
```

67) The application commands are well depicted by buttons and symbols *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```
```

68) The layout of the mobile digital library screens is clear and consistent *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

```
```

69) Fonts (style, color, and saturation) are easy to read on-screen *

☐ Strongly Agree

☐ Agree

☐ Undecided

☐ Disagree

☐ Strongly Disagree

Comments:

<div dir="rtl">

استبيان لقياس مدى تقبل المكتبة المحمولة المرحلة الثانية

عزيزي الطالب/ الطالبة:

أنا طالبة دكتوراة كويتية أجري حاليا دراسة لقياس مدى تقبل الطلبة لفكرة استخدام المكتبة المحمولة أو الخدمات المكتبية مثل (فهرس المكتبة، ساعات العمل، حساب الطالب، تجديد استعارة الكتب) عبر الجوالات الذكية الحديثة مثل الآيفون، البلاك بيري، الاندرويد، الح). أود من خلال هذا الاستبيان أن أتمكن من معرفة العوامل التي تؤثر في قبولك لاستخدام برنامج جوال (تطبيقات) مخصص لاستخدام مصادر المكتبة. رأيك يهمني وكل ما أرجوه منك بضع دقائق لاستكمال هذا الاستبيان

الرجاء مشاهدة الفلم قبل الاجابة على الاستبيان أو بامكانك تحميل نموذج البرنامج المتوافق مع هاتفك **

</div>

log in: User1

Password: smart

iphone

https://itunes.apple.com/WebObjects/MZStore.woa/wa/viewSoftware?id = 736787310&mt = 8

Android

https://play.google.com/store/apps/details?id = smart.l&hl = en_GB

<div dir="rtl">

لكم جزيل الشكر

سمية الفارسي

طالبة دكتوراة، جامعة برونل بريطانيا

</div>

Sumayyah.alfaresi@brunel.ac.uk

<div dir="rtl">

**اذا كانت لديك شكوى او سؤال متعلق في هذا البحث يمكنك الاتصال بمركز البحوث

</div>

research@zu.ac.ae

Mobile Digital Library Acceptance | *Sumayyah AL-Faresi*

1) الجنس*

☐ ذكر

☐ انثى

2)   العمر*

☐

3) القسم/التخصص*

☐

4)   المستوى التعليمي*

☐ بكالريوس

☐ ماجستير

☐ دكتوراة

5) الجنسية

☐

6)   عدد سنوات الخبرة باستخدام المحمول الذكي؟*

☐ أقل من سنة

☐ من 1-2 سنوات

☐ من 3-5 سنوات

☐ أكثر من 5 سنوات

7) الرجاء ذكر مدى خبرتك في التقنيات التالية*

خبرة مكثفه	خبرة طويلة	بعض الخبرة	خبرة محدودة للغاية	ليس لدي خبرة	
☐	☐	☐	☐	☐	المحمول الذكي
☐	☐	☐	☐	☐	تطبيقات المحمول الذكي
☐	☐	☐	☐	☐	البريد الالكتروني من خلال المحمول الذكي
☐	☐	☐	☐	☐	الانترنت من خلال المحمول الذكي
☐	☐	☐	☐	☐	مصادر المكتبة من خلال الانترنت
☐	☐	☐	☐	☐	بلاك بورد من خلال الانترنت
☐	☐	☐	☐	☐	قراءة الاخبار أو أحوال الطقس من خلال الانترنت

التعليقات

```


```

8) استخدام برنامج المكتبة المحمولة سيجعلني انجز العمل أسرع*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

9) استخدام برنامج المكتبة المحمولة سيحسن من مستوى دراستي*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

10(استخدام برنامج المكتبة المحمولة سيحسن من مستوى تعليمي*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

11) استخدام برنامج المكتبة المحمولة سيحسن من فعالية تعليمي*

☐ أوافق بشدة

<div dir="rtl">

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

12 (استخدام برنامج المكتبة المحولة سيجعل حل الفروض أسهل*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

13 (أجد أن برنامج المكتبة المحمولة مفيد لدراستي*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

</div>

التعليقات

14) تعلم كيفية استخدام برنامج المكتبة المحمولة سيكون سهلا بالنسبة لي*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

15) سيكون من السهل علي أن أجعل برنامج المكتبة المحمولة أن يقوم بالمهام التي أريدها*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

16) تفاعلي مع برنامج المكتبة المحمولة سيكون واضحا و مفهوما*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

```



```

17) أجد أن التفاعل مع برنامج المكتبة المحمولة مرن*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

```



```

18)   سيكون من السهل علي أن أصبح ماهرا باستخدام برنامج المكتبة المحمولة*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

لا أوافق بشدة ☐

التعليقات

┌─────────────────────────────────────┐
│   │
│   │
│   │
└─────────────────────────────────────┘

19) أجد أن برنامج المكتبة المحمولة سهل الاستخدام*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

┌─────────────────────────────────────┐
│   │
│   │
│   │
└─────────────────────────────────────┘

20) على افتراض أنني استطيع الوصول الى برنامج المكتبة المحمولة فانني*

لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة	
☐	☐	☐	☐	☐	أنوي أن أستمر باسخدامه بالمستقبل
☐	☐	☐	☐	☐	سأستمر باستخدامه بالمستقبل
☐	☐	☐	☐	☐	سأستخدمه بانتظام بالمستقبل
☐	☐	☐	☐	☐	أنوي أن أزيد استخدامي له بالمستقبل

التعليقات

21 **)** الأشخاص الذين يستخدمون تطبيقات المحمول الذكي لجمع المعلومات رفيعي المستوى*

☐ **أوافق بشدة**

☐ **أوافق**

☐ **محايد**

☐ **لا أوافق**

☐ **لا أوافق بشدة**

التعليقات

22 **)** الأشخاص الذين يستخدمون مصادر المكتبة من المحمول الذكي رفيعي المستوى*

☐ **أوافق بشدة**

☐ **أوافق**

☐ **محايد**

☐ **لا أوافق**

☐ **لا أوافق بشدة**

التعليقات

23 **(**الأشخاص الذين يستخدمون تطبيقات المحمول الذكي لجمع المعلومات لديهم اعتبار (بريستيج) أكثر من الذين لا يستخدمونه

*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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┌─────────────────────────────┐
│                             │
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└─────────────────────────────┘
```

24) الأشخاص الذين يستخدمون خدمات المكتبة من محمولهم الذكي ليس لديهم اعتبار (بريستيج) أكثر من الذين لا يستخدمونه*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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┌─────────────────────────────┐
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│                             │
└─────────────────────────────┘
```

25) الأشخاص المقربين مني يعتقدون أنه يجب علي أن استخدم برنامج المكتبة المحمولة*

☐ أوافق بشدة

☐ أوافق

☐ محايد

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

☐ (box)

26) من المتوقع أن يستخدم الطلبة مثلي برنامج المكتبة المحمولة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

☐ (box)

27) الأشخاص الذين احترمهم (معلمي) يتوقع مني أن استخدم برنامج المكتبة المحمولة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

☐ (box)

28) الأشخاص المهمين في حياتي سيشيدون باستخدم برنامج المكتبة المحمولة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

29) الأشخاص المهمين في حياتي سيجدون أن استخدام برنامج المكتبة المحمولة مفيد*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

30) الأشخاص المهمين في حياتي سيجدون أن استخدام برنامج المكتبة المحمولة فكرة صائبة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

☐

31) أقرأ المقالات المكتوبة باللغة الانجليزيه براحة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

☐

32) مقدرتي على القراءة باللغة الانجليزية ضعيفة جدا*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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┌─────────────────────────────┐
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└─────────────────────────────┘
```

33 (أستخدم تطبيقات المحمول الذكي المتوفرة باللغة الانجليزية براحة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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┌─────────────────────────────┐
│                             │
│                             │
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└─────────────────────────────┘
```

34) عموما لغتي الانجليزية جيدة جدا*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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┌─────────────────────────────┐
│                             │
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│                             │
└─────────────────────────────┘
```

35 (أحب أن أكون قادرا على التواصل مع المكتبة أينما أكون*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

```



```

36 (أحب أن أكون قادرا على تنسيق مهامي اليومية في أي وقت*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

```



```

37 (أحب أن أكون قادرا على تنسيق مهامي اليومية أينما أكون*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

☐ لا أوافق بشدة

التعليقات

[ ]

38) بامكاني تصور نفسي أقوم بمهام متعددة بوقت واحد*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

[ ]

39) يمكنني استخدام برنامج المكتبة المحمولة لاتمام مهمة ما دون الحاجة لمساعدة أحد من حولي*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

[ ]

_____

40) يمكنني استخدام برنامج المكتبة المحمولة لاتمام مهمة ما فقط اذا كان بحوزتي كتيب يوضح طريقة الاستخدام*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

41 (يمكنني استخدام برنامج المكتبة المحمولة لاتمام مهمة ما فقط اذا ساعدني شخص في البداية على استعماله

*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

42) يمكنني استخدام برنامج المكتبة المحمولة لاتمام مهمة ما فقط اذا رأيت أحدا يستخدمه قبلي*

أوافق بشدة ☐

أوافق ☐

محايد ☐

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

43 (يمكنني استخدام برنامج المكتبة المحمولة لاتمام مهمة ما فقط اذا كان بامكاني الاستعانة بشخص يساعدني اذا واجهت صعوبة
*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

44 (يمكنني استخدام برنامج المكتبة المحمولة لاتمام مهمة ما فقط اذا توفر لدي الوقت الكافي لاتمام مهمة ما*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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45 **)** يمكنني استخدام برنامج المكتبة المحمولة لاتمام مهمة ما فقط اذا كان البرنامج يتضمن خدمة المساعدة

*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

46 **)** برنامج المكتبة المحمولة جدير بالثقة*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

47 **)** أثق بفوائد برنامج المكتبة المحمولة*

☐ أوافق بشدة

</div>

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

☐

48) هذا البرنامج يفي بوعوده والتزاماته*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

☐

49)   هذا البرنامج يضع مصلحة الطالب بالحسبان*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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50) هذا البرنامج سيقوم بالعمل بشكل صحيح*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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51)   عموما أنا أثق بهذا البرنامج*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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52) برنامج المكتبة المحمولة يقدم معلومات حديثة متعلقة باهتماماتي*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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53 (الخدمات الموجودة في برنامج المكتبة المحمولة مرتبطة جدا باحتياجاتي*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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54 (المعلومات التي أجدها في برنامج المكتبة المحمولة عموما تتماشى مع اهتماماتي*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

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لا أوافق بشدة ☐

التعليقات

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55 **)** برنامج المكتبة المحمولة يحتوي على مصادر كافية لاحتياجاتي*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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56 **)** عموما المعلومات الموجودة في برنامج المكتبة المحمولة ليس لها علاقة بي*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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57) أستطيع الحصول على مساعدة أمين المكتبة بسهولة*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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58) موظفي المكتبة يجيبون على استفساراتي بسرعة*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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95) أجد أن موظفي المكتبة لديهم المعرفة اللازمة لارشادي حول كيفية الحصول على المعلومات التي أريدها *

☐ أوافق بشدة

☐ أوافق

☐ محايد

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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60) أجد أن موظفي المكتبة لديهم القدرة لارشادي حول كيفية الحصول على المعلومات*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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61) من السهل التصفح والتنقل في برنامج المكتبة المحمولة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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62) ‎في برنامج المكتبة المحمولة أستطيع التنقل والتصفح أينما أريد بسهولة*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

63) توجيهات التنقل بين الصفحات في برنامج المكتبة المحمولة واضحة*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

64) أغلب المصطلحات المستخدمة في برنامج المكتبة المحمولة مفهومة*

☐ أوافق بشدة

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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65) استخدام المصطلحات في البرنامج متناسقة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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66) برنامج المكتبة المحمولة يوفر مصطلحات سهلة الفهم*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

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67)   الأوامر الموجودة في البرنامج مرتبة بمفاتيح ورموز*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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68) تصميم صفحات برنامج المكتبة المحمولة واضحة ومتناسقة*

☐ أوافق بشدة

☐ أوافق

☐ محايد

☐ لا أوافق

☐ لا أوافق بشدة

التعليقات

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69)   الشكل واللون والخط يسهل قراءتهم على الشاشة*

أوافق بشدة ☐

أوافق ☐

محايد ☐

لا أوافق ☐

لا أوافق بشدة ☐

التعليقات

Appendix G-1: Descriptive statistics

Item no.	Mean	SD	Frequency	Percentage
Mobile and web experience				
EXP 1	3.72	.993	8 None	3.8%
			13 Very limited	6.2%
			53 Some experience	25.2%
			91 Quiet a lot	43.3%
			45 Extensive	21.4%
EXP 2	3.52	.999	7	3.3%
			22	10.5%
			71	33.8%
			75	35.7%
			35	16.7%
EXP 3	3.70	1.059	12	5.7%
			15	7.1%
			50	23.8%
			81	38.6%
			52	24.8%
EXP 4	4.02	1.009	4	1.9%
			16	7.6%
			32	15.2%
			77	36.7%
			81	38.6%
EXP 5	2.86	1.113	29	13.8%
			44	21.0%
			79	37.6%
			43	20.5%
			15	7.1%
EXP 6	3.21	1.243	25	11.9%
			33	15.7%
			61	29.0%
			55	26.2%
			36	17.1%
EXP 7	3.46	1.137	15	7.1%
			23	11.0%
			64	30.5%
			67	31.9%
			41	19.5%
Perceived usefulness				
PU 1	4.31	.682	- Strongly disagree	-
			2 Disagree	1.0%
			20 Undecided	9.5%
			98 Agree	46.7%
			90 Strongly agree	42.9%
PU 2	4.18	.729	1	.5%
			1	.5%
			31	14.8%
			103	49.0%
			74	35.2%
PU 3	4.15	.729	1	.5%
			3	1.4%
			27	12.9%
			111	52.9%
			68	32.4%

Item no.	Mean	SD	Frequency	Percentage
PU 4	4.12	.875	5 5 24 102 74	2.4% 2.4% 11.4% 48.6% 35.2%
PU 5	4.33	.707	- 1 26 86 97	- .5% 12.4% 41.0% 46.2%
PU 6	4.28	.656	- 2 18 110 80	- 1.0% 8.6% 52.4% 38.1%
Perceived ease of use				
PEOU 1	4.36	.726	- 3 22 82 103	- 1.4% 10.5% 39.0% 49.0%
PEOU 2	4.10	.791	1 5 35 100 69	.5% 2.4% 16.7% 47.6% 32.9%
PEOU 3	4.12	.732	2 1 30 114 63	1.0% .5% 14.3% 54.3% 30.0%
PEOU 4	4.12	.708	- 2 35 108 65	- 1.0% 16.7% 51.4% 31.0%
PEOU 5	4.33	.651	- 1 18 101 90	- .5% 8.6% 48.1% 42.9%
PEOU 6	4.18	.686	- 2 28 111 69	- 1.0% 13.3% 52.9% 32.9%
Behavioural intention				
BI 1	4.25	.736	3 1 16 111 79	1.4% .5% 7.6% 52.9% 37.6%
BI 2	4.17	.774	3 - 30 103 74	1.4% - 14.3% 49.0% 35.2%

Item no.	Mean	SD	Frequency	Percentage
BI 3	3.98	.886	3	1.4%
			4	1.9%
			54	25.7%
			82	39.0%
			67	31.9%
BI 4	4.12	.880	3	1.4%
			5	2.4%
			37	17.6%
			84	40.0%
			81	38.6%
Distinctiveness/Prestige				
PRE 1	3.81	.944	3	1.4%
			14	6.7%
			57	27.1%
			82	39.0%
			54	25.7%
PRE 2	3.84	.914	2	1.0%
			11	5.2%
			62	29.5%
			79	37.6%
			56	26.7%
PRE 3	3.32	1.102	11	5.2%
			39	18.6%
			63	30.0%
			65	31.0%
			32	15.2%
PRE 4	3.03	1.085	18	8.6%
			43	20.5%
			87	41.4%
			39	18.6%
			23	11.0%
English literacy				
ENG 1	3.64	1.027	5	2.4%
			28	13.3%
			48	22.9%
			86	41.0%
			43	20.5%
ENG 2	3.30	1.356	26	12.4%
			43	20.5%
			23	15.2%
			60	28.6%
			49	23.3%
ENG 3	3.85	1.056	5	2.4%
			24	11.4%
			33	15.7%
			84	40.0%
			64	30.5%
ENG 4	3.84	1.016	3	1.4%
			26	12.4%
			31	14.8%
			91	43.3%
			59	28.1%

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Item no.	Mean	SD	Frequency	Percentage
Mobile self-efficacy
MSE 1	4.16	.802	- 6 35 88 81	- 2.9% 16.7% 41.9% 38.6%
MSE 2	3.44	1.169	14 23 54 67 43	6.7% 15.2% 25.7% 31.9% 20.5%
MSE 3	3.63	1.117	10 27 42 82 49	4.8% 12.9% 20.0% 39.0% 23.3%
MSE 4	3.49	1.133	8 44 36 82 40	3.8% 21.0% 17.0% 39.0% 19.0%
MSE 5	3.63	1.024	2 37 40 89 42	1.0% 17.6% 19.0% 42.4% 20.0%
MSE 6	3.71	.946	3 21 51 93 42	1.4% 10.1% 24.3% 44.3% 20.0%
MSE 7	3.65	.933	2 22 63 84 39	1.0% 10.5% 30.0% 40.0% 18.6%
Trust
TRU 1	4.01	.770	- 3 52 95 60	- 1.4% 24.8% 45.2% 28.6%
TRU 2	4.19	.718	1 1 29 106 73	.5% .5% 13.8% 50.5% 34.8%
TRU 3	3.91	.774	- 3 64 92 51	- 1.4% 30.5% 43.8% 24.3%
TRU 4	4.02	.794	1 5 43 101 60	.5% 2.4% 20.5% 48.1% 28.6%

Mobile Digital Library Acceptance *Sumayyah AL-Faresi*

Item no.	Mean	SD	Frequency	Percentage
TRU 5	4.00	.821	4 2 41 107 56	1.9% 1.0% 19.5% 51.0% 26.7%
TRU 6	4.02	.850	1 6 49 85 69	.5% 2.9% 23.3% 40.5% 23.9%
Relevance				
REL 1	4.01	.735	- 2 49 103 56	- 1.0% 23.3% 49.0% 26.7%
REL 2	3.90	.728	- 3 58 106 43	- 1.4% 27.6% 50.5% 20.5%
REL 3	4.02	.695	- 3 39 118 50	- 1.4% 18.6% 56.2% 23.8%
REL 4	3.83	.744	- 8 55 112 35	- 3.8% 26.2% 53.3% 16.7%
REL 5	2.88	1.134	16 78 55 38 23	7.6% 37.1% 26.2% 18.1% 11.0%
Assistance				
ASSIS 1	3.70	.906	4 12 66 88 40	1.9% 5.7% 31.4% 41.9% 19.0%
ASSIS 2	3.56	.906	2 20 80 74 34	1.0% 9.5% 38.1% 35.2% 16.2%
ASSIS 3	3.87	.834	2 7 55 98 48	1.0% 3.3% 26.2% 46.7% 22.9%
ASSIS 4	3.79	.879	6 5 57 102 40	2.9% 2.4% 27.1% 48.6% 19.0%

Item no.	Mean	SD	Frequency	Percentage
Social influence				
SOC 1	3.43	.906	2 31 74 80 23	1.0% 14.8% 35.2% 38.1% 11.0%
SOC 2	4.08	.817	3 4 32 105 66	1.4% 1.9% 15.2% 50.0% 31.4%
SOC 3	3.89	.878	1 11 55 87 56	.5% 5.2% 26.2% 41.4% 26.7%
SOC 11	3.90	.844	1 9 53 94 53	.5% 4.3% 25.2% 44.8% 25.2%
SOC 22	4.07	.758	- 8 29 113 60	- 3.8% 13.8% 53.8% 28.6%
SOC 33	4.10	.738	- 5 32 109 64	- 2.4% 15.2% 51.9% 30.5%
Mobility				
MOB 1	4.16	.841	2 8 24 97 79	1.0% 3.8% 11.4% 46.2% 37.6%
MOB 2	4.27	.805	4 2 17 97 90	1.9% 1.0% 8.1% 46.2% 42.9%
MOB 3	4.32	.769	1 7 12 94 96	.5% 3.3% 5.7% 44.8% 45.7%
MOB 4	4.08	.925	3 12 28 90 77	1.4% 5.7% 13.3% 42.9% 36.7%

| Item no.	Mean	SD	Frequency	Percentage
Interface design				
NAV 1	4.05	.793	2 5 34 109 60	1.0% 2.4% 16.2% 51.9% 28.6%
NAV 2	4.08	.711	- - 45 103 62	- - 21.4% 49.0% 29.5%
NAV 3	4.06	.765	- 4 43 99 64	- 1.9% 20.5% 47.1% 30.5%
TER 1	3.90	.744	- 8 46 116 40	- 3.8% 21.9% 55.2% 19.0%
TER 2	3.90	.695	1 1 53 118 37	.5% .5% 25.2% 56.2% 17.6%
TER 3	4.02	.722	2 2 34 123 49	1.0% 1.0% 16.2% 58.6% 23.3%
SCR 1	3.94	.689	0 2 50 116 42	- 1.0% 23.8% 55.2% 20.0%
SCR 2	3.88	.813	3 7 44 114 42	1.4% 3.3% 21.0% 54.3% 20.0%
SCR 3	3.97	.773	- 9 39 112 50	- 4.3% 18.6% 53.3% 23.8%

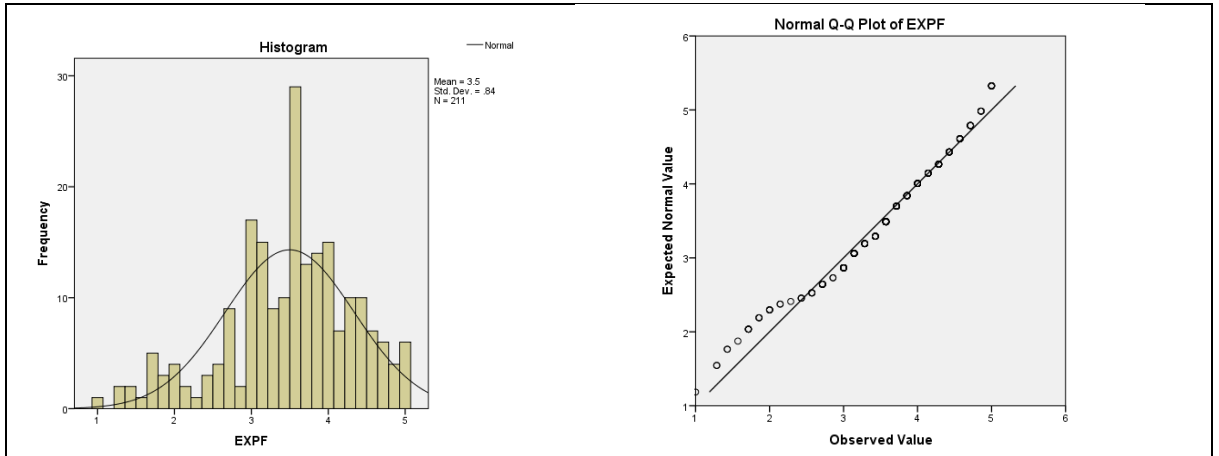## Appendix G-2: Normality testing (Histogram and Q-Q Plot) for each construct
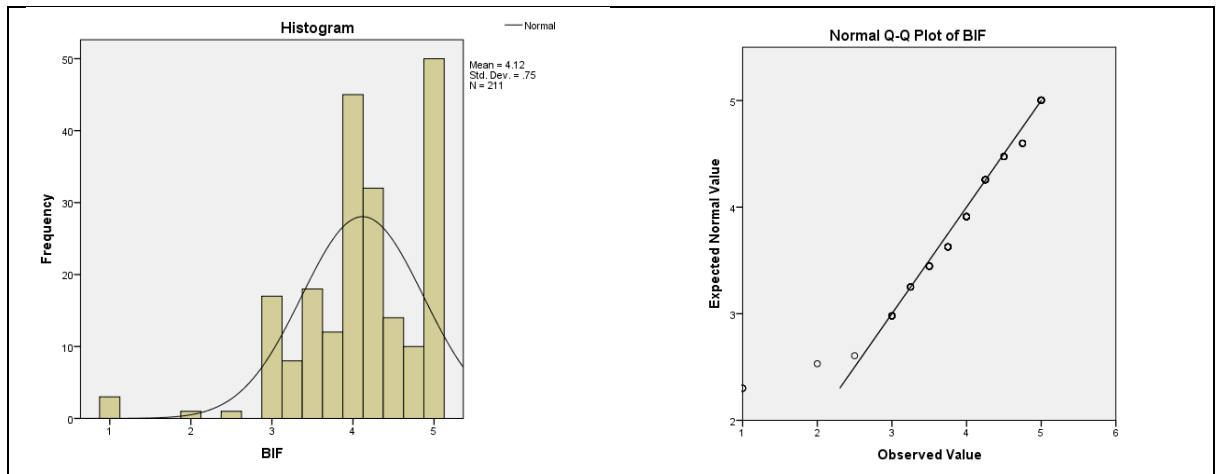
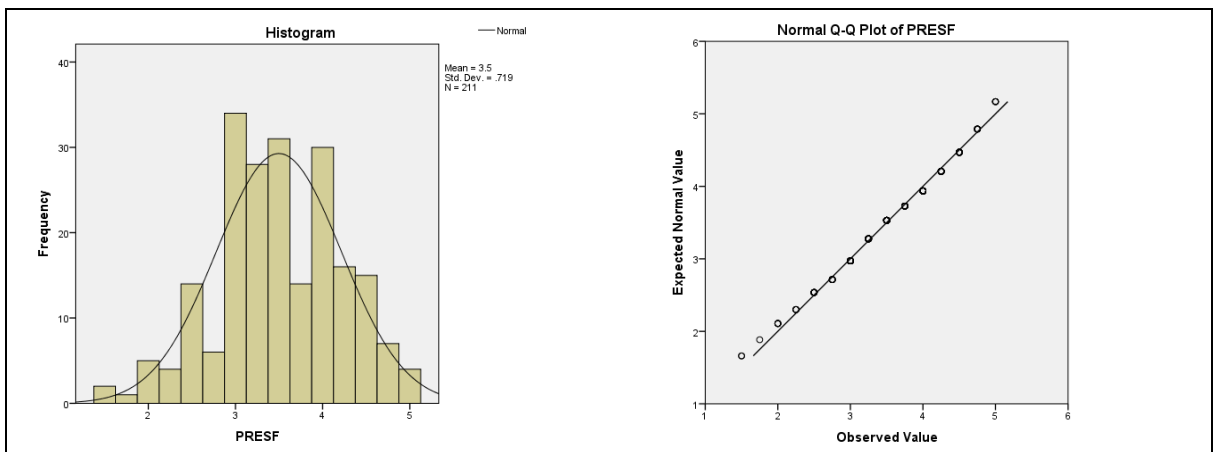**Normality of *Behavioural intention* value**
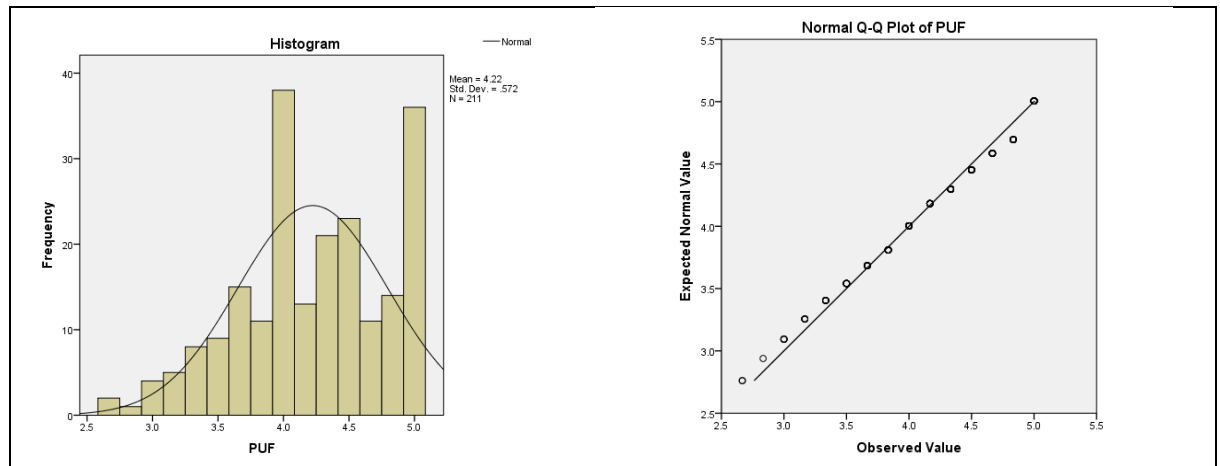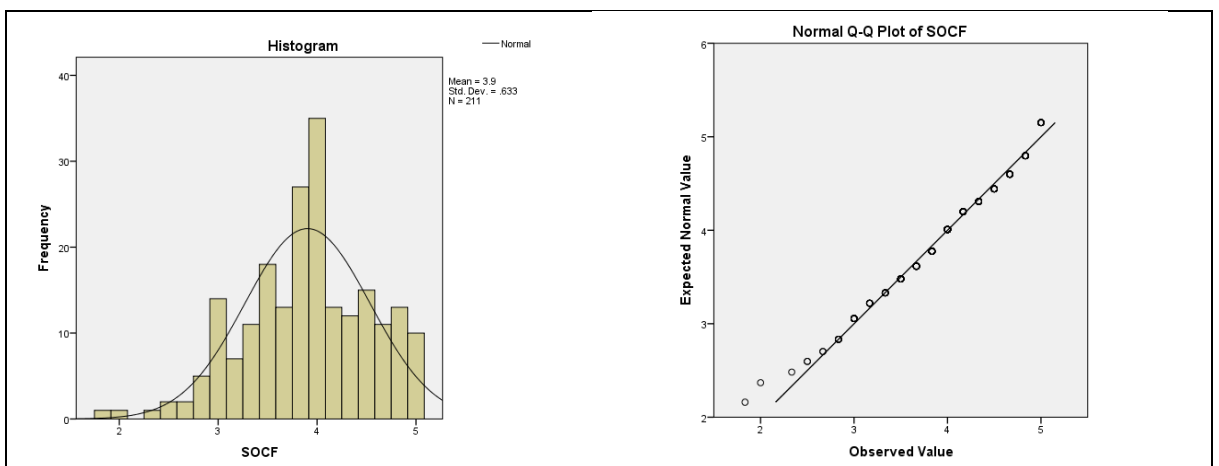

Normality of *Perceived usefulness*
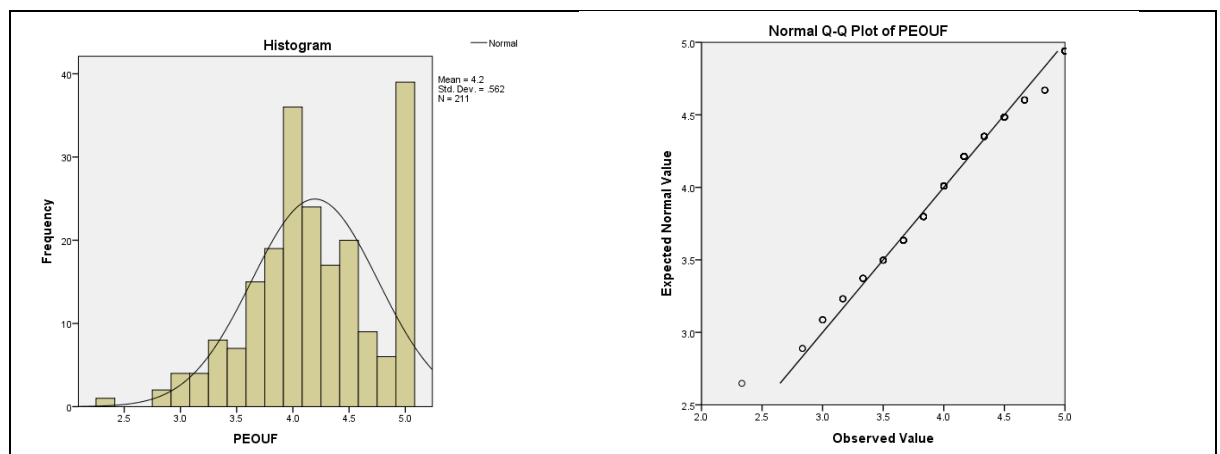
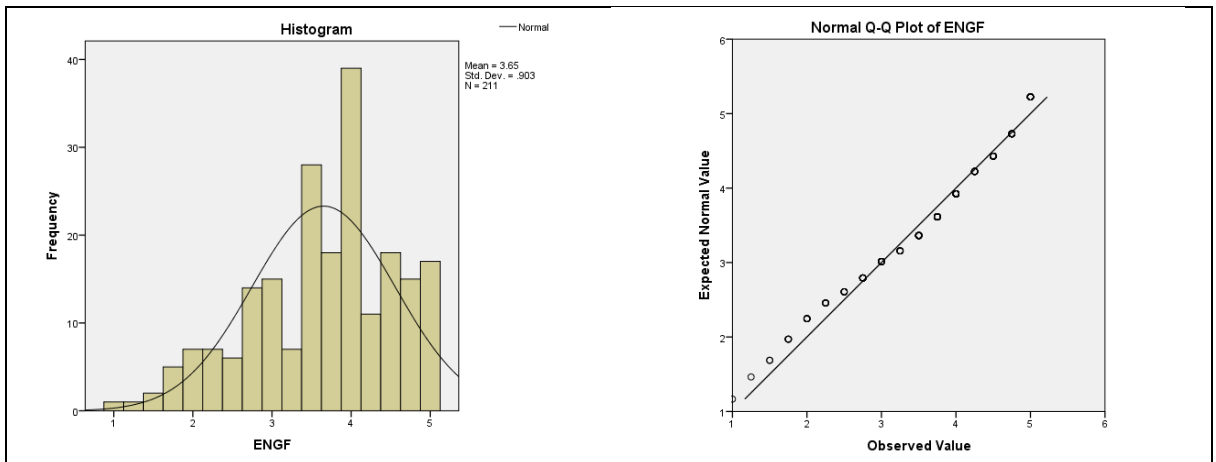**Normality of *Perceived ease of use***

Normality of *Mobile and web experience*
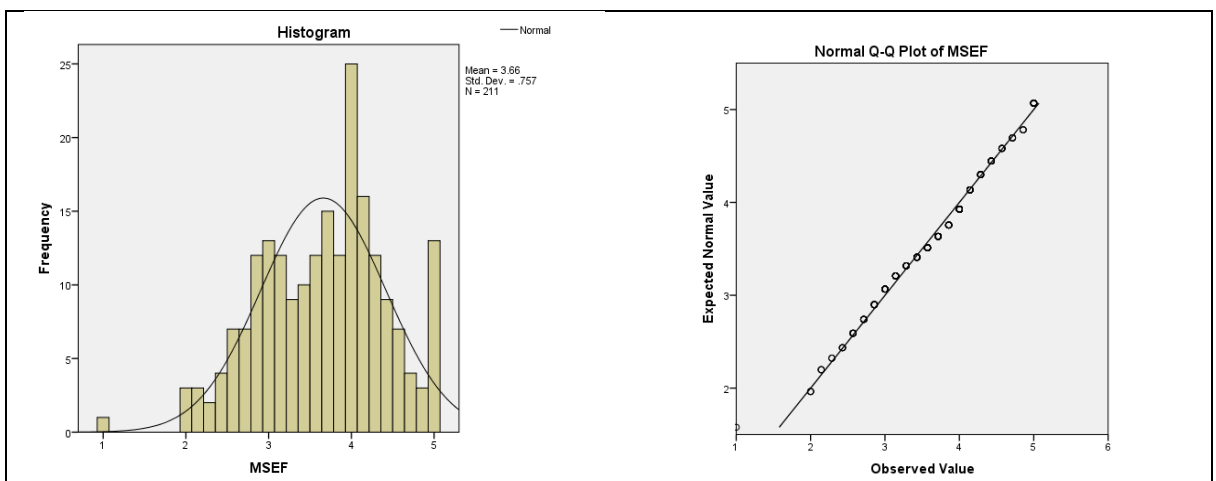

Normality of *Prestige*

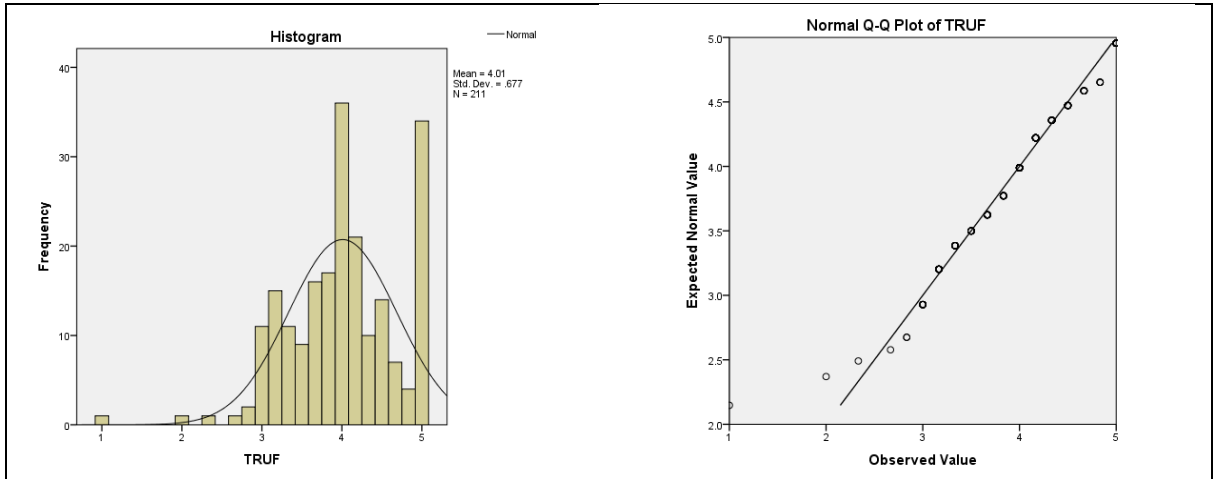
Normality of *Social influence*

Normality of *English literacy*
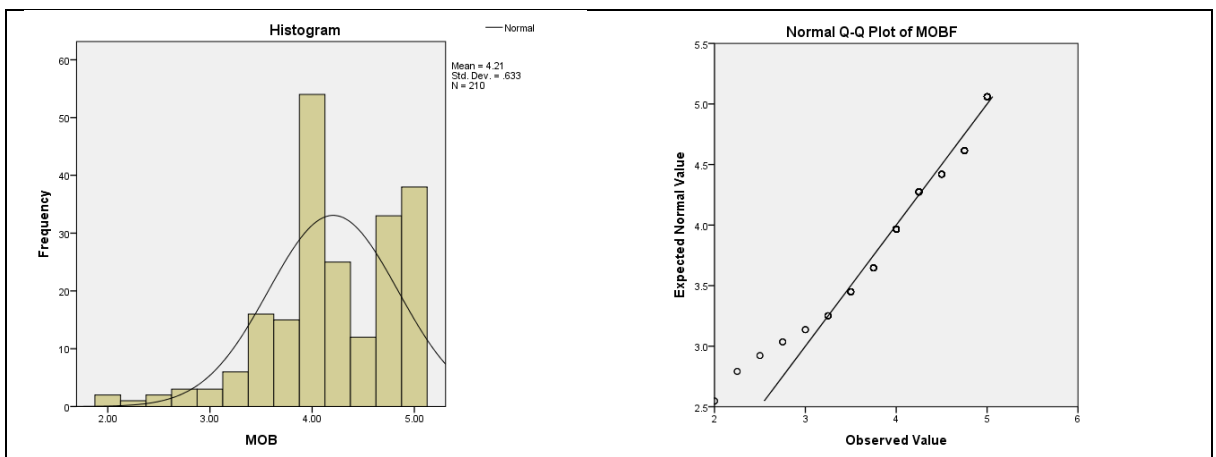
Normality of *Mobility*

Normality of *Mobile self-efficacy*

Normality of *Trust*
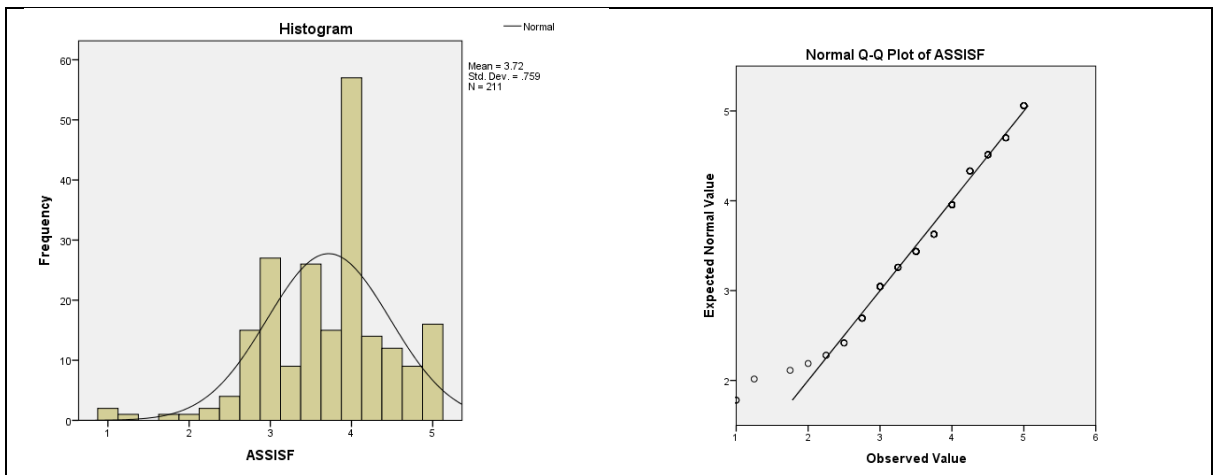
Normality of *Library assistance*
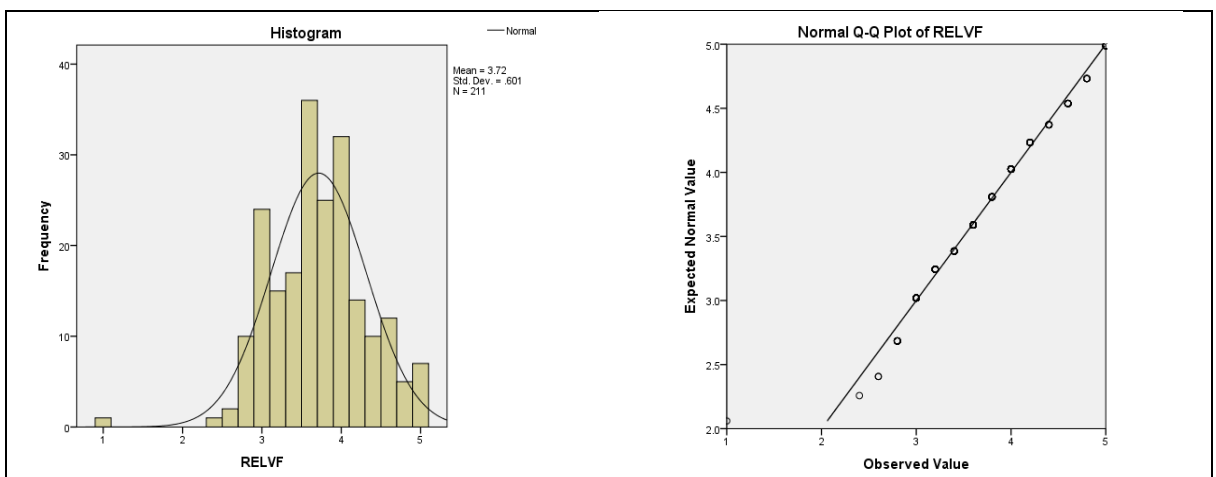
Normality of *Relevance*

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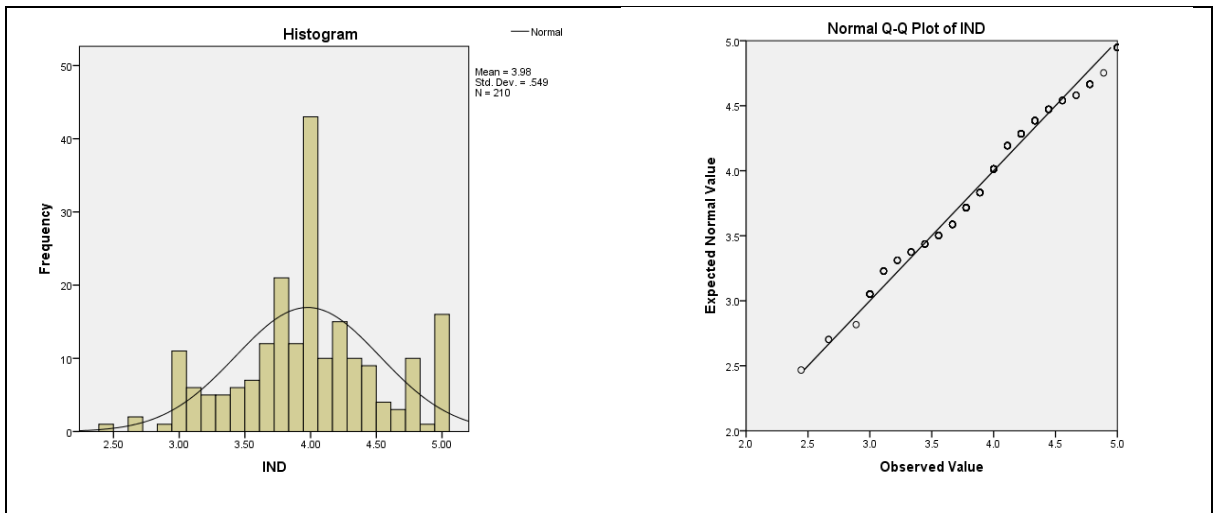
Normality of *Interface design*

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Appendix H: AMOS full results

First Run Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	135	949.275	531	.000	1.788
Saturated model	666	.000	0		
Independence model	36	4801.446	630	.000	7.621

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.041	.805	.756	.642
Saturated model	.000	1.000		
Independence model	.194	.267	.225	.253

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.802	.765	.902	.881	.900
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.843	.676	.758
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	418.275	336.140	508.247
Saturated model	.000	.000	.000
Independence model	4171.446	3954.664	4395.540

FMIN

Model	FMIN	F0	LO 90	HI 90

Model	FMIN	F0	LO 90	HI 90
Default model	4.542	2.001	1.608	2.432
Saturated model	.000	.000	.000	.000
Independence model	22.973	19.959	18.922	21.031

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.061	.055	.068	.002
Independence model	.178	.173	.183	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	1219.275	1277.356	1671.134	1806.134
Saturated model	1332.000	1618.535	3561.174	4227.174
Independence model	4873.446	4888.935	4993.942	5029.942

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	5.834	5.441	6.264	6.112
Saturated model	6.373	6.373	6.373	7.744
Independence model	23.318	22.281	24.390	23.392

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	129	135
Independence model	31	32

Second Run Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	133	949.945	533	.000	1.782
Saturated model	666	.000	0		
Independence model	36	4801.446	630	.000	7.621

RMR, GFI

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Model	RMR	GFI	AGFI	PGFI
Default model	.041	.805	.757	.644
Saturated model	.000	1.000		
Independence model	.194	.267	.225	.253

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.802	.766	.902	.882	.900
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.846	.679	.761
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	416.945	334.831	506.897
Saturated model	.000	.000	.000
Independence model	4171.446	3954.664	4395.540

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	4.545	1.995	1.602	2.425
Saturated model	.000	.000	.000	.000
Independence model	22.973	19.959	18.922	21.031

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.061	.055	.067	.002
Independence model	.178	.173	.183	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	1215.945	1273.166	1661.110	1794.110

Model	AIC	BCC	BIC	CAIC
Saturated model	1332.000	1618.535	3561.174	4227.174
Independence model	4873.446	4888.935	4993.942	5029.942

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	5.818	5.425	6.248	6.092
Saturated model	6.373	6.373	6.373	7.744
Independence model	23.318	22.281	24.390	23.392

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	130	135
Independence model	31	32