



JÖNKÖPING INTERNATIONAL
BUSINESS SCHOOL
JÖNKÖPING UNIVERSITY

Mobile learning in higher education

Students' acceptance of mobile learning in three top Chinese universities

Bachelor's thesis within Informatics

Business and IT Management

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Jönköping June 2012

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Date: 2012-06-07

Subject terms: Mobile learning, Technology Acceptance Model (TAM), top Chinese universities, end-users' acceptance, Behavioral Intention

Abstract

Introduction: Along with the swift spread of 3G and wireless network, wireless technologies are applied in many areas, especially in education. The advent of mobile learning overcomes several limitations and barriers of traditional classroom education. As for higher education in China, mobile learning is in its infancy stage. Understanding end-users' acceptance of mobile learning is crucial, because new technological advances cannot enhance performance if they are not accepted by end-users. This study focuses on three top Chinese universities and answers the following research questions:

1. How do students perceive mobile devices as a learning tool incorporated in class and what are their attitudes towards mobile learning?
2. What are the motivational factors that affect students' acceptance of mobile learning?

Purpose: The purpose of this study is to test the proposed Technology Acceptance Model (TAM) in explaining students' acceptance in three top Chinese universities. The goal of this work is to enhance the understanding of user acceptance of incorporating learning into mobile device inside and outside classes.

Method: A deductive, theory-testing approach was used in this study. Eleven hypotheses were built based on a literature review and on the proposed TAM model, and were tested using primary data and literature review. Primary data was gathered via semi-structured interviews and questionnaires. The data collected through the questionnaire was analysed by Structural Equation Modeling.

Conclusion: Through testing the proposed model, the authors found that students are positive towards mobile learning but they do not have a strong willingness to adopt it. The proposed TAM model can improve the understanding of students' motivation by suggesting what factors are the most important in enhancing students acceptance of mobile learning.

Acknowledgement

The successful completion of this thesis would not have been possible without the guidance and support offered by several key individuals. We would like to dedicate special thanks to our tutors Christina Keller and Jörgen Lindh for their inspiration and guidance throughout the whole thesis writing process. Special thanks to Thomas Holgersson, Professor of Statistics, for patiently examining our Empirical Study and providing precious comments and suggestions. We also appreciate the help from Zangin Zeebari who guided us how to solve our statistical issues. We should also give thanks to our friends, colleagues, and classmates, thanks for giving us help, suggestions, and feedbacks.

Qiyao Zhu, Wentao Guo, Yan Hu

Jönköping, June 2012

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I Introduction

This introductory chapter intends to provide readers with a general background about mobile learning in real life, and in educational areas related to Chinese environment. The Background is followed by Problem discussion, Purpose, and Research questions. Thereafter, Perspective, Delimitation and Definitions will be presented.

I.1 Background

In the contemporary society, Information Technology is developing at an astonishing speed, has become a part of our daily life, and has provided numerous benefits and values in various domains. In the technological era, there are an increased number of information communication technologies that are applied to help people deal with difficulties and problems. As a result, the swift growth of Information Communication Technologies (ICT) and ascending computer skills of students enable several new educational forms to appear in the market (Georgiev, Geirgieva & Smrikarov, 2004). The past two decades have witnessed the unprecedented growth of the Internet and an ensuing transformation in the educational landscape (Yuen, Fox, Sun & Deng, 2009).

Neglecting some weaknesses that exist in the direct contact between a teacher and students and in the first-hand feedback that the traditional classroom education has, the traditional education generally relies on the condition that both a teacher and students must physically involve in the study (Georgiev et al., 2004). E-learning is one of the significant new educational forms that influence our normal daily study. The adoption of a wide range of web-based tools has given rise to the trend of e-learning in education worldwide (Yuen et al., 2009).

With the rapid economic development, China now has a strong ability to provide better infrastructure and other necessary conditions for higher education. E-learning is believed to be a promising approach, since it offers students ways to interact with experienced teachers. A number of Chinese universities have established well-built e-learning platforms and provided various e-learning programs. Currently, e-learning has been applied widely by the higher education in China. E-learning provides an approach to self-study with the assistance from teacher in distance, and a positive result shows that this approach of learning experience is sound and the built-in support tools are meaningful for students to broaden knowledge (Wang, Zhu, Chen & Yan, 2009).

While considering the pragmatality and initiative of studying, some severe problems still occur in e-learning. For example, it requires certain fixed-location and increases time limitation (Singh & Zaitun, 2006). However, accompany the accelerated advancement and rapid development of mobile technology, the use of wireless network and handheld devices enables educational settings to build a critical foothold as a milestone in tackling drawbacks of e-learning. Meanwhile, the growing availability of wireless and mobile technology enables e-learning to be even more ubiquitous and pervasive (Yuen et al., 2009). Correspondingly, a novel learning tool, mobile learning, has appeared and enables learning to be easily accessed, regardless of place and time limitations (Chen, Chang, Shen, Wang, Chang & Shih, 2010). Mobile learning complements e-learning by creating a wireless channel for users with mobile devices. As referring to Sheng, Siau and Nah's (2010, p. 25-26) article:

“As for mobile learning, educational materials can be delivered via SMS (Short MessageService) using mobile devices; handheld devices can be connected through a wireless network in the classroom to enable cooperative learning. The delivery of educational materials through mobile technology can eliminate time and

space constraint in learning and provide more freedom for learners.”

Mobile learning allows users to access learning material anytime and anywhere (Huang, Lin & Chuang, 2007). Because of the potential usage of 3G and wireless network, mobile learning is likely to be the next wave of learning environment (Wu & Chao, 2008). Some developed countries, such as US, Australia and Japan, have already provided mobile learning environments in education (Litchfield, Dyson, Lawrence & Zmijewska, 2007).

But in many developing countries, mobile learning is diffusing more slowly than expected. Also, mobile learning is currently in an exploratory phase with universities unclear about the case for investing in a new set of expensive technologies (Litchfield et al., 2007). Indeed, as it is still in its infancy, limited understanding is available regarding the willingness and acceptance of using this new digital way for learning purposes.

In addition, prior research studies have significantly investigated the technical part of mobile learning, but few empirical works are available on mobile learning from a customer's standpoint (Huang et al., 2007). Most previous studies have examined the mobile learning systems, reported several mobile learning projects at various rates, and evaluated the performance of mobile learning systems. Nonetheless, limited research has been carried out on the acceptance of mobile learning environment from the end-user's point of view. It is necessary to gain a better understanding of higher education of China about the acceptance of mobile learning environment and if it can be used to ease and enhance studying. Also, the key identification factors should be considered that affect users' attitudes and willingness. To study the acceptance of mobile learning in higher education in China, a survey is performed to find answers to a number of research questions. ‘

Additionally, Technology Acceptance Model (TAM) by Davis, Bagozzi and Warshaw (1989) and its successor TAM2 (Venkatesh & Davis, 2000) have obtained much attention, and can be used to explain the individual likelihood of a new technological advance being adopted within an organization. In this thesis, the new technological advance studied in China is mobile learning, also known as a mobile learning system or mobile learning environment, which is designed to support and enhance learning experience without location and time limitation by utilizing wireless network to connect dedicated systems. The models, which will be introduced (TAM, TAM2, and other extended models) render the underlying rationale that could help the authors propose the research model and develop hypotheses. To satisfy the need of this research, the authors propose a conceptual TAM model, based on a literature review. The proposed conceptual model will be tested in explaining future user acceptance of mobile learning at three Chinese universities.

1.2 Problem discussion

As the new generation of learning approaches occur by using technologies, students start to demand more flexibility, alternative modes of instruction, and more multimedia-enriched and interactive learning (Clarke, Keing, Lam & McNaught, 2008). Early research rendered encouraging results for the use of mobile devices as an approach to support teaching and learning (Kennedy, Krause, Judd, Churchward & Gray, 2006; Yordanova, 2007). Previous studies also revealed that students would like to use mobile devices to learn, that students are motivated and engaged while using mobile devices (Al-Fahad, 2009; Wang, Shen, Novak & Pan, 2009; Rogers, Connelly, Hazlewood & Tedesco, 2010), and that achievement levels increase when students use mobile technologies (McContha, Praul & Lynch, 2008; Shih, Chen, Chang & Kao, 2010; Wyatt, Krauskopf, Gaylord, Ward, Huffstutler-Hawkins & Goodwin, 2010; Hsu, Wang & Comac, 2008; Williams & Bearman, 2008). Regarding

mobile learning, learners in general hold a positive attitude. In 2006, a survey by 3G Consultant Co., Ltd, including 2678 students, parents of students and white-collar workers showed that 34% of university students, 42% of senior high school students, and 42% of junior high school students explicitly declared their preference for phones with mobile learning function.

However, some usage and deployment issues with the mobile devices themselves were also revealed. It was difficult for most students to learn to use quickly in a short time that they had available (Litchfield et al., 2007). New technological advances in educational environment might cause curiosity, frustration, and anxiety from students (Litchfield et al., 2007). Students might also fear some technical difficulties, which can result in they disliking the new technological advances. On the other hand, students might reject the new technological advances, because of poor “ease of use”. Thus, some factors that affect users’ attitudes and behavior intentions are significant for acceptance of new technological advances.

Recently, many researchers have focused on mobile learning in developed countries (James, 2008). The adoption of mobile learning is not the same in all countries. Therefore, a specific country case should be concentrated on by this research. Within the Chinese context, the main issue of mobile learning existence is because of the speeding in numbers of mobile devices used (Hashim, Wan, Wan, & Ahmad, 2010). Additionally, there are 9.75 billion mobile phone users in China, and the total amount of mobile web users in China has reached 3.56 billion, 17.5% more than 2010 (Ministry of Industry and Information Technology of the People's Republic of China, 2011). Thus, mobile devices have an undeniable potential to expand the accessibility of learning opportunities. It is fair to assume that the opportunity of using mobile device as a learning approach will increase in the future. But the best practices of using mobile devices in learning are not well defined in China. Additionally, there are only two top universities (University of Zhejiang and Shanghai Jiaotong University) that are currently researching and using try-out mobile learning systems. Mobile learning is in an initial stage in China. Most of top Chinese universities do not have mobile learning systems. There is limited research available on students’ acceptance or rejection before adoption in these two universities, not to mention in other top Chinese universities.

Wang, Novak and Shen (2009) evaluated the impacts of mobile learning systems and learning experience through pre- and post-implementation surveys in Shanghai Jiaotong University. They found a positive result and relationship towards how students feel about using mobile learning system, and some significant dimensions are summarized that affect their willingness and satisfaction, such as course activity and student social interaction (Wang, Novak & Shen, 2009). These dimensions might be the key identification factors that affect the end-users acceptance and behavior intention before adopting mobile learning in those universities, which do not have mobile learning systems. Thus, to find the identification factors that affect students’ acceptance is significant for this research.

Suggested by Rogers (1995), the distribution of adopters of an innovation can be approximated by a normal distribution of the adoption time. Also, the process of which a new idea or product is accepted by the market is called *Diffusion*. Rogers (1995) proposed the diffusion of innovation model (see *Figure 1.1*) to illustrate the rate of adoption and the stages through which a certain technology passes before adopting innovation. Regarding mobile learning in China, merely two universities are using try-out mobile learning systems. Associated with the diffusion of innovation model, these two universities are Innovators. Other top Chinese universities, which do not have mobile learning currently, can be considered Early Adopters only if they plan to adopt it in a near future.

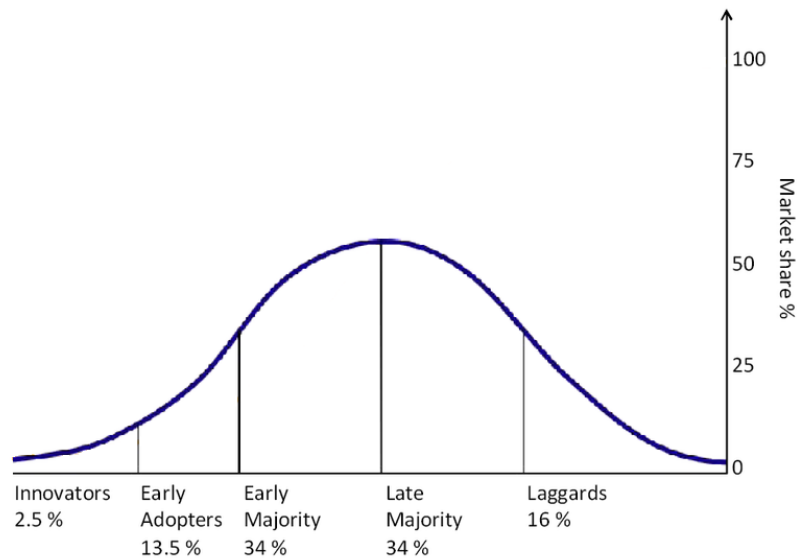


Figure 1.1 Roger's diffusion of innovation model (1995)

The interest of this topic is to find a knowledge gap about acceptance and behavior intention of using mobile learning from students' viewpoints, in those universities that do not have mobile learning systems yet. The authors of this study have decided to pick up three top Chinese universities in central part of China, in order to find a trend of students' acceptance in higher education of China.

New technological advances cannot improve performance if they are not accepted and used by the end-users (Davis, Bagozzi & Warshaw, 1989). Farlee (1972) found that users' acceptance of a new technological advances was a critical factor in the success of their implementation. Namely, the more resistance form end-users means the more impact on performances and outcomes. Ideally, the organization or the administration should be able to predict whether a technological advance will be accepted by users, to enhance the performance regarding the investment of money and time (Davis, Bagozzi & Warshaw, 1989). In many cases, people may apply the technological advances because they are mandated from the organization, rather than using the technological advances of free will. If individuals are pressured from organization, then the outcomes of the new technological implementation would be performed at a lower level (Davis, Bagozzi & Warshaw, 1989). Therefore, to understand why people accept or reject a new technological advance has become a very crucial issue.

In mobile learning system, if the student as the end-user does not accept this system, the university may fail to provide satisfactory services to students and perform better in educational quality and revenues. In order to prove that the end-users accept or reject, identification of these factors affecting technology acceptance by students are needed.

1.3 Purpose

The primary purpose of this study is to predict the students' acceptance of using mobile learning in three top Chinese universities. This research aims to measure and test the proposed Technology Acceptance Model (TAM) in explaining students' acceptance in three top Chinese universities, and to determine the factors that affect the adoption of mobile learning based on proposed TAM. In addition, the goal of this work is to enhance the understanding of user acceptance of incorporating learning into mobile device inside and out-

side classes. Therefore, there is a need for the current study to examine TAM in order to predict and interpret the acceptance before adopting it in those Chinese universities.

1.4 Research questions

The research questions are used to lead the readers to understand the research goal clearly and directly. This study includes two main research questions that the authors intend to answer through the analysis of the empirical findings, which are collected using interviews and questionnaires. For each research question, it will be associated with some hypotheses which need to be presented and examined by SPSS approach before answering it. Quantitative data will be analyzed by SPSS and AMOS and used to test the hypotheses in the proposed TAM. The research questions which will be answered are:

- 1. How do students perceive mobile devices as a learning tool incorporated in class and what are their attitudes towards mobile learning?**
- 2. What are the motivational factors that affect students' acceptance of mobile learning?**

1.5 Perspective

All the study is performed from a certain perspective, which is used to guide the readers to have a comprehensive understanding of the research purpose from our intended angle. In this sort of research, there exist several perspectives which can be taken to conduct the study. It can be studied from end-user perspective, namely people who directly have or have not behavior intention towards mobile learning. Another perspective can be in terms of the provider side, people who are concerned with end-users' acceptances and then address the critical issues associated with the operational effects of the learning tool.

This research predicts the students' acceptance towards mobile learning for educational purposes from students' perspective. Students are the ones who directly apply mobile learning; therefore, students are the end-users. Through the investigation of students' intention in three Chinese universities, the authors can test not only the feasibility of applying TAM to predict end-users' acceptance, but also determine motivational variables that affect the acceptance.

1.6 Delimitation

This research paper aims at predicting end-users' behavior intention by examining the proposed TAM model, through testing hypotheses and determining the key factors that influence the end-users' acceptance in three top Chinese universities. The authors are not going to build a model or a theory in mobile learning area besides China context, so the research will be limited to Chinese universities. All top universities (top 10) in China are not going to be investigated. Because of accessibility issues, the authors have convenient access to three top universities that do not have mobile learning systems. Hence, the result of this study can be only statistically generalized to these three investigated universities. Other top universities are not considered in our research but could be a future discussion or further research and generalizability.

Since mobile learning is a broad topic nowadays, it has diverse definitions in various ways. There are many related areas about using mobile devices for learning purposes. Within this research, it was decided to only focus on using wireless network (e.g. 3G, cellular network, Wi-Fi) to connect mobile learning systems for learning anytime, anywhere on mobile devices.

es both inside and outside classroom. Other definitions are not considered in this research purpose.

Further, this investigation will not cover technical aspects of building mobile learning systems thoroughly, but instead focus on logical level of viewing acceptance and attitudes of mobile learning. It is more user-centric than system-centric.

1.7 Terms and definitions

Term	Definition
Mobile learning (m-learning)	M-learning refers to any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies (O'Malley, Vavoula, Glew, Taylor & Sharples, 2005).
Electronic learning (e-learning)	The delivery of content via all electronic media, including the Internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV, and CD-ROM (Bachman, 2000).
CNNIC	China Internet Network Information Center
TAM	Technology acceptance model, used to analyze the factors which influence how users will accept and use a new technology (Davis, 1985). The elements of TAM will be called factors.
Huazhong University of Science and Technology	Huazhong University of Science and Technology (HUST) ranks top 10 in China. It is located in city Wuhan.
Wuhan University	One of the top 10 universities in China. It is directly under the administration of the Ministry of Education of the People's Republic of China. Wuhan University is located in the city Wuhan.
Sichuan University	One of the oldest national universities in China. According to the 2010 Academic Ranking of World Universities, it is ranked No. 8 among the Chinese universities and located in the city Chengdu.
Hubei	A province located in the middle part of China, has the population of 57 million roughly, and the capital city is Wuhan.
Sichuan	A province of China, has the population of 80 million. The capital city is Chengdu.

I.8 Disposition of the thesis

Chapter 2 - Frame of reference presents some existed knowledge carried out by other researchers in previous studies regarding mobile learning in learning development, and explores how can mobile device as a learning tool in higher education, the potential market development and uses within the underlying Chinese background. Some definitions and perspectives from early research are summarized.

Chapter 3 - Methodology illustrates the research approaches and in what ways that data are collected as planned. The interview and questionnaire are significant strategies in this exploratory study; secondary data are also concerned to support the primary data. Pilot test and reliability, validity, generalizability of this study are presented comprehensively.

Chapter 4 – Empirical study demonstrates the data collected from students through the interview and questionnaire, and embraces the factors that affect the students' perceptions and attitudes. Some significant relations respect to their attitudes would be found towards mobile learning based on the Technology Acceptance Model (TAM).

Chapter 5 - Conclusion is used to summarize the findings and to indicate the overall answers to research questions. Major discussion and reflection are included in this part, and suggestions for further research are also given.

2 Frame of reference

2.1 Definitions of mobile learning

Mobile learning refers to any learning that takes place when the location of the learner is not fixed, or the process of learning is enhanced by using mobile devices and technologies (O'Malley et al., 2003).

Quinn (2000) considered mobile learning as the overlap of using e-learning (learning by using information technologies and devices) and mobile computing, which includes mobile applications in the small, wireless, and portable devices such as smart phones and PDAs (Quinn, 2000).

However, as the mobile technologies are developing rapidly, the shift to mobility is occurring day by day, and the mobile devices are now becoming more portable than ever. The mobile activities of students once consisted of carrying textbooks, pencils, and paper from classroom to classroom. At present, mobile learning has been reconsidered as the activities of using capable electronic information communication technologies and devices to support students to access meaningful learning materials both inside and outside classes (Messinger, 2011).

With time, the perspectives and understanding of mobile learning are becoming broader and deeper, since many researchers and communities have defined mobile learning differently, based on their own backgrounds and experiences. This has made the characteristics and properties of mobile learning even harder to define. Currently, the concept of mobile learning is somehow misunderstood. As Sharples (2007) said “*it seems to be all things to all people*” (Sharples, 2007).

Besides, other researchers also drew their understanding on the definition of m-learning as listed in *Table 2.1*.

Table 2.1 Other definitions of mobile learning

Researcher/Year	Definition
Georgiev, Georgieva & Smrikarov (2004)	“The ability to learn anywhere at any time without permanent physical connection to cable networks” (Georgiev et al., 2004, p. 28).
Caudill (2007)	“M-Learning is any e-Learning application distributed on-demand through mobile digital device” (Caudill, 2007, p. 3).
Traxler (2005)	“Any educational delivery where the sole or prevailing technologies are handheld or palmtop devices” (Traxler, 2005, p. 262).
Laouris & Eteokleous (2005)	“MLearn = f { t, s, LE, c, IT, MM, m } t = time; s = space; LE = l-environm; c = content; IT = technology; MM = mental; m = method” (Laouris & Eteokleous, 2005, p. 8)
Wexler, Schlenker, Brown, Metcalf, Quinn, Thor, Van Barneveld, Wagner. (2007)	“Any activity that allows individuals to be more fruitful when consuming, interacting with, or generating information, mediated via a compact digital portable device that the individual carries on a ordered basis, has reliable connectivity, and fits in a pocket or purse” (Wexler et al., 2007, p. 7).
Poslani (2003)	“A form of education whose site of production, transmission and depletion is the network” (Poslani, 2003, p.12-13).
Sharples (2005)	A process of getting to know, by which students in collaboration with their peers and teachers construct transiently stable interpretations of their world (Sharples, 2005).
Milrad (2003)	“E-learning that uses mobile devices and wireless transmission” (Milrad, 2003, p. 255-259).
Ally (2009)	“The process of using a mobile device to access and study learning materials and to communicate with fellow students, instructors or institution” (Ally, 2009, p. 58).

Laouris and Eteokleous (2005) pointed out that the definitions of mobile learning are different based on the context. They stated two contexts of defining mobile learning “In the context of devices” and “In the context of the experiences and environment”. And the technology and devices are the main consideration of most definitions. The most frequently used definition by Sharma and Kitchens (2004) states “... *learning supported by mobile devices, ubiquitous communications and intelligent user interfaces*” (Sharma & Kitchens, 2004, p. 1). Only one definition, which was proposed by Nyiri (2002), expressed mobile learning through a general point of view. He defined it “*as learning that arises in the course of person-to-person mobile communication.*” Laouris et al. (2005, p. 74) comments that the character of cell phones was stimulated from a philosophical point of view (Laouris et al., 2005).

Laouris et al. (2005) considered that “*Definition of mobile learning might change as a function of time, but also as a function of our (biased) perspective. From the point of view that learning takes place in our heads, it has always been mobile.*” (Laouris et al., 2005, p. 6)

2.2 Mobile learning and relevant learning approach

M-learning, E-learning and D-learning

Electronic learning includes any kind of learning and teaching that are supported electronically. No matter whether the information systems for learning are networked or not, they are all used as the media to support the learning process (Tavangarian, Leypold, Nölting & Röser, 2004). As Bachman (2000) suggests “*The term e-learning was defined as the delivery of content through all electronic media, including the Internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV, and CD-ROM.*” (Bachman, 2000, p. 8)

Traditionally, distance learning refers to learning where students and teachers are separated in time and space (Williams, Paprock & Covington, 1999). However, the very initial stage of distance learning was available before the technology was well developed so that allows students to become connected digitally (Pollara, 2011). So what is the relationship between m-learning, e-learning and d-learning?

Pollara states that “*the relationship between distance learning, e-learning, and m-learning is still being explored with various researchers focusing on aspects of pedagogy, technology, and social factors in order to classify mobile learning*” (Pollara, 2011, p. 13). New methods of distance education is presented by e-learning which uses computers and network technologies. However, at the same time, according to Georgiev et al. (2004), “*Real-time to e-Learning the other forms of d-learning still exist (for instance satellite based d-learning)*” (Georgiev et al., 2004, p. 1).

Georgiev et al. (2004) view the relationship as nested. He states that m-learning is a subset of e-learning, and e-learning is a subset of distance learning (*Figure 2.1*). Part of the researchers in this field think that mobile learning has to be wireless network connected. Georgiev et al. (2004) suggests that the concept of mobile learning should involve the learning experience of anywhere, anytime and not always using cables to connect .

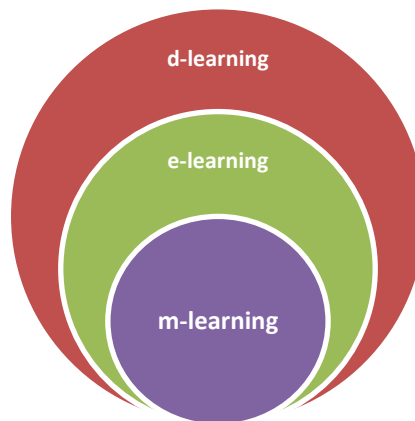


Figure 2.1 Perspective of learning paradigms (Georgiev et al., 2004)

Also in contrast, Traxler (2005) views the relationship between m-learning and e-learning as follows:

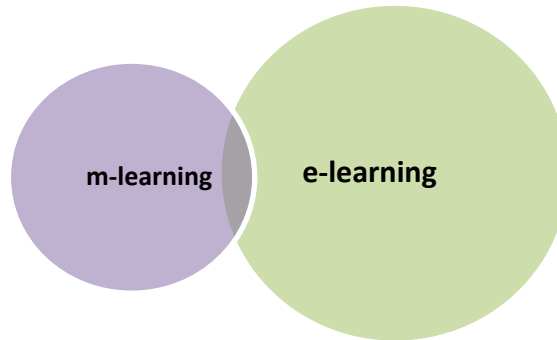


Figure 2.2 Relationship between m-learning and e-learning (Traxler, 2005)

From Traxler’s perspective, e-learning involves the using of PC and laptop, while mobile learning is mainly delivered by SMS, MMS, PDA, and smartphone. However, the boundary between mobile learning and e-learning is not that clear (*Figure 2.2*), since some devices, such as tablet PC and netbook are hard to be located in either side (Traxler, 2005).

Currently, there are many contentions about whether mobile learning is the next generation of e-learning or only an enhanced technique which is combined with e-learning. However, mobile learning is acknowledged as a new and distinctive element in distance learning (Caudill, 2007). No matter how people view the relationship between these three learning approaches, it is certain that there are many differences between them.

Sharma and Kitchens identify the differences between e-learning and m-learning (*Table 2.2*). Instead of comparing these two in the context of devices or terminology, Traxler (2005) has made a comparison in the context of learning experience (*Table 2.3*).

Table 2.2 Terminology comparisons between e-learning and m-learning (Sharma & Kitchens, 2004)

e-learning	m-learning
computer	mobile
bandwidth	GPRS, G3, bluetooth
multimedia	objects
interactive	spontaneous
collaborative	networked
media-rich	lightweight
distance learning	situated learning
more formal	informal
simulated situation	realistic situation
hyper learning	constructivism, situationism, collaborative

Table 2.3 Comparison in the context of learning experience (Traxler, 2005)

e-learning	m-learning
spontaneous	intelligent
situated	personalized
portable	interactive
context-aware	media-rich
lightweight	structured
informal	institutional
personal	multimedia
	usable
	massive
	hyper-linked
	accessible
	connected

The majority of researchers writing in this field express their vision of mobile learning to enable “*anywhere, anytime, and any device*” handy and customized studying; it will support and ease communication, interaction, and creativity between both learners and teachers (Cobcroft, Towers, Smith & Bruns, 2006).

2.3 Current study of mobile learning on students’ attitudes and perceptions

Recent research conducted by Pollara and Broussard (2011), which focuses on summarizing students’ perceptions on mobile learning, claims that consideration of student perceptions of mobile learning was originally suggested by prior researchers as an area in the future research of mobile learning. This consideration of student perceptions is now evident in the selected research. Most of the research show a positive result on student perceptions of mobile learning in a total number of 18 research studies (Clarke, Keing, Lam & McNaught, 2008, Al-Fahad, 2009; Wang, Shen, Novak & Pan, 2009; Garrett & Jackson, 2006; Cavus & Uzunboylu, 2009; Uzunboylu, Cavus & Ercag, 2009; Manair, 2007; Maag, 2006) and it was suggested by the students that mobile learning improved their learning experiences and made the learning process more interesting (Rogers et al. 2010; Venkatesh, Nargundkar, Sayed & Shahaida, 2006; Wang et al 2009) (cited in Pollara & Broussard, 2011).

Pollara and Broussard also summarized those studies on students’ perceptions in *Table 2.4*. Mobile phones and PDAs are the most common tool for mobile learning. Also, out of eighteen current studies, seventeen of them show that students are positive towards mobile learning.

Table 2.4 Summary of current studies on mobile learning (n=18) (Pollara & Broussard, 2011)

Research Question	Research Design		Technology Used in the Study			Study Results	
	Experimental study	Survey-driven study	Mobile phones/PDAs	mp3 players	Other/not specified	Positive Results	Mixed Results/Not clear
What are the student perceptions of m- learning?	6	12	14	2	2	17	1

2.4 Mobile learning in China

2.4.1 Mobile technology in China

The rapid growth of wireless telecommunication technologies has provided new opportunities for the development from e-learning to m-learning (Keegan, 2007). Statistics from China's three largest telecommunication companies in 2011 show that the 3G network users in China is close to 0.7 billion. There were 859 million mobile subscribers (64 percent of population) in December 2010, an increase of 112 million subscribers from 2009. Of these 47 million were 3G mobile phone users (National Bureau of Statistics of China, 2011). China has a larger population of mobile Internet users than other countries. As reported by the China Internet Network Information Center (CINIC) in 2010: In China there are currently 277 million mobile Web users, an increase of 43 million in half a year. This amount is 65.9 percent of total web users (420 million) in China, and most of the mobile Web users also access the Internet via PC or laptop. However, 11.7 percent of Web users exclusively use mobile devices to surf the Internet" (mobiThinking, 2011). In the year 2011, the populations that use mobile devices to access Internet is 3.18 billion, 14.94 million larger than 2010 (National Bureau of Statistics of China, 2011). In addition, the China Internet Network Information Center (CNNIC) reports that there were 155,000,000 mobile phone users who use wireless technologies to access the Internet in 2009 in China (Yang & Wang, 2011).

According to a report conducted by Our Mobile Planet, the penetration rate of smartphones in China (urban) has reached 35% (Our Mobile Planet, 2011). According to Boston-based Research and Consulting Firm Strategy Analytics, nearly 24 million smartphones were shipped to providers in China during the third quarter of 2011, compared to 23.3 million units in the United States. The growth of China's smartphone market has been significant, 58% more than the second quarter of 2011 (Indvik, 2011). The statistics show that educating Chinese population via mobile learning has a great potential, as mobile learning may provide a more equal access and brighter future for all people regardless of races, colors, ages, and living places (Yang et al., 2011).

2.4.2 Mobile learning in Chinese universities

In the last few years, the investment in higher education has been increased by the Chinese government. As a result, the total number of students graduated from higher education institutions has almost quadrupled in five years. Now, the biggest beta version of mobile learning is implemented in Shanghai Jiaotong University. In developing countries, such as China, one primary objective is to enable the availability of education to the largest number of users possible (Li, Whalley, Zhang & Zhao, 2008).

The booming of mobile technologies nowadays provides people with a great opportunity to utilize mobile application in learning activities, since the mobile learning implementation has several advantages (Hashim, Ahmad, W. & Ahmad, B., 2010). Even though mobile learning in China is not fully developed yet, it has the potential to combine mobile learning as a new teaching and learning method with today's education (Dias, Carvalho, Keegan, Kismihok, Mileva, Nix & Rekkedal, 2008).

Mobile learning has already become an interesting topic to study by some Chinese universities. The researchers and programmers in Shanghai Jiaotong University is trying to establish an standard for future education changes as well as better access to the higher education system of China by adapting the current courses for interactive learning and teaching by means of mobile learning. Their core objective is to provide the learning ex-

perience of *Learning Anytime, Anywhere*. And the benefits taken from wireless telecommunication and mobile technologies will assist them in achieving this goal (Wang et al., 2009).

2.4.3 Mobile learning, advantages, drawbacks and challenges

There exist some sorts of learning systems, for example, conventional learning, instructional learning, electronic learning, and mobile learning (Alonso & Norman, 1996). Each of the learning system has its own benefits and drawbacks (*Table 2.5*). Nevertheless, mobile learning could address the disadvantages of other learning systems (Singh & Zaitun, 2006).

Table 2.5 Advantages and Disadvantages of Learning Systems (Singh & Zaitun, 2006)

Learning System	Advantages	Disadvantages
Conventional Learning	<p>Students travel to a single location and attend lectures in a classroom.</p> <p>Good socialization among students and it allows them to learn from each other.</p> <p>Group discussion, team projects, group presentations, individual assessment through quizzes and tutorials (Heckman and Owens, 1996).</p>	<p>The lecturer talks and writes on a blackboard while the student furiously takes down notes or sits back or falls asleep.</p> <p>Poor interaction among students and lecturers during class.</p> <p>Learning is done in an asynchronous mode – i.e. lecturer’s actively presenting information and students passively observing.</p> <p>Lecturers do not know how a particular lesson went.</p> <p>Lack of learning resources in a conventional classroom.</p> <p>Not meant for individualized learning (Alonso & Norman, 1996).</p> <p>Students must keep pace with the lecturer.</p> <p>Student interaction is limited in a large classroom.</p> <p>Small group interaction is not suitable in large classrooms.</p> <p>Poor feedback from students on the delivery of lectures.</p>

Table 2.5 Advantages and Disadvantages of Learning Systems (Singh & Zaitun, 2006)

Learning System	Advantages	Disadvantages
Computer Based Instruction	<p>Reduces the need for students to travel to college.</p> <p>Movies and animation can improve students to recall information.</p> <p>System can log user's access to learning resources.</p>	<p>System usability is not user friendly Students said that it difficult to remember information as they scroll back and forth when answering questions.</p> <p>Multimedia images and movies slow down the performance of the computer (Pane, Corbett & John, 1996).</p> <p>Lecturers are needed for explanation on working problems in classrooms (Nizar & Clum, 1999).</p> <p>Do not inform students of new content are made available when students login into the courseware systems (Huckvale, Benoit, Bowenman, Eriksson, Rosner, Tatham & Williams, 1997).</p>
Computer Aided Learning	<p>Specific to a learning domain area.</p> <p>Uses the Internet to disseminate information and learning materials.</p> <p>High quality resources such as web documents, video conferencing email, news group, chat, notes, cooperative applications that allows students and tutor to participate.</p>	<p>Not compatible with older software versions</p> <p>Slow down bandwidth.</p> <p>High quality resources such as web documents, video conferencing email, news group, chat, notes, cooperative applications that allows students and tutor to participate.</p>
Computer Based Education	<p>Can take place at home or at college.</p> <p>Contains digitized sound and graphics</p> <p>Distance education materials can be presented synchronously i.e. creating a classroom on the computer or asynchronous mode</p> <p>Synchronous lecturer's voice and video with a slide show.</p> <p>Includes a table of contents for quick access to materials.</p>	<p>Lack in table of contents to search for required materials.</p> <p>Lack in allowing students to socialize, students feel isolated (Chen, 2003).</p>

Table 2.5 Advantages and Disadvantages of Learning Systems (Singh & Zaitun, 2006)

Learning System	Advantages	Disadvantages
Electronic Learning	<p>Can be accessed at fixed locations with Internet connections such as computer labs, at home or cyber cafés (Moore and Richardson, 2002).</p> <p>Can use several tools such as mini lectures, electronic conventional discussion or active cooperation.</p>	<p>Depend on constant internet connection to provide service. Cannot be used when internet connection is not available.</p> <p>Depend on a fixed location with internet access and does not support mobile learning.</p> <p>Not meant to be used for long courses.</p> <p>Students may be confused on actual submission of assignments.</p> <p>Not much interaction with lecturers and students.</p> <p>Reduces social interaction.</p> <p>Instructors are not available when students need assistance.</p>
Mobile Learning	<p>Instructors can incorporate multimedia demonstrations in their lectures and receive real-time feedback from their students using quizzes or surveys (Adewunmi, Rosenburg, Basorun & Koo, 2003).</p> <p>Learning can be done anytime and anywhere. Supports continuous learning.</p> <p>Able to collaborate with instructor's notebook during class.</p> <p>Communication and teaching support while outside the classroom.</p> <p>Mobile learning is able to synchronous team member's appointments and schedules (Lehner, Nosekabel & Lehman, 2001).</p> <p>Classroom seating does not have to have a fixed seating arrangement (Kar, 1999).</p>	<p>Small screens bound the amount and sort of information that can be presented.</p> <p>There are restricted storage capacities for mobiles and PDAs.</p> <p>Bandwidth may degrade with large number of users.</p> <p>PDA's and mobile phones are less robust than desktops.</p> <p>Batteries have to be charged regularly as data can be lost if this is not executed properly.</p>

Table 2.5 Advantages and Disadvantages of Learning Systems (Singh & Zaitun, 2006)

Learning System	Advantages	Disadvantages
Mobile Learning	<p>Individual student activities can take place such as web browsing, independently running example program or working through example problems in class (Brown, 2001).</p> <p>An instructor can get immediate feedback on the lesson being taught.</p> <p>Students can be assessed on multiple choices, true/false questions in the classroom.</p> <p>Real-time experiments can take place in classrooms.</p> <p>Instructors can provide examples such as simulations and web based documents that can be accessed at specific time to improve retention (Brown, 2001).</p> <p>Students did not have to waste time copying what the instructor wrote on the whiteboard (Brown, 2001).</p>	

Moreover, according to Georgiev et al. (2004), other benefits of mobile learning when compared to e-learning are: most of mobile devices have lower prices than desktop PCs; smaller size and lighter weight than desktop PCs; ensures better students' engage as m-Learning is based on up-to-date technologies, which students use in daily life; using GPS technology the m-Learning can offer location dependent education. Also, mobile phones, PDAs or tablets holding notes and e-books are lighter and can support the entire mobile learning process with ease, instead of bags full of files, paper and textbooks (Loomba & Loomba, 2009). The size, shape, weight, and portability of mobile devices have made them terrifically effective for end-users with permanent or temporary disabilities (Loomba et al., 2009). As suggested by Nikana (2000), mobile learning may lead to better grasp of the material/curriculum content. Nikana states that student motivation may rise via the use of mobile devices, because students could be participating in group discussion and dialogue with classmates/teachers more often and obtain swift and effective feedback. Nikana (2000) declares that mobile devices may perform as a proper assessment tool for students and enable those students who communicate less during class to express their opinions in a way that is more comfortable to them.

According to Georgiev et al. (2004), although mobile learning has several weaknesses at present, potential technological solutions have the abilities to tackle these problems (*Table 2.6*).

Table 2.6 Current problems using mobile devices for mobile learning and potential solutions Georgiev et al. (2004)

Problems	Potential solutions
Small PDA and cellular phone screen sizes limit the abilities to display information.	There are two possible solutions to this issue: to use projection technology to project the information from the screen into the air; the other solution is to use wireless technologies to convey video data to the computer or TV monitors supporting these technologies.
The small keyboards of PDA and cellular phones enable the input of the information tough.	The solution of this matter is a technology called "virtual keyboard", which is already used in mobile phone Siemens SX1 (Catch a glimpse of the future, 2004).
Today PDA and mobile phones have limited memory size.	An approach to solve this issue is to use flash memory cards that developed by Toshiba micro HDDs with capacity up to 4,0 GB (Toshiba, 2012).
It is necessary to regularly charge the mobile devices battery.	The possible solution of this task is to use a technology of methanol fuel cell, developed by Toshiba. There are claims that this technology will be built-in in notebook computers this year (Toshiba Announces World's Smallest Direct Methanol Fuel Cell, 2003).
So far it is impossible to use applications developed for desktop PC in mobile devices.	The solution of this matter is universal operating system for mobile devices - Motion eXperience Interface (MXI) developed by RADIXS company.
There are troubles to use multimedia elements (especially video) in cellular phones.	This problem will be tackled with the use of 3G and next generation communications.
The prices for wireless communications are still high.	The growth of the number of mobile operators and services will lower the prices.

Apart from technological changes in the near future, the alteration from e-learning to m-learning will excite the shift in educational paradigm (Sharma et al., 2004). This will necessitate the instructive methods to alter and communication to be modified between teachers and students on one hand, and among students on the other hand.

To make mobile learning a success, several challenges still need to be solved: mobile learning may favor technologically advanced students; the large variety of learning devices and lead lectures to be encoded in several formats; being a digital media, video lectures might be subject of intellectual properties and copyright issues. (Svetlana & Yoon, 2009). One of the current challenges is to comprehend what content should be transferred by smaller devices and how it should be adapted to a certain learners' community (Costabile, De Angeli, Lanzilotti, Ardito, Buono & Pederson, 2008). As Pollara et al. pointed out, "Because technology is developing and progressing so rapidly that we have yet to understand the educational possibilities of advanced mobile devices like smartphones, the use of personal mobile devices for education, informal learning that currently exists in the classroom, and the results of full-scale initiatives or longitudinal studies (Pollara et al., 2011, p.25)." According to Traxler (2009), "there still exist challenges of scale, sustainability, inclusion and equity in all their different forms in the future, and of

context and personalization in all their possibilities, of blending with other established and emerging educational technologies and of tracking the changes in technology” (Traxler, 2009, p. 3). A significant challenge existing in mobile learning is the inability to keep pace with technology (Pollara, 2011).

2.5 Mobile learning, currently and in the future

Mobile learning is in its infancy stage (Pollara & Broussard., 2011). Regardless of current disadvantages the mobile learning will become increasingly popular with the progress of mobile devices. Its common use within the traditional education will accord to the needs of educational quality improvement. The educational process will become more versatile and will satisfy the demands of life long learning (Georgiev et al., 2004). Mobile learning is absolutely obtaining momentum (Pollara et al., 2011). The vast majority of research studies relating to mobile learning have yielded positive results in both achievement and attitudes (Pollara et al., 2011). Moreover, according to Pollara et al. (2011, p. 8), *“the need for ubiquitous learning opportunities is immediate.”* The implications of mobile learning are far-reaching, and its potential influence on education are profound (Group, 2004). The following years will witness a period of swift growth for mobile learning, with evolutionary rather than revolutionary alterations (Librarian, 2007).

The Commission of the European Communities announced that it was planning Europe’s “digital future” via the identification of strategic challenges for competitiveness and ICT take-up in Europe (Kukulaska-Hulme, Sharples, Milrad, Arnedillo & Vavoula, 2011). It is crucial that education embraces this new technology and develops pedagogies to foster and enrich learning with the use of mobile devices. Since smartphones become increasingly ubiquitous and capabilities rise up, the need for real-time communication and access to learning materials will ascend and modern education must meet the challenge (Pollara et al., 2011). Researchers in mobile learning will be keen to address the current challenges ascending from the technical advancements and from learner activities in multiple virtual and informal learning environments. This will request a blend of technical, educational and sociological expertise to be able to make sense of, and shed lights on the mobile learning (Kukulaska-Hulme, et al., 2011).

In the learning field, mobile learning was predicted to be one of the top trends in 2011 (Brink, 2011). Along with the advancements of new technologies and the wide availability and use of mobile device, especially those that are web-enabled, mobile learning will realize its full potential in the near future (Brink, 2011). Nevertheless, how will mobile learning progress at a rapid speed? According to Brink (2011), advanced mobile platforms and emerging technologies, for example, HTML5, cloud computing, and online gaming will enable people to easily access the interactive and engaging content. HTML5 will decrease the need for flash-based content on mobile devices, while cloud computing can flatten the app industry so that materials can be created once and then accessed by any device. The challenges for the educators and technology developers will be to search for ways to make sure that mobile learning is highly situated, personal, collaborative and long term, offering a truly learner-centered learning experience (Siff, 2006).

Considering the facts presented above, in order to prepare for implementing mobile learning in Chinese universities, it is essential to understand the end-users’ acceptance of mobile learning. In this thesis, the authors study students’ acceptance of mobile learning in three Chinese universities by means of the Technology Acceptance Model (TAM). In the next section, TAM is described.

2.6 Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) was conceived to explain and predict the individual's acceptance of technological advances, which has been used worldwide in business, information system, and educational settings. However, there exists a problem in applying it beyond workplaces, because the original TAM basic constructs cannot completely reflect the variety of user task contexts (Davis, 1985; 1989). Therefore, many researchers have tested, replicated and extended TAM with additional constructs. TAM has been developed and validated over time within different areas, populations, and technologies.

By applying TAM model, this thesis will test the proposed TAM model in explaining and predicting students' acceptance of mobile learning in three Chinese top universities. Their perceptions and attitudes of mobile learning will be measured and described through *Perceived Usefulness*, *Perceived Ease Of Use*, and *External Variables* within TAM model. The key predictors and factors that finally affect students' acceptance of using mobile learning will be investigated. In this chapter, the key determinants, such as *Perceived Usefulness*, *Perceived Ease Of Use*, *Attitude*, and *Behavior Intention*, are based on the original TAM. The other external variables are reviewed by other extended TAM models. The proposed conceptual model of mobile learning is briefly addressed and will be examined.

2.6.1 Original TAM and early development

The technology acceptance model (TAM) originally developed by Davis (1985), is a widely used model to study the user's acceptance of a technology, which includes interpreting the causal relationships between *Perceived Ease Of Use*, *Perceived Usefulness*, *Attitude*, *Intentions* and *Behaviors*.

TAM aims “to provide an explanation of the determinants of technology acceptance that is generally capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified” (Davis, Bagozzi & Warshaw, 1989, p. 985).

Davis (1985) considered that users' motivation to use a particular computing technology is determined by three elements: *Perceived Usefulness* (PU), *Perceived Ease of Use* (PEOU) and *Attitude Towards Using* (ATT). He assumed that the actually use of a system depends on the user's attitudes towards that system. *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEOU) are the main indicators of user's attitudes. Moreover, *Perceived Ease of Use* can also affect the *Perceived Usefulness* directly. Chuttur (2009) assumed that other variables, including system properties, can influence both PU and PEOU directly (Figure 2.3).

Subsequently, Davis et al. (1989) added another element, *Behavioral Intention* (BI), to TAM, which can be directly influenced by *Attitude Towards Using* and *Perceived Usefulness*. It is suggested that if a system is perceived useful by the user, the user may express a strong *Behavioral Intention* and skip the element *Attitude Towards Using*. Therefore, the previous TAM was revised to the first modified version of TAM (Chuttur, 2009).

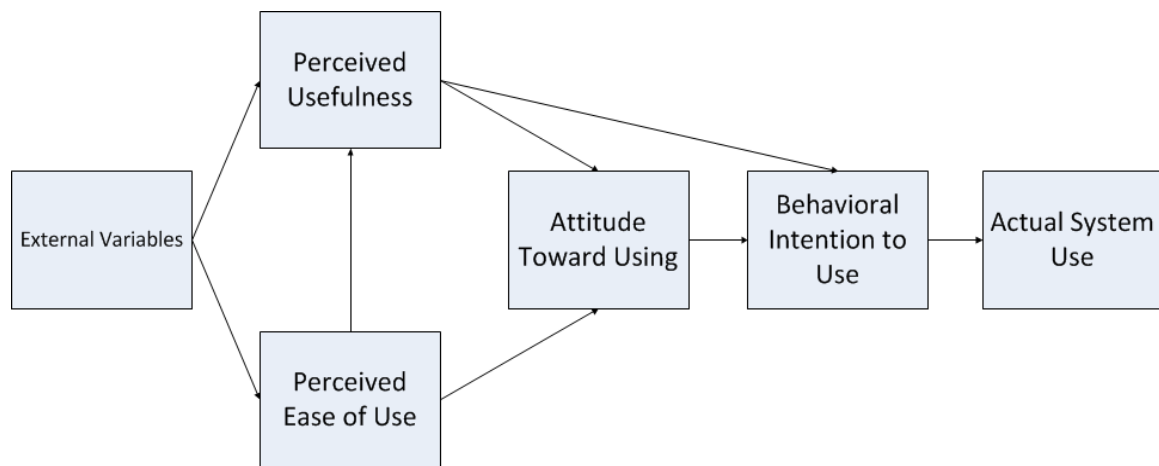


Figure 2.3 First modified version of TAM (Davis, Bagozzi and Warshaw, 1989, p. 985)

In this revised model, *Perceived Usefulness* refers to the degree to which a person considers that the tasks of him or her are well executed by the system. *Perceived Ease Of Use* is defined as the degree to which the use of the system is easy. *Attitude* means the positive or negative feelings from the person about executing a certain behavior (use the system). Finally, *Behavioral Intention* indicates the degree to which an individual has made consciously plans to decide whether to perform a certain future behavior or not. (Venkatesh, 2000)

According to Ajzen (2002), there are four stages that are followed by the choice of using a certain IT system. The first stage is that users assess a number of external variables to exam the outcome of using a system. The result of users' assessment will influence the *Perceived Ease Of Use* and *Perceived Usefulness* of the system. Then, on the second stage, users' beliefs about the outcome (known as *Perceived Ease of use* and *Perceived Usefulness*) will affect users' *Attitudes*. The following stage is the users' positive or negative attitudes towards the system. It decides the intention of users to use the system. Last stage is the actually use of the system driven by the users' intention (Ajzen, 2002).

Additionally, based on the literature review, several studies (Yousafzai, Foxall, & Pallister, 2007; King & He, 2006) conducted meta-analyses and also confirmed positive results on TAM Model. King & He (2006) suggested that the model measures are fairly reliable and might be applied in more contexts (King & He, 2006). Also, many studies used the original TAM model as the streamline and apply it in many areas. However, the results of the research is conflicting, because the external variables of technology acceptance that affect the key determinants are *Perceived Usefulness* and *Perceived Ease Of Use* (Kowitlawakul, 2008). Therefore, the above-mentioned several studies' results point out that there is a need to focus on more different area settings, diverse population, and different technologies regarding the acceptance (Davis, Bagozzi & Warshaw, 1989; Venkatesh & Davis, 2000). That is the reason why TAM2 and TAM3 are developed which concentrate on the crucial external variables that affect two key determinants. TAM2 and TAM3 help understand how the key predictors finally influence the end users' acceptance in different contexts.

2.6.2 TAM2 and TAM3

During the last two decades, TAM model has been well developed as a powerful, effective, and parsimonious tool, to predict user acceptance of computing technology (Venkatesh & Davis, 2000). A number of researchers have also developed TAM model by adding additional elements to the model to explain the user acceptance in a more detailed

level. As Venkatesh and Davis (2000) suggest, subjective norm, image, experience, output quality, computer self-efficacy, computer anxiety etc. can also influence *Perceived Usefulness* and *Perceived Ease Of Use*.

A lot of research has been conducted to validate TAM model. Generally, all the results from this research present strong arguments in favor of TAM as a model used to explain user behavior. Nevertheless, previous TAM has certain difficulties in recognizing the cause of *Perceived Usefulness* or *Perceived Ease Of Use*. As a result, most of the studies using TAM in that time were limited in a voluntary setting (Chuttur, 2009). Some researchers attempted to revise and extend the initial TAM model to enhance its predicting ability. Hence, a variety of modified and extended versions of the original TAM model have been developed (Karmakar & Dolley, 2008). In order to include the mandatory aspect in TAM, Venkatesh and Davis (2000) therefore extended TAM to TAM2. TAM2 model comprises a lot of previous efforts, and it explicitly concludes several external variables that influence *Perceived Usefulness* and *Perceived Ease Of Use*.

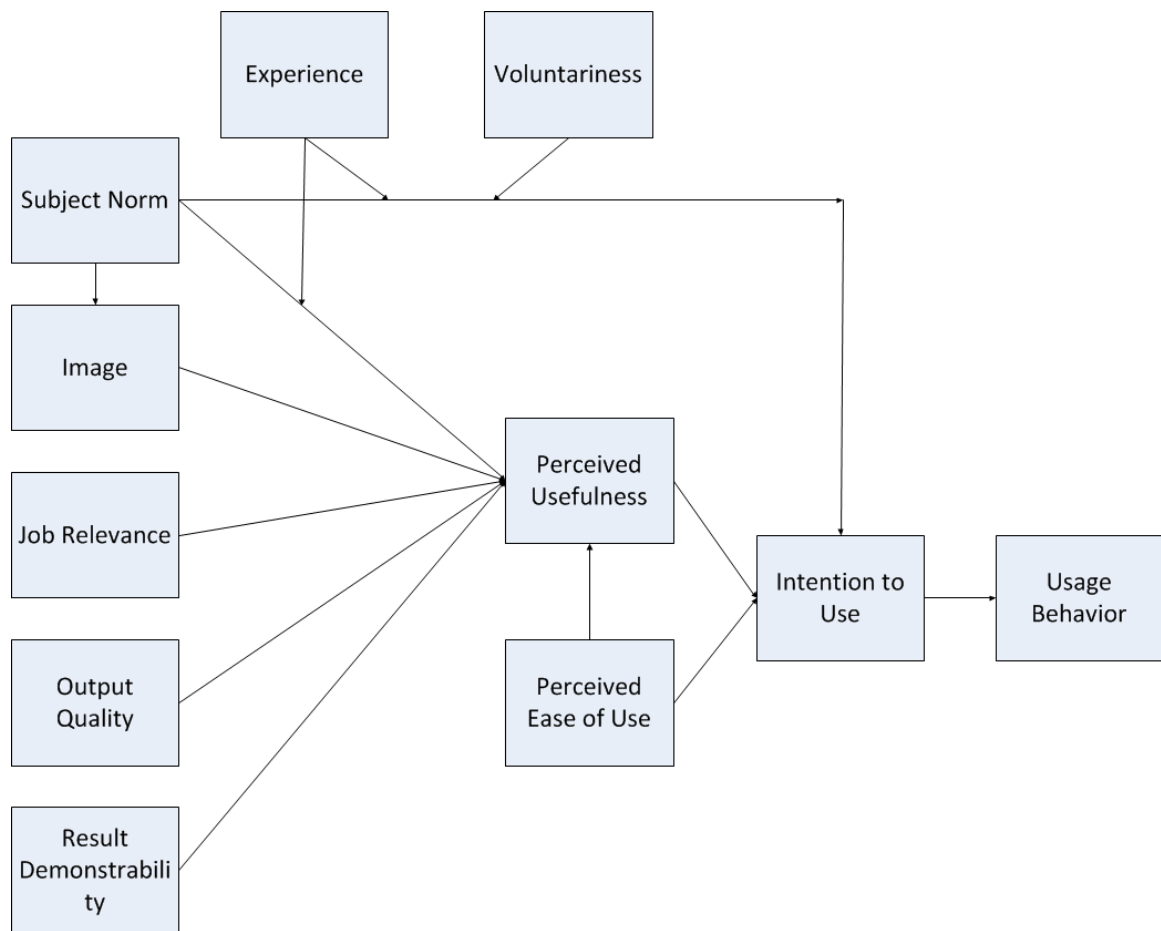


Figure 2.4 TAM2 (Venkatesh & Davis, 2000)

In TAM2 (see *Figure 2.4*), several additional variables were proposed as the preconditions of *Perceived Usefulness* element so that TAM2 could better interpret the causes of certain usefulness. *Subject Norm* refers to an individual’s perceptions that those people who are important to him or her consider that this individual should or should not use the system. *Image* is the degree to which use of a new system is perceived to improve a person’s status in his or her social network. *Job Relevance* indicates a person’s feeling about the degree to which a certain system is relevant to the task. *Output Quality* represents the degree to which a person consider that the system execute the tasks well. And *Result Demonstrability*

means the authenticity of the outcome of using a new system (Venkatesh & Davis, 2000)). After evaluating the performance of TAM2 in both voluntary and mandatory environments, Venkatesh and Davis (2000) confirmed that TAM2 can give more detailed interpretations of the causes of certain usefulness.

Venkatesh (2000) developed another essential extension of TAM model. Instead of studying the causes of *Perceived Usefulness*, he focused on the antecedents to the *Perceived Ease Of Use*. Therefore, two addition categories were added to the model. They are *Adjustments* and *Anchors* (Chuttur, 2009). This version of TAM is also known as TAM3 (Figure 2.5).

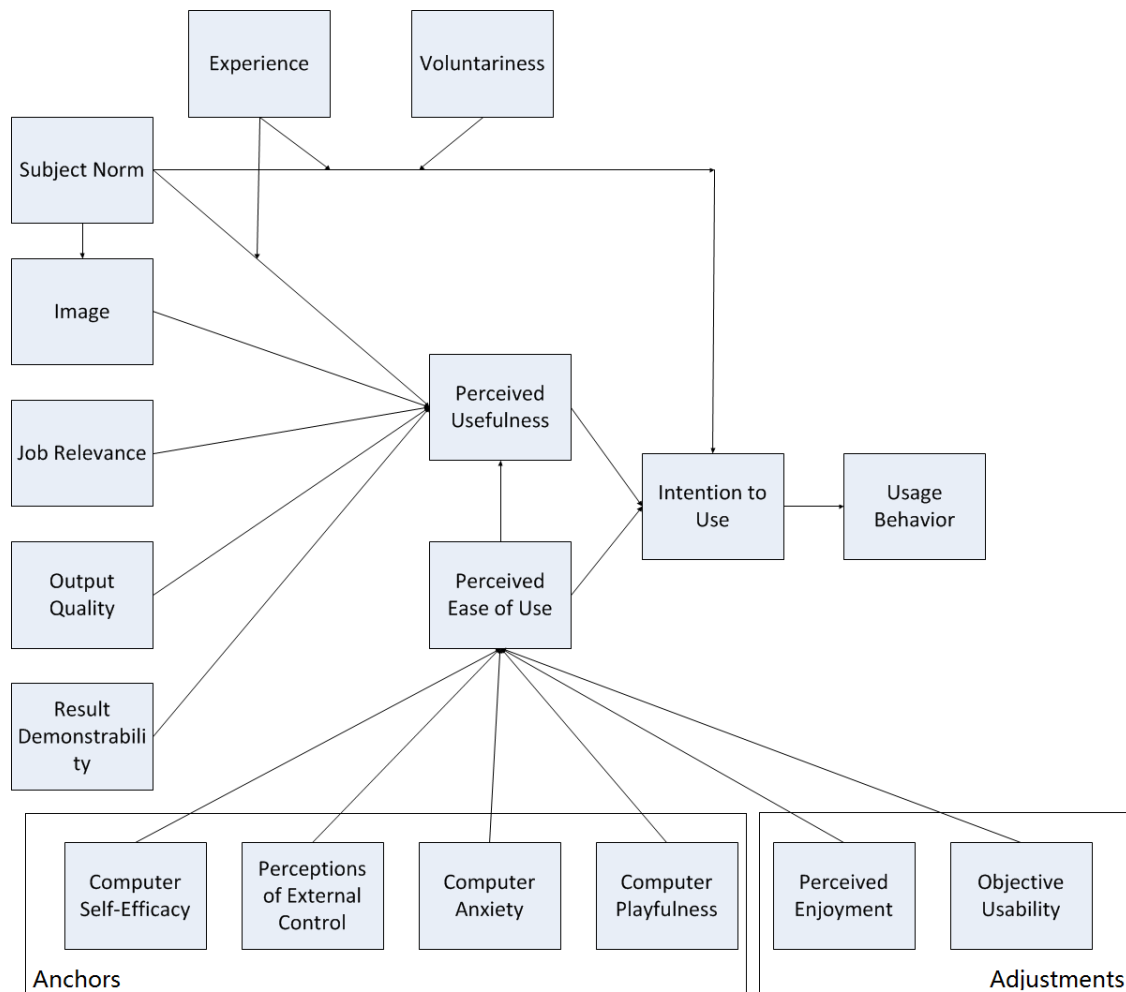


Figure 2.5 TAM3 (Venkatesh, 2000)

Anchors represent the uses and beliefs about computers. *Computer Self-Efficacy* refers to the extent to which a person believes that himself or herself is about to perform a certain task by using a computer system. *Perceptions of External Control* represents the degree to which a person considers that a current organizational and technical infrastructure can enable the use of a system. *Computer Anxiety* is defined as the degree of a person’s fear while facing the possibility of using computer. And *Computer Playfulness* means the extent of cognitive spontaneity while interacting with a microcomputer (Venkatesh, 2000).

Adjustments focus on the shaped beliefs that result from the user experiences towards a system. In this category, *Perceived Enjoyment* refers to the extent to which a person perceives that a system enjoyable to use. Additionally, *Objective Usability* is about the compari-

son of systems grounded on actual usability (instead of perceptions) of effort needed to finish a specific task (Venkatesh, 2000).

Venkatesh (2000) proposed those key factors that are mostly derived from previous research of identifying the antecedents to *Perceived Ease Of Use* (Davis, Bagozzi and Warshaw, 1992; Venkatesh and Davis, 1996). The findings insulated that the predictors support the explanation of *Perceived Ease Of Use* for a given system.

Finally, TAM3 was formed in a manuscript in-preparation in 2012 by combining TAM2 and those factors found for *Perceived Ease Of Use* by Venkatesh in 2000. It provides a whole overview of predictors that affect two key determinants (*Perceived Usefulness* and *Perceived Ease Of Use*) in TAM development. Additionally, the factors can be used to help researchers to apply TAM in different areas to explain the users' acceptance of a technological advance.

2.6.3 Extended TAM in mobile learning

In another TAM extension study, Huang, Lin & Chuang (2007) use two crucial factors that affect *Perceived Usefulness* and *Perceived Ease of Use* respectively: *Perceived Mobility Value* and *Perceived Enjoyment*. The authors explored students' perception in two universities in Taiwan and they applied TAM and built hypotheses to test the correlations within the model (Figure 2.6). Two major factors derived from their results are the main contribution to the mobile learning in higher education area (Huang, Lin & Chuang, 2007).

Perceived mobility value (PMV): it illustrates the end-users' awareness of mobility value during their studies of mobile learning. Seppälä and Alamäki (2003) claimed that the mobility value contains convenience, portability and immediacy. Mobility value supports the users to access and check the information needed anywhere at any time through mobile devices. The real-time data would be checked and gained if the end-users have some geographical limitations, which result in the inconveniences of being there. Put another way, the mobility value solves some disabilities and guide users in a new learning situation without when and where limitations (Huang, Lin & Chuang, 2007). Thus, mobility value is valuable as a primary concern. In their study, the Perceived Mobility Value is a crucial factor of individual which has an impact on users' intention and behaviors. The authors treated *Perceived Mobility Value* as new variable in TAM and also proved their hypothesis as accepted in the researched area (Huang, Lin & Chuang, 2007).

Perceived enjoyment (PE): Davis, Bagozzi and Warshaw (1992) claimed *Perceived Enjoyment* can be defined as “the extent to which the activity of using the technology is perceived to be enjoyable in its own right, apart from any performance consequences that may be expected (Davis et al., 1992, p.1111-1132).”

The authors indicated *Perceived Enjoyment* as a key determinant which intrinsically motivates users' acceptances, and attitudes of mobile learning, because the users might feel less frustrated when they are highly engaged in those activities and feel enjoyable (Huang, Lin & Chuang, 2007).

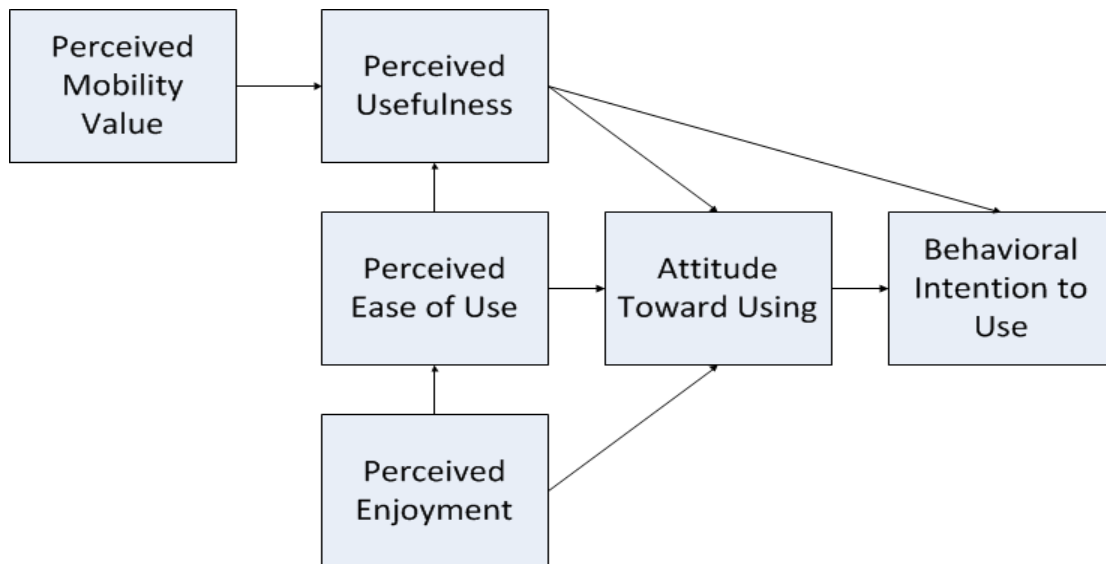


Figure 2.6 Extended TAM for user behavior of mobile learning (Huang, Lin & Chuang, 2007)

2.6.4 Research model and hypotheses

In order to answer the research questions, a conceptual model is proposed, which is derived from TAM model of Davis et al. (1989, 2000), and extended TAM model of mobile learning (Huang, Lin & Chuang, 2007). The proposed research hypothesis model for extending TAM to account further mobile learning research is illustrated in *Figure 2.7*. The purpose of this model is to test all the hypotheses, in order to explain users' acceptance and attitudes towards mobile learning before implementation in three top Chinese universities.

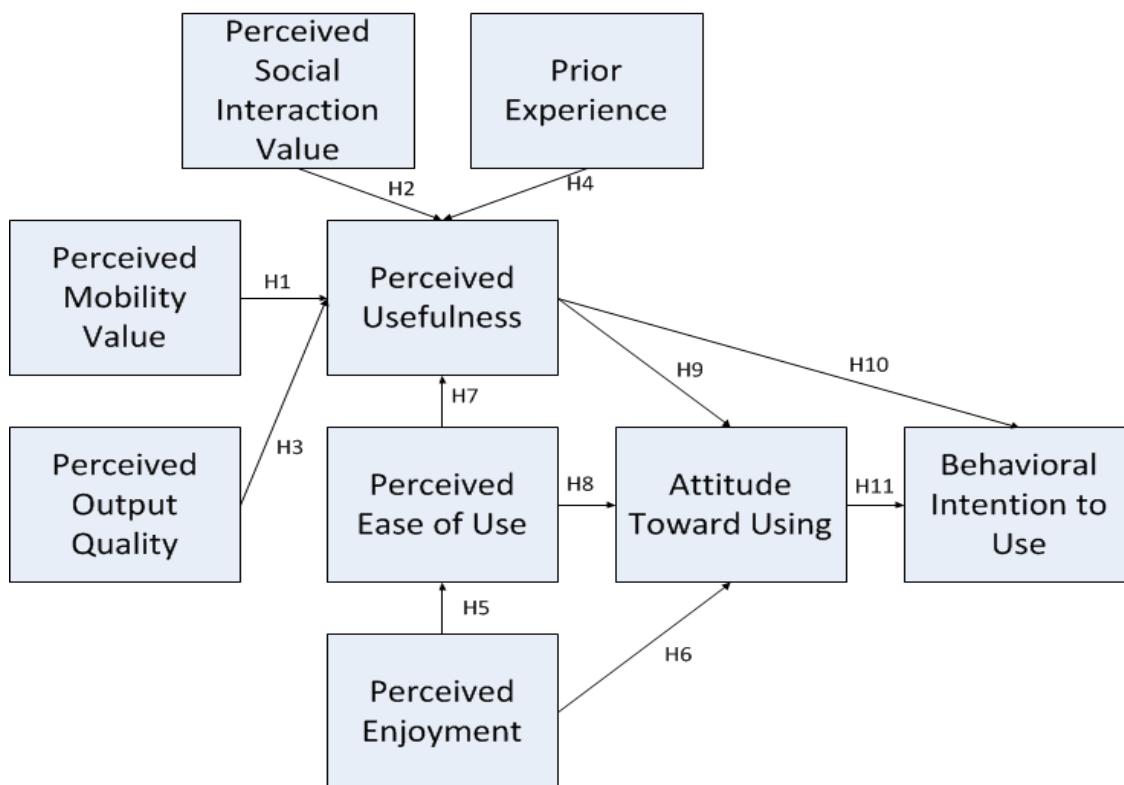


Figure 2.7 Proposed TAM and hypotheses

The external variables influencing key determinants (*Perceived Usefulness* and *Perceived Ease of Use*) might be different in different settings. In a mobile learning setting, there might be factors that affect the two key determinants of *Behavioral Intention* differently in other organization and context. As shown in *Figure 2.6.4*, the proposed TAM model consists of several external variables: *Perceived Mobility Value*, *Perceived Enjoyment*, *Perceived Social Interaction Value*, *Perceived Output Quality*, and *Prior Experience*. The first two factors are proved by Huang, Lin and Chuang (2007). *Perceived Output Quality*, and *Prior Experience* towards mobile learning derived from TAM2 and TAM3 are added to the base model, so as to examine external factors in relation to students' attitudes and acceptances. Also, *Perceived Social Interaction Value*, which has been already tested in other area such as computer-based online gaming as a crucial external variable. These factors might significantly affect other TAM factors.

The elements and hypotheses in the conceptual model are described in-depth as follows:

- **Perceived Mobility Value (PMV)**

Perceived Mobility Value was first tested and proved by Huang et al. (2007). It relates to the significant value of mobile devices, namely - mobility. Mobility value can be determined as a way of accessing, transmitting and receiving information anywhere at any time (Huang et al., 2007). Also, it enhances the real-time data sharing and interchange based on the accessibility of data without time and geographic limitation. Mobile technology conforms to the increasingly mobile nature of human lifestyle. Mobility is accordingly perceived as a crucial edge of mobile learning that makes it different from e-learning (Liu, Han & Li, 2010). Kaigin and Basoglu (2006) and Mallat, Rossi, Tuunainen and Öörni (2008) provided evidence that *Perceived Mobility Value* has an impact on one's decision to adopt mobile services. Therefore, mobility value can be considered as a key influence that has an impact on *Perceived Usefulness* towards students' perceptions and attitudes before adoption. Hence, the authors of this thesis hypothesize that *Perceived Mobility Value* affects *Perceived Usefulness* positively.

H1: Perceived Mobility Value (PMV) has a positive effect on Perceived Usefulness (PU)

- **Perceived Social Interaction Value (PSIV)**

Perceived Social Interaction Value has not been tested before in the area of mobile learning but has appeared in other business and computer-based areas. It is also associated with the significant awareness value of students interviewed, which helped gather information needed for questionnaire construction.

Lee and Tsai (2010) proposed a theoretical research model by combining the Technology Acceptance Model and theory of Planned Behavior Model, which consists of Experience, Human Computer Interaction, Social Interaction, and Perceived Enjoyment in computer-based gaming. In this study, Social Interaction is considered both a key factor incorporated in TAM model and an external variable, in order to test the hypothesis on usefulness towards acceptance.

Furthermore, from the theory aspect, Walther (1996) claimed that there is a social interaction cue that drives people to get to know and communicate with one another online. They can better create and manage their relationship in this environment. Once the online interpersonal relationship is established, it may demonstrate not only the same relational elements as face-to-face (FtF) relationship, but also enhanced relationships and improved quality of communication, which would not have been formed in FtF situation due to geographic and other limitations. Social Interaction Value mentioned here can be

realized within social information processing based on online communication. Some individuals prefer social interaction online synchronously or asynchronously, because social interaction enables interaction more controllable and malleable, reduces the uncertainty, stress, and frustration during the sending message and receiving feedback. According to the research by Walther, the study depicts that online interaction as interpersonal communication has developed an increasingly optimistic view of social information processing, which indicates their high capabilities of creating and maintaining relationship with others (Walther, 1996). Walther also represents social interaction can help users to ask more questions and express more openly about themselves than FtF way. Thus, people are motivated in social interaction online with others to establish good impressions and affinity (Walther, 1996).

Social Information Processing theory suggests that communication attitudes and behaviors are determined by social communication (e.g. instant message, chat forum, e-mails). Some empirical studies are supportive of the proposition that it moderates usefulness perception. Dickinger, Arami and Meyer (2008) analyzed the effect of peers on individuals' adoption behavior of a new Voice over Internet Protocol (VoIP) service based on General Packet Radio Service (GPRS) or Enhanced Data rates for GSM Evolution (EDGE). This study exemplifies that the users are not being limited to one-to-one communication but still prefer one-to-many social interaction (Dickinger et al., 2008). The result shows that a high degree of social interaction value plays a significant role on users' perception of usefulness.

H2: Perceived Social Interaction Value (PSIV) has a positive effect on Perceived Usefulness (PU)

- **Perceived output quality (POQ)**

Venkatesh et al. (2000) extended the original TAM so as to explain detailed *Perceived Usefulness* and *Behavioral Intention* through social influences. They proposed TAM2 by adding several significant factors affecting *Perceived Usefulness*; indeed, output quality is one of them, which means perceived output quality has a direct effect on perceived usefulness that represents the influence of cognitive instrumental process. Venkatesh and Davis (2000, p.191) explained the perceived output quality as “*the degree to which an individual believes that the IS/IT performs well with tasks as they expected*”. Also, Zeithaml (1988) defined it as the consumer's judgment about a product's or service's overall excellence or superiority. Concerning Information Systems, a number of studies suggest that quality of both infrastructure and service delivered would impact overall output quality, which further affects users' acceptance (Liu, Han & Li, 2010). Cheong and Park (2005) showed that perceived system and content quality were positively related to perceived usefulness of the mobile internet. Dai, Gao, Fan and Kang (2007) suggested that the *Perceived Output Quality* is one of the significant determinants of *Perceived Usefulness* of online social information services. Considering both system and content output issues, Liaw (2008) proved that *Perceived Output Quality* is an important factor of users' satisfaction with e-learning. Therefore, the following hypotheses are proposed:

H3: Perceived Output Quality (POQ) has a positive effect on Perceived Usefulness (PU)

- **Prior Experience (PEX)**

Users' *Prior Experience* was incorporated into TAM to predict *Behavioral Intention* (Fusilier & Durlabhji, 2005). Also, Liao and Lu (2008) claimed *Prior Experience* affects learners' adoption of new technological advances. Beliefs and attitudes correlate more strongly with behavior for people who have had direct experience with an object (Taylor & Todd,

1995), suggesting a stronger influence of *Perceived Usefulness* and *Attitude* on *Behavioral Intention* and subsequent behavior of experienced users. Specifically, it has been suggested that knowledge gained from past behavior will help to shape intention (Taylor & Todd, 1995), in part because experience makes knowledge more accessible in memory (Taylor & Todd, 1995), and also because past experience may make low probability events more salient, ensuring that they are accounted for in the formation of intentions (Taylor & Todd, 1995). This indicates that IT usage may be more effective for those who have a well-built prior experience. Additionally, in other fields, some prior experience of using internet with e-shopping channels had a positive influence on the *Perceived Usefulness* of new direct shopping channels (e.g. mobile-shopping) even in future *Behavioral Intention*, since the end-users are skillful in purchasing procedures (Joaquín, Carla & Silvia, 2009).

H4: Prior Experience (PE_x) has a positive effect on Perceived Usefulness (PU)

- **Perceived enjoyment (PE)**

Perceived Enjoyment indicates that end-user would be entertained and feel enjoyed during their using of mobile devices as a learning tool. Phuangthong and Malisawan (2005) showed evidence, which insulates in addition to basic constructs of TAM, perceived enjoyment could partly explain users' intention and behavior. Davis et al. (1992) extended their original TAM to encompass Perceived Enjoyment as an additional motivational factor. In the original TAM, there is no provision for intrinsic motivation or any other motivational related elements. In fact, in an effort to synthesize and extend the existing work, Venkatesh, Speier and Morris (2002) analyzed and featured intrinsic motivation and ease of use in their proposed model and proved it along with perceived usefulness (Venkatesh, 2000; Yi and Hwang, 2003; Venkatesh et al., 2002). They found that intrinsic motivation brought by *Perceived Enjoyment* was positively related to *Perceived Ease of Use*.

H5: Perceived Enjoyment (PE) has a positive effect on Perceived Ease Of Use (PEOU)

Research subsequent to TAM has added *Perceived Enjoyment* as a key factor in predicting *Attitude* and *Behavioral Intention* (Wu & Gao, 2011). Moon and Kim (2001) view PE as an intrinsic element of motivation and find that PE is positively related to attitudes towards using technology. Other studies find PE to be a strong predictor of attitudes towards using the Internet (Novak, Hoffman & Yung, 2000), handheld Internet devices (Bruner & Kumar, 2005), instant messaging (Lu, Zhou, & Wang, 2008), and virtual reality (Shen & Eder, 2009). This study expects the same relationship to hold for educational technology. These findings imply that *Perceived Enjoyment* correlates positively to the factor *Attitude*.

H6: Perceived Enjoyment (PE) has a positive effect on Attitude (ATT)

- **Perceived Ease Of Use (PEOU), Perceived Usefulness (PU), Attitude (ATT), and Behavioral Intention (BI)**

TAM (Davis, 1989) consists of several factors with casual relationships among them. *Perceived Usefulness* and *Perceived Ease Of Use* have direct effects on *Attitude*. There is also a relationship between *Perceived Ease Of Use* and *Perceived Usefulness*, reflecting that PEOU is a predictor of PU. Finally, *Behavioral Intention* is determined by *Attitude* and *Perceived Usefulness*.

The strong relationship between *PEOU* and *PU* implies that those people who feel a new technology is easy to use, will find it very useful (Davis, 1985, 1989; Davis et al., 1989). Thus, *Perceived Ease Of Use* is likely to have a direct effect on *Perceived Usefulness*.

H7: Perceived Ease Of Use (PEOU) has a positive effect on Perceived Usefulness

The effect of PEOU and PU on ATT: Davis (1985) hypothesize that the attitude of a user towards a new system was a critical determinant of whether the user will accept or reject the system (Davis, 1985). Attitude towards a new information system or new technology service is mainly predicted by *PEOU* and *PU* before adoption. The previous studies depict that the levels of *PEOU* and *PU* are two crucial components that influence the degree of the users' attitudes (Davis, 1985, 1989; Davis et al., 1989). Many studies have found that the *Perceived Usefulness* and *Perceived Ease Of Use* are important determinants in explaining attitudes and predicting intention of use (Lu, Yu, Liu & Yao, 2003; Drennan, Kennedy & Pisarki, 2005). The purpose of these studies was to determine the individual attitude, and final *Behavioral Intention* as opposed to actual use. The results showed that these two key determinants have a high ability to predict the attitudes and intentions of use. Thus, the proposed hypotheses are listed:

H8: Perceived Ease Of Use (PEOU) has a positive effect on Attitude (ATT)

H9: Perceived Usefulness (PU) has a positive effect on Attitude (ATT)

The effect of PU and ATT on BI: in TAM, *BI* is determined by *PU* and *ATT*. According to some previous research (Adams et al., 1992; Davis et al., 1989; Venkatesh et al., 1996, 2000), it supports and examines this relationship by researchers.

H10: Perceived Usefulness (PU) has a positive effect on Behavioral Intention (BI)

H11: Attitude (ATT) has a positive effect on Behavioral Intention (BI)

3 Method

Research methods are the specific techniques employed in the execution of a piece of research, for example, the way in which subjects or participants are sampled, the construction and use of a data collection instrument, and the specific processes whereby data are analyzed (Sim, 2000).

3.1 Research purpose

There are a number of ways of classifying research, depending on the purpose of the research, the data that is collected, and how such data is analyzed (Gratton & Jones, 2010). A research purpose can be classified as explanatory, descriptive, and exploratory (Saunders, Lewis & Thornhill, 2007).

An exploratory study is a valuable means of finding out ‘what is happening; to seek new insights; to ask questions and to assess phenomena in a new light’ (Robson, 2002). The purpose of a descriptive study is to provide a picture of a phenomenon as it naturally occurs (Hedrick, Bickman & Rog, 1993). However, one of the weaknesses of descriptive studies is that they cannot explain why an event has occurred (Blumberg, Cooper & Schindler, 2005). Explanatory studies, meanwhile, are built on exploratory research and endeavor to demonstrate the factors why something occurs (Neuman, 2003). While descriptive studies may ask ‘what’ questions, explanatory studies seek to ask ‘why’ and ‘how’ questions. This difference between descriptive and explanatory research applies equally to both quantitative and qualitative studies (Gray, 2009).

This study is an explanatory research. The research questions are aimed to measure how students perceive and accept mobile learning in three Chinese universities as an integral population. The Technology Acceptance Model (TAM) has been developed and used by many researchers in a wide range of fields, not only within mobile learning. This research examines the model within a differently specified context, mobile learning in Chinese top universities. The research model attempts to explain students’ attitudes and behavioral intentions towards mobile learning. Hence, this study comprises explanatory purpose.

3.2 Research approach

All research projects, and particularly research programs or clusters of research projects on the same topic, have as an ultimate goal either discovery or testing (Tashakkori & Teddlie, 2003). The theoretical drive, the primary way in which the researcher is approaching a research topic, may be deductive (for testing) or inductive (for discovery) (Morse, 1991).

Deduction drive is a research approach in which you suggest your theory and hypothesis and then test it by proposing a research strategy (Saunders et al., 2007). It is the prevailing research approach in natural sciences, while laws reflect the fundamental of explanation, grant the expectation of phenomena, forecast their emergence, and thus allow them to be managed (Collis & Hussey, 2003). Deduction possesses certain crucial characteristics. First, there is a search to explain the causal relationship between variables. In the deductive approach, there exists a crucial point to guarantee it is reliable, that is, to use and describe a well-organized methodology to ease duplication (Gill & Johnson, 2002). The last feature of deduction is generalization. It is necessary to select samples of sufficient numerical size, so as to make the statistical generalization of regular patterns in human social behavior possible (Saunders et al., 2007).

The result of an inductive research is the formulation of a theory. Researchers conducting the inductive research deal mainly with qualitative data and use a wide range of approaches to collect these data so as to build various perspectives of a phenomenon (Easter-Smith, Thorpe & Lowe, 2002).

The authors have chosen to work with an deductive approach, in order to collect primary data about students' perceptions and intentions. There exist a wealth of literature on mobile learning and technology acceptance. The authors developed eleven hypotheses based on the research questions and TAM on causal relationships between variables in the conceptual model. Quantitative data was collected through questionnaires, and later on, analyzed statistically in order to test the hypotheses. Moreover, the purpose is to measure students' perceptions and intentions and to examine TAM model, not about formulating a theory. Also, the main focus of this research is on questionnaires, which mainly collect quantitative data. Interviews are merely conducted to support the design of the questionnaire, so that the questions in the questionnaire are comprehensive enough and suitable for students to answer. Therefore, this research uses a deductive approach.

Multi-method refers to those combinations where more than one data collection technique is conducted with related analysis techniques (Tashakkori and Teddlie, 2003). Both quantitative and qualitative data collection techniques were employed in this research. However, qualitative data, which gathered from the interview, are merely used to support the questionnaire design. Moreover, the focus of this study is on quantitative data. Hence, this study is a multi-method quantitative study.

3.3 Data collection

3.3.1 Literature review

The authors have used the university library (DiVa) and Google Scholar as the main searching engines to collect valuable literature resources and information. Also, Jönköping University Library resources (databases such as Emerald and ACM Digital Library) were utilized largely by the authors in order to gain a comprehensive view the research and to conduct the research in a scientific way. The table below (*Table 3.1*) illustrates the keywords that were used for searching for literature information.

Table 3.1 Keywords used to search for literature

Keywords	Keywords
mobile learning	mobile learning, e-learning
mobile learning, china	mobile learning in university
mobile learning, student perception	technology acceptance model
mobile learning, higher education	mobile device, learning tool
mobile learning, attitude	e-learning in China
mobile learning adoption	learning development in university
Technology Acceptance Model	mobile learning, trend
mobile learning, stage	technology diffusion
mobile technology acceptance	wireless technology adoption
extension of Technology Acceptance Model	factors influence user acceptance of mobile technology

3.3.2 Primary data source

Data collected specifically for the research project being undertaken are called primary data (Saunders et al., 2007). The primary data, gathered from three top Chinese universities through interviews and questionnaires by the authors, will be processed and analyzed in order to test the hypotheses. All of the three investigated Chinese universities rank top-10 among Chinese universities, and are located in the middle part of China.

➤ Sichuan University (SCU)

Sichuan University is one of the oldest national universities in China. According to the 2010 Academic Ranking of World Universities, it is ranked No. 8 among the Chinese universities. Located in the city Chengdu, Sichuan province, Sichuan University has a current total staff of 11,357, among which 1,323 are professors and 2,345 associate professors. Currently, about 60,000 students are enrolled (SCU, n.d.).

➤ Wuhan University (WHU)

Wuhan University is regarded as one of the top-10 universities in China. It is directly under the administration of the Ministry of Education of the People's Republic of China. Wuhan University is located in the city Wuhan, Hubei province. There are about 50,000 students currently enrolled (WHU, u.d.).

➤ Huazhong University of Science and Technology (HUST)

Huazhong University of Science and Technology also ranks top-10 in China. It is located in city Wuhan, Hubei province. HUST manages Wuhan National Laboratories for Optoelectronics (WNLO), which is one of the five national laboratories in China. About 50,000 students are currently enrolled (HUST, u.d.).

3.3.3 Population and sample

The target population is the collection of cases in which the researcher is ultimately interested in, and to which he or she wishes to make generalization. The accessible population is the portion of the target population that is accessible to the researcher for the purposes of a specific study (Sim & Wright, 2000). Originally, the authors intended to investigate students in top-10 Chinese universities. However, many factors restrict the original plan, for example, accessibility reasons, time and resources limitations. Hence, students studying in SCU, WHU, and HUST are the target population, because the authors of this study were grown up in these cities.

There are about 2300 universities in China, ranging from world-class universities to low-level ones. It is fairly hard to access all the universities. Only two universities in China currently have mobile learning, Shanghai Jiaotong University and University of Zhejiang, and both of them rank top-10. Moreover, SCU, WHU, and HUST are accessible for the authors and all of them rank top-10. Therefore, the sampling frame is all the students who are currently enrolled in SCU, WHU, and HUST. This research views the students of these three universities integrally, not as three separate groups.

According to Sim (2000), a sample is the selection of the accessible population on which a study is conducted. Commonly, constraints of time and resources dictate that only a portion of the accessible population is included. The sampling units are the individual members of the sample. In this research, the sampling units are individual students from Sichuan University, Wuhan University, and Huazhong University of Science and Technology. Two types of sampling techniques are available, probability (representative) sam-

pling and non-probability (judgmental) sampling (Saunders et al., 2007). With probability sampling, the chance or probability of each case being selected from the population is known and is usually equal for all cases. It is also possible to estimate characteristics of the population from the sample. Taking the representativeness of probability sampling into consideration, the authors chose to use probability sampling in this research, so that the samples can be generalized to the students at the three universities .

According to Saunders et al. (2007), stratified random sampling is a modification of random sampling technique in which researchers divide the whole population into relevant and significant strata based on one or several attributes. By dividing the population into a series of relevant strata, the sample is more likely to be representative, as researchers can ensure that every stratum is represented proportionally within the sample. In this research, the population is divided into three strata by choosing the three different universities as the stratification variable. Hereby, every stratum has the population around 50,000 students. In order to ensure that each of the strata is represented proportionally, the authors assign the same sample size for each stratum. Simple random sampling was used in each of the strata. The ideal situation is that as much as possible respondents could be randomly chosen by the system and contacted to fill in the questionnaire. However, many students claim that they rarely use the university's email address to contact their teachers, and they often use free public email services, such as 163 email, qq email, gmail, and hotmail. This undoubtedly increases the time and efforts that are required to make contact with them. Therefore, due to time and resource limitations, 150 students were randomly selected by each university system. The authors contacted teachers in these three universities and asked them to log in the university's student affair system, access student contact information list, and randomly select students. Teachers, tutors, and friends in these universities helped the authors to send out the questionnaires and collect them back via both face-to-face and email when completed.

According to Tabachnick and Fidell (2001), the sample size for the Structural Equation Modeling (SEM) define 50 as very poor, 100 as poor, 200 as fair, 300 as good, and 500 as very good. Additionally, Leedy and Ormrod (2001) provide a guideline for selecting suitable sample sizes for any quantitative study, stating that if a certain population size is larger than 5000, a sample size of around 400 is adequate. Originally, the estimated overall sample size is at least 300 students, each 100 students coming from one of these three universities. Concerning that not every student would respond to the questionnaire, the authors sent out questionnaires to a total number of 450 students. The choice of sample size was decided by the confidence level, margin of error, the types of analyses undertaken, and the size of total population (Saunders et al., 2007). The population size of sampling frame was roughly 160,000. The sampling size for the population was calculated as 383 at a 5% confidence interval and 5% margin of error. As of March 20th 2012, a total number of 309 valid questionnaires were collected. 309 out of 323 collected questionnaires are valid. 14 questionnaires are incomplete, several multiple choices missing. Due to the reason that the achieved valid response number 309 is less than 383, leading to an increase in the margin of error, achieving 5.58%, and also a rise in the confidence interval, reaching 5.6%.

3.3.4 Interviews

An interview is a purposeful discussion between two or more people (Kahn & Cannell, 1957). The use of interviews can help gather valid and reliable data that are relevant to research questions and objectives (Saunders et al., 2007). The authors decided to take advantage of interviews, so as to design the questionnaire in a more scientifically rigorous based on students' perceptions towards mobile learning obtained from the interviews.

Related to the level of formality and structure, interviews may be categorized as one of structured, semi-structured, or unstructured. As for structured interviews, researchers use questionnaires based on a predetermined and standardized or identical set of questions. In semi-structured interviews, researchers have a list of themes and questions to be covered, may omit some questions in particular interviews, and additional questions may be required to explore the research questions and objectives given the nature of events within particular contexts. The order of questions may be varied in semi-structured interviews, depending on the flow of the conversation. Unstructured or in-depth interviews are informal. The interviewee in unstructured interviews is given the chance to express their perceptions and opinions freely.

Since the authors had designed several questions to be covered in the interview, in-depth interviews were not conducted. The choice of semi-structured interviews rather than structured interviews was done as semi-structured interviews could offer sufficient flexibility to approach different respondents differently while still covering the same areas of data collection (Noor, 2008). The development of interview questions was based on the research questions, relevant literature, and the Technology Acceptance Model (Davis, 1989).

As suggested by Sewell (2002), qualitative data collected from interviews can be used as an exploratory step before formulating more quantitative and structured questionnaires to better determine the appropriate questions. It was decided to interview 15 students, every 5 students from each of the three investigated universities. Purposive sampling enables researchers to use their judgment to choose cases that will best enable them to meet their objectives (Saunders et al., 2007). There are several purposive sampling techniques, and one of them is maximum variation sampling. Maximum variation sampling helps researchers gather data to document uniqueness (Saunders et al., 2007). To guarantee maximum variation within a sample, Patton (2002) points out that it is better to identify different characteristics prior to selecting the sample. The authors intended to interview students from diverse background that could best support the questionnaire design. As for each university, interviewees come from 5 different majors. Because students studying diverse majors may think differently, interviewing students from diverse majors can ensure the maximum variation within the sample. Additionally, literature reviews were used to support the questionnaire design.

The outcome of the interviews were used as a basis for the questionnaire design, especially when designing the multiple-choice questions, because the authors desired to formulate the questionnaire in a way that is as comprehensive as possible, and also easily understandable to the students in these universities. The authors would like to cover the students' understanding of mobile learning, and present the questionnaire in a way that can meet this need. If the questionnaire is designed only based on the authors' ideas or literature, the questionnaire may not match students' understanding of mobile learning and may be biased. Therefore, conducting interviews prior designing questionnaire is necessary to guarantee that the questionnaire is designed scientifically enough.

3.3.5 Questionnaire design

The questionnaire was designed to explore how students in three Chinese universities perceive mobile learning. Questionnaire types are divided into five sorts, internet-mediated questionnaire, postal questionnaire, delivery and collection questionnaire, telephone questionnaire, and structured interview (Saunders et al., 2007). Considering that some students may miss some questions or even refuse to answer, the questionnaire was translated into Chinese, in order to overcome the language barrier. To conduct this re-

search, the authors used delivery and collection and Internet-mediated questionnaire, which are both self-administered. The questionnaires were handed out to students studying at three Chinese universities via both face-to-face and email ways.

Three types of data variables can be collected via questionnaires are: opinion, behavior, and attribute (Dillman, 2007). This questionnaire collects all three kinds of variables. Questions relating to attribute variables are presented at the beginning, followed by questions concerning opinion and behavioral variables. The last question in the section “Perceptions and attitudes from students” addresses behavioral variables. Since the aim of the research is to understand students’ perceptions and attitudes, the majority of the questions are rating questions. Rating questions most frequently use the Likert-style rating scale in which the respondent is asked how strongly he or she agrees or disagrees with a statement or series of statements, normally on a four-, five-, six- or seven-point rating scale (Saunders et al., 2007). The authors chose to use five-point rating scales. List and category questions are also included in the questionnaire. The questionnaire is designed in accordance with the Technology Acceptance Model. Each factor in the model is operationalised by several questions. For example, the first three degree questions are related to Perceived Usefulness (PU). The general information of questionnaire constructs is shown in the table (*See Appendix 4*). The question design in questionnaire related to proposed TAM in the table (*See Appendix 5*).

Suggested by Saunders et al. (2007), the questionnaire should be pilot tested before using it to collect data. The aim of a pilot test is to refine the questionnaire in a way that respondents will have no troubles in filling in the questionnaire and there will be no problems in recording the collected data (Saunders et al., 2007). The number of individuals for the trial run was 30 students, evenly distributed among these three universities. All subjects completed the questionnaire within 15 minutes. Some problems arose after the pilot test. Some students complained that the questionnaire was too long and that the English version questionnaire was hard to understand. To solve these problems, the authors shortened the questionnaire by deleting five questions and combining similar questions into one. Also, the authors translated the original English version into a Chinese version so that respondents would answer the questionnaire without having to struggle with the language barrier. Initially, the section “comparing traditional learning with mobile learning” was composed of list questions. After the pilot test, the authors realized that using list questions for SPSS analysis would require much more efforts than using degree questions. Hence, the list questions in the section “comparing traditional learning with mobile learning” were converted into Likert-style rating scale, in accordance with those questions in the section “Perceptions and attitudes from students”. The questionnaire was deliberately reformulated to reflect the research questions in a way that respondents could fill in all the questions without any problem.

3.3.6 Non-response analysis

Non respondents are those who have refused to be involved in the research for different kinds of reasons. As a result, the respondents will not represent the population well, and the data collected may be biased. Therefore, a high response rate is needed to ensure that the sample is representative. The researcher should analyze the respondents who refused to answer to both entire questionnaire and individual questions (Saunders et al., 2007). In this research, 127 respondents (28.22%) did not respond, including some students who refused to answer the entire questionnaires and failure to make contact with several students. Fourteen respondents omitted (3.11%) on individual questions. During questionnaire administrations, a total number of 450 students were issued questionnaires, and 309 students sent back valid questionnaires to the researchers. The questionnaires deliv-

ered to the 127 students who refused to answer the entire questionnaire were all sent via email. Those refusals didn't reply to the email with answered questionnaires as requested. The authors consider that there are various reasons for this, it might be due to that the student is too busy to read the email, has deleted the email as an advertisement email, or is not interested in the survey. As for the 14 respondents missing individual questions, 9 of them have missed the entire last page of the questionnaire. Perhaps these respondents did not notice that there is the additional page in the questionnaire. Therefore, the structure of the questionnaire may need improvement. Meanwhile, the other 5 respondents had missed one or more degree question in each of the questionnaire. This might be due to that these respondents were not patient, not careful, or have been interrupted. The total response rate was 71.78% and the active response rate was 68.67%.

3.3.7 Quantitative data analysis

Data obtained from semi-structured interviews were only used to formulate and design the questionnaire. The analysis tools for quantitative data in this research are Statistical Package for Social Science (SPSS) and Analysis of Moments Structure (AMOS). Questions regarding general personal information, capability of mobile devices, current uses of mobile devices for learning purposes will be presented in graphical ways for analysis, for instance, pie chart, histogram, and frequency table. As for degree questions connected with constructs in TAM, obtained data will be analyzed via both Pearson Correlation tests and Structural Equation Modeling (SEM), in order to not only test the hypotheses, but also understand students' perceptions and attitudes. The Pearson Correlation Coefficients is used to assess the strength of relationship between two variables (Saunders et al., 2007). The Structural Equation Modeling (SEM) can be viewed as a combination of factor analysis and regression or path analysis (Hox & Bechger, 1998). SEM is used to study complicated relationships among variables, where several variables could be unobserved or hypothetical (Wothke, 2010). *Table 3.2* illustrates how the research questions will be answered.

Table 3.2 Quantitative analysis for research questions

Research questions	Variables	Measurement approaches	Data analysis
1. How do students perceive mobile devices as a learning tool incorporated in class and what are their attitudes towards mobile learning?	<ol style="list-style-type: none"> 1. External variables (PMV, PSIV, POQ, PEx, PE) 2. Key determinants (PU, PEOU) 3. Attitude towards using 4. Behavior intention 	<ul style="list-style-type: none"> -To find the nature of the data; mean, percentage, standard deviation -To find the relationship among the variables 	<ul style="list-style-type: none"> - Descriptive frequencies and percentages procedure - Pearson Correlation statistics
2. What are the motivational variables that affect students' acceptance of mobile learning?	<ol style="list-style-type: none"> 1. External variables (PMV, PSIV, POQ, PEx, PE) 2. Key determinants (PU, PEOU) 3. Attitude towards using 4. Behavior intention 	<ul style="list-style-type: none"> -To find the regression equation to predict the students' acceptance towards intention to use. -To find significant path coefficients among the proposed model -To explain the motivational variables in predicting behavior intention 	<ul style="list-style-type: none"> -Structural Equation Modeling (SEM) by using AMOS -Path analysis

3.3.8 Time horizon

The time horizon of a research study can be either longitudinal or cross-sectional. According to Saunders et al. (2007), longitudinal studies are similar to ‘diaries’ and can be representation of events over a given period. Cross-sectional studies mean studies of a particular phenomenon (or phenomena) at a particular time, like a ‘snapshot’. The main advantage of longitudinal research is the capacity that it has to study change and development. The authors are aware of the advantages brought by longitudinal studies. However, due to time and resource constraints issues, the authors decided to adopt a cross-sectional approach. The study focuses on a single point in time rather than over a period of time.

3.4 Research credibility

For research to have the potential to create new knowledge, it must be viewed as credible. Research that is not seen as credible is unlikely to be accepted as a contribution to a larger body of knowledge (O’Leary, 2004). As Saunders et al. (2007) suggested, research credibility is demonstrated by reliability, validity, and generalizability. The reliability, validity, and generalizability of this research will be discussed below, and the reliability and validity of the collected primary data will be addressed in the Empirical Study section.

3.4.1 Reliability

Reliability mainly refers to the consistency of the results gathered (Gratton et al., 2010). There exist three forms of reliability that are significant to the researcher: inter-observer reliability, the extent to which various observers would provide alike scores to the same phenomenon; test-retest reliability, the extent to which the research would offer the same assessments if echoed at another time; and internal consistency reliability, the extent to which every question within a measure is actually gauging the same phenomenon (Gratton et al., 2010). The authors adopted internal consistency to assess the reliability of the questionnaire. Every question in the questionnaire was reviewed independently with the research topic and objective. Additionally, the authors designed the questions in a way that correlate with other questions in the same construct, in order to ensure internal consistency reliability. The internal consistency was measured with Cronbach’s Alpha.

Also, if more students answer the questionnaire, the research result will be more reliable. The authors were trying to reach as many students as possible within the limits of time and resources.

3.4.2 Validity

Validity is related to whether the findings are really about what they appear to be about (Saunders et al., 2007). Internal validity in relation to questionnaires refers that what you find with your questionnaire actually represents the reality of what you are measuring (Saunders et al., 2007). The authors will assess the validity of this research based on content validity. According to Saunders et al. (2007), content validity refers to the extent to which the assessment questions in the questionnaire provide adequate coverage of the investigative questions.

According to *Appendix 4* and *Appendix 5*, all the questions in the questionnaire are designed in accordance with TAM. The questionnaire is divided into several sets, each set corresponding to a certain block in TAM. To answer the research questions, TAM was used to examine and analyze the collected data. Therefore, answers to questions in the questionnaire can answer the research questions plausibly. The authors invested a large

amount of effort on collecting, interpreting, and analyzing the primary data collected through interviews and questionnaires to ensure the reliability and validity of this research study.

The data validity was tested by AVE (Average Variance Extracted), which measures the shared or common variance in an latent variable, the amount of variance captured by a latent variable regarding the portion of variance caused by its measurement error (Dillon & Goldstein, 1984). The results of measured AVE will be discussed the chapter of Empirical Study.

3.4.3 Generalizability

Generalizability refers to the external validity of a research. It questions whether the findings can be generalized or applicable to other research settings (Greenberg & Shroder, 2004). Since these three investigated universities were not selected randomly, they cannot statistically represent the average top university level in China. However, the authors consider that if other universities have similar conditions as these three universities (e.g. size, education qualities, e-learning platform, and hardware facilities), the result of this research could be conceptually generalized to those universities.

4 Empirical study

This study was designed to investigate students' perceptions and intentions of using mobile learning in three Chinese universities; Sichuan University, Wuhan University, and Huazhong University of Science and Technology. The questionnaire was distributed to 450 students in these three universities, and a total number of 309 valid questionnaires were collected.

4.1 Demographics of students

The demographics of students contain background information, including gender, school belonging, education degree, ownership of smart mobile devices, major, and capability of mobile devices.

The number of male students represented 58.9%, whereas female student was less than male, representing 41.1%. Students were almost equally distributed in these three universities. The majority of questionnaire respondents were bachelor students, which occupies at an astonishing percentage, 82.5%, followed by 15.9% master students, and 1.6% students who are PhD or higher. As for major, students studying Engineering and Humanities & Social Science, were dominant, 17.5% and 17.2% respectively (see *Appendix 6*). Since different universities may have various academics focuses, certain majors in a specific university may admit more students than other majors. An explanation for the highest percentage in major could be that Huazhong University of Science and Technology emphasizes Engineering. The majors of investigated students are illustrated in the following pie chart (see *Appendix 7*). Therefore, the majority of students of this university study Engineering and Science.

The ownership of mobile devices is shown in *Figure 4.1*. As for the highest percentage, 218 out of 309 students have smart phones. The number of students with none of these devices is 27, which is comparably a very small amount, provided that the total sum is 309.

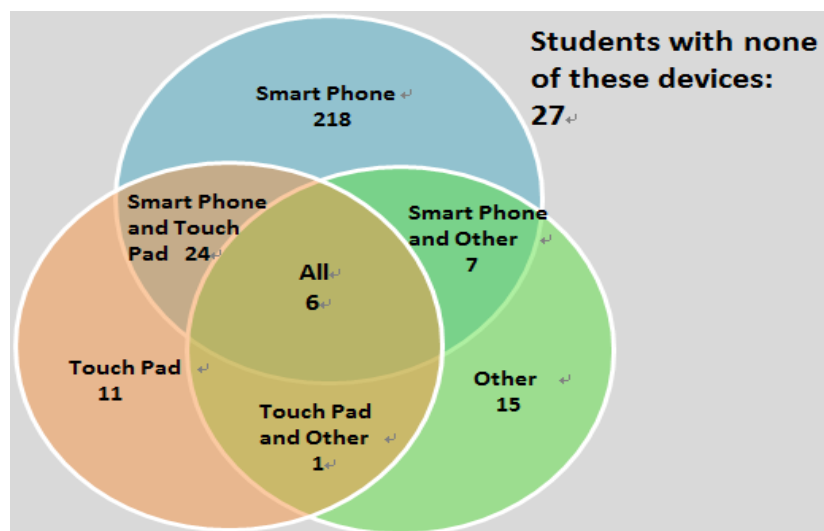


Figure 4.1 Venn Diagram for mobile devices ownership

Detailed descriptive statistics regarding Capabilities, the number of students choosing each option, are shown in *Figure 4.2*. C1-15 represent in sequence that the student is able to skillfully use mobile devices to check Internet news (C1), for e-booking and e-shopping (C2), to download applications (C3), to download interesting podcasts (C4), to watch videos and listen to music (C5), to process pictures (C6), to deal with calculations (C7), to set a reminder/alarm for a coming event (C8), to translate a foreign language (C9), to send messages and emails (C10), to access a social network site (C11), to remotely control personal computer (C12), to subscribe some services by sending messages (C13), to search needed information (C14), and to play games (C15). The first option was chosen by 278 students, which is the highest frequency.

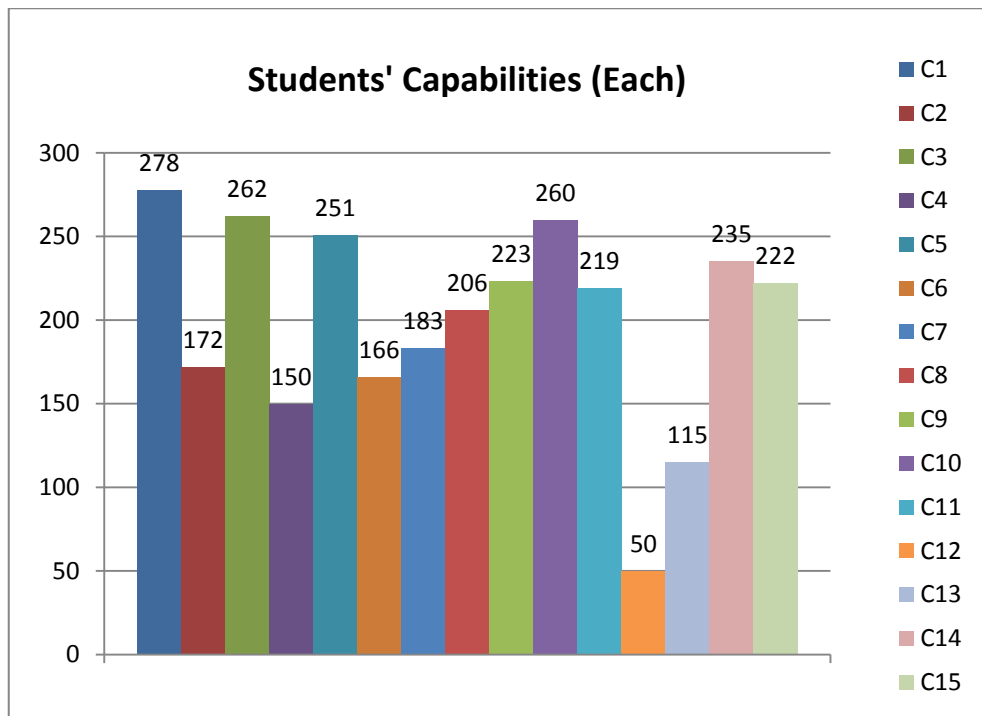


Figure 4.2 Students' Capabilities for each option

In order to see the categorization of Capabilities easily, the number of students choosing capability options was grouped. Since this Capabilities question is a multiple choice question, students who choose 7 options were tagged 7 within this question. Students choosing 11-15 options represented the highest percentage, followed by 6-10 options, and finally 0-5 options (see *Figure 4.3*).

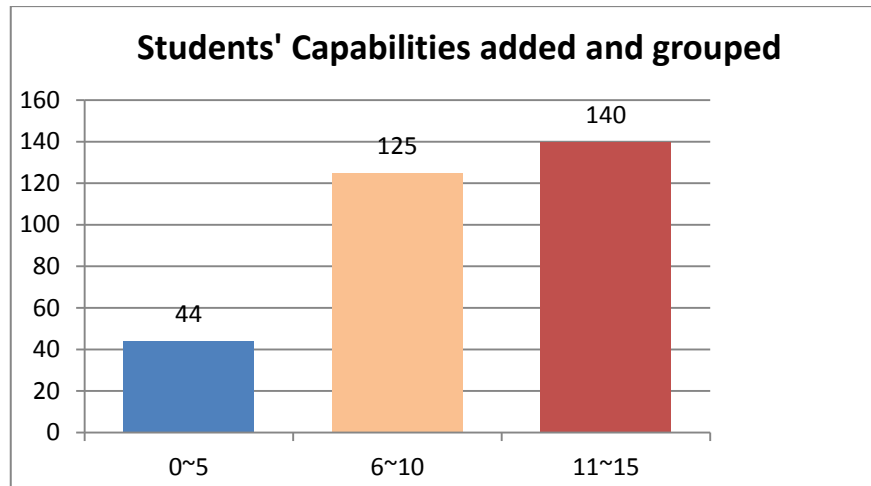


Figure 4.3 Students' Capabilities added and grouped

4.2 Analysis of proposed TAM model

This section collects and presents primary data associated with the proposed TAM model, and provides results from the statistical analyses of SPSS and AMOS.

4.2.1 Measurement assessment

Before examining the proposed model, it is necessary to test the reliability and construct validity. According to Mitchell (1996), internal consistency is one of the common approaches to assess reliability. Internal consistency encompasses correlating the responses to each question in the questionnaire with those to other questions in the questionnaire (Saunders et al., 2007). This study uses the Cronbach's alpha or coefficient alpha to evaluate the internal consistency reliability. All measures were expected to have higher reliabilities than 0.70. Coefficient alpha of 0.70 is normally adequate (Polit & Beck, 2004). The coefficients of each of the constructs are presented in *Table 4.1*. All constructs of the questionnaire exceeded 0.70 in Cronbach's alpha value.

Construct validity relates to the extent to which the measurement questions actually measure the presence of those constructs that they are intended to measure (Saunders et al., 2007). Average Variance Extracted (AVE), the average variance shared between a construct and its measures (Fornell & Larcker, 1981), is used to assess the construct validity. According to Chin (1998), construct validity is adequate when constructs have AVE loading greater than 0.50, which means that at least 50% of measurement variance was captured by the construct. *Table 4.1* demonstrates the AVE scores for the constructs in the proposed model. The AVE scores for all construct items exceeded 0.50.

Table 4.1 Summary of reliability and validity

Constructs items	Cronbach's alpha	Average (AVE)	Variance	Extracted
Perceived usefulness (PU)	0.834		0.580	
Perceived mobility value (PMV)	0.797		0.500	
Perceived social interaction value (PSIV)	0.784		0.557	
Perceived enjoyment (PE)	0.739		0.592	
Perceived ease of use (PEOU)	0.846		0.581	
Perceived output quality (POQ)	0.900		0.532	
Attitude (ATT)	0.829		0.589	

4.2.2 Descriptive analysis

Similar to the previously mentioned Capability multiple choice question, the obtained data concerning Prior Experience (PEX) multiple choice question was presented in an alike way. Detailed descriptive statistics regarding PEX, the number of students choosing each option, are shown in *Figure 4.4*. Students choosing 6-10 options represent the highest percentage, followed by 0-5 options, and finally 11-15 options (see *Figure 4.5*).

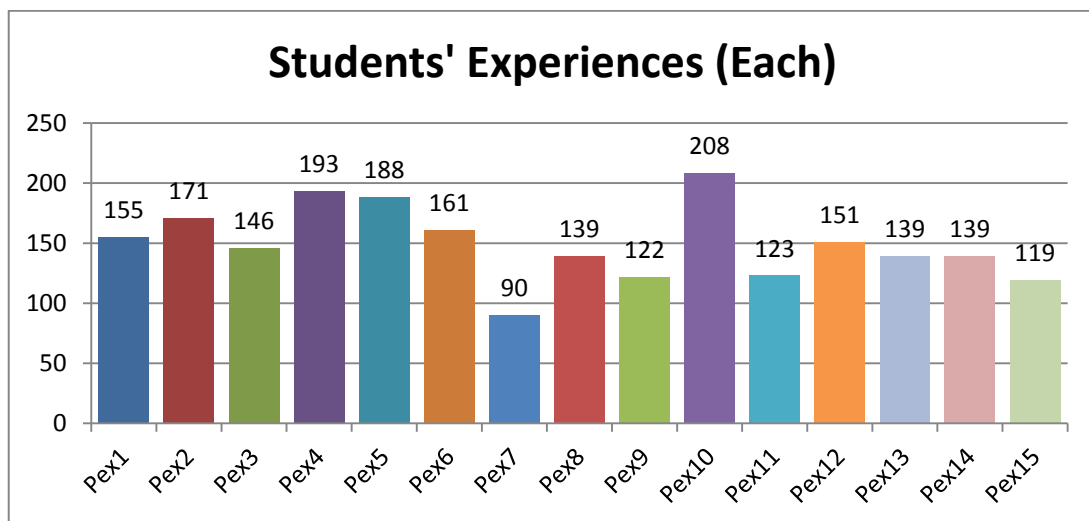


Figure 4.4 Students' Prior Experiences for each option

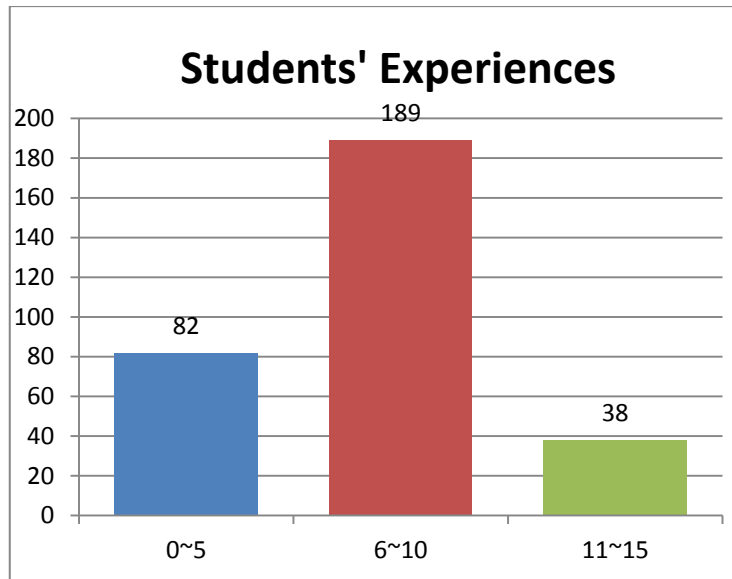


Figure 4.5 Students' Prior Experiences added and grouped

All the degree questions are in Likert-style, 1 representing Strongly Disagree and 5 representing Strongly Agree. The mean and standard deviation of each question and each block were calculated (See *Appendix 8*). Standard deviation represents how much variation in responses exists from the mean. A low standard deviation dictates that the data tend to be very close to the average. All the means are between 3 and 4. As for the means of each block in the proposed TAM model, the largest mean occurs in *Perceived Enjoyment*. The calculated mean for *Attitude* is 3.55, and for *Behavioral Intention* is 3.50.

In order to examine the proposed TAM model, relations between blocks should be tested. A correlation analysis was carried out based on each of these constructs in the proposed model. Pearson Correlation aims at exploring the strength of the relationships between continuous variables (Pallant, 2001). Correlations between variables, including each construct in the proposed model, were tested at significance level 0.05.

The results of the Pearson Correlation analysis are presented *Table 4.2*. Correlation testing results regarding proposed eleven hypotheses are highlighted. Each construct in the presented hypothesis has a relation with the other construct within the hypothesis. The correlation coefficients of the 10 hypotheses are colored in grey. Among these eleven relations, the relationship between ATT and BI (0.536) demonstrates the highest correspondence. The least correlation coefficient (0.092) occurs in the relationship between PSIV and PU.

Table 4.2 Correlation coefficients between the components of proposed TAM

	PE _x	PU	PMV	PSIV	PE	PEOU	ATT	BI	POQ
PE _x	1								
PU	.195**	1							
PMV	.226**	.444**	1						
PSIV	.034	.092*	.051	1					
PE	.091	.307**	.348**	.172**	1				
PEOU	.139*	.386**	.433**	.084	.249**	1			
ATT	.141*	.521**	.439**	.030	.305**	.380**	1		
BI	.096	.476**	.267**	.185**	.228**	.204**	.536**	1	
POQ	.200**	.397**	.347**	.051	.354**	.395**	.296**	.246**	1

* Pearson's correlation is significant at the 0.05 level (two-tailed)

** Pearson's correlation is significant at the 0.01 level (two-tailed)

4.2.3 Path Analysis

The suggested hypotheses were examined by formulating a Structural Equation Modeling (SEM) analysis (See *Appendix 9*) to estimate the causal relationships among the constructs. The results of the SEM analysis are shown in *Figure 4.6*.

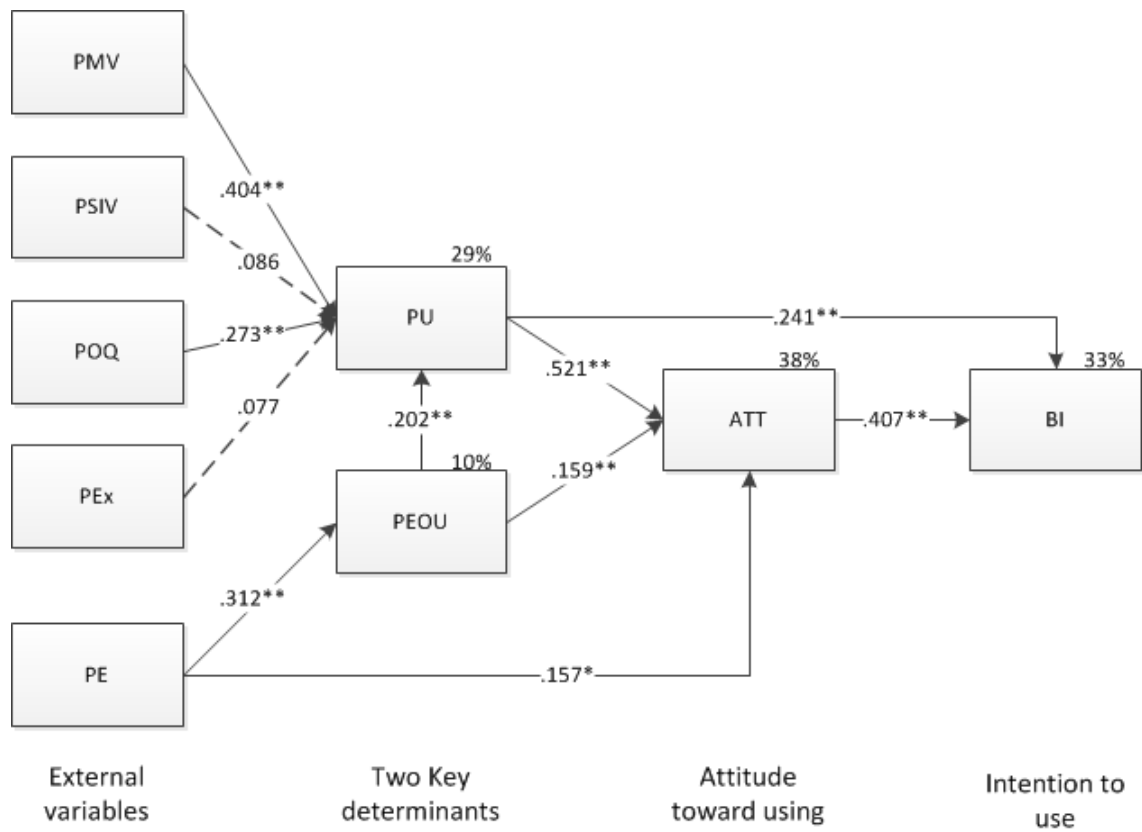


Figure 4.6 Results of Structural Equation Modeling (SEM) analysis

Key:

- PMV=Perceived Mobility Value
- PE=Perceived Enjoyment
- PU=Perceived Usefulness
- PEOU=Perceived Ease of Use
- ATT=Attitude
- BI=Behavior Intention
- POQ=Perceived Output Quality
- PEx=Prior Experience
- PSIV=Perceived Social Interaction Value

Note:

* significant at a 0.05 level ** significant at a 0.01 level

In order to provide a clear view of the path analysis of proposed TAM model, the authors divided model structure into four multi-regressions. There are four endogenous variables connected to several exogenous variables, *Table 4.3* shows the causal relationship between them among the paths.

Table 4.3 Four paths in multiple regression analysis in proposed TAM

Path analysis	Exogenous variables	Endogenous variables	R ²
Regression 1	<ul style="list-style-type: none"> • Perceived Mobility Value • Perceived Social Interaction Value • Perceived Output Quality • Prior Experience • Perceived Ease Of Use 	Perceived Usefulness	0.29
Regression 2	<ul style="list-style-type: none"> • Perceived Enjoyment 	Perceived Ease Of Use	0.10
Regression 3	<ul style="list-style-type: none"> • Perceived Usefulness • Perceived Ease Of Use • Perceived Enjoyment 	Attitude	0.38
Regression 4	<ul style="list-style-type: none"> • Perceived Usefulness • Attitude 	Behavior Intention	0.33

Regression 1

According to *Table 4.3*, four external variables and one endogenous variable are all connected PU. Two exogenous variables fail to support the causal-and-effect relationship on PU, namely PSIV and PEx (path coefficient are 0.086 and 0.77 respectively). However, compared to other supported hypotheses, PMV has the most influential effect on PU, which means that students emphasize the mobility value of mobile devices for learning purposes (0.404). Meanwhile, POQ and PEOU positively affect PU (0.273 and 0.202 separately). Nevertheless, the relationship between PSIV and PU was rejected because students show a weak willingness to use mobile devices to interact with classmates and others. They have been inclined to face-to-face communication for decades and this new form of interaction may cause uncertainty and inadaptation especially in a study context. Group work and discussions are not paid much attention to. Additionally, many students are not active enough to share their thoughts in real-time. According to *Appendix 8*, the lowest mean occurs in the construct PSIV, which may explain the rejection of this hypothesis. The causal relationship between PEx and PU was also rejected. Based on *Figure 4.5*, students do not have enough prior experiences in applying mobile devices for learning purposes. Another reason for explaining the rejection of the hypothesis might be that even if students have experiences in using mobile devices, they might not be satisfied with them. This could affect the way they perceive mobile devices' usefulness. Among the motivational variables that positively affect PU, PEOU has a weak impact. To summarize, PU was the first endogenous variable analyzed, and PMV, PSIV, POQ, PEx, PE, and PEOU explained 29% of the variation of PU.

Regression 2

As for regression 2 path analysis, the relationship between PE and PEOU is supported (path coefficient 0.312). In *Appendix 8*, the mean of PE is the highest, which insulates that students perceive enjoyment as the most significant issue towards learning purposes. Because for most youngsters, they are keen on finding things of interest during the learning process. When they find anything that interests them, they will feel less frustrated and find

it more enjoyable and easier to use. Furthermore, PE accounted for 10% of the variance explained in PEOU.

Regression 3

According to *Figure 4.6*, PU has a strong causal relationship with ATT (0.521). Compared to the linkage between PU and ATT, PEOU and PE support this relationship weakly (0.159 and 0.157), which means that ATT is more determined by PU than PEOU and PE. If there are more students perceiving the tool useful, there will be more users that are positive towards it, and vice versa. PU, PEOU, and PE occupied 38% of the variation explained in ATT.

Regression 4

ATT (0.406) contributes more causal influences on BI than PU (0.241) does, which indicates that BI is more dependent on ATT (*Figure 4.6*). ATT and PU explained 33% of the variation of BI.

4.2.4 Summary of empirical studies

Overall, respondents show positive attitudes towards mobile learning, but not any obvious willingness to adopt it. The means of ATT and BI are 3.53 and 3.48 respectively. Moreover, as can be seen from *Appendix 8*, the mean of students' perceived usefulness is 3.48, which indicates that the general perceptions of students on usefulness is slightly positive. The students' perceived efforts of using mobile learning is measured as 3.71, which means that the students are holding positive perceptions towards the efforts that are required in using mobile learning. Other factors are also ranged between 3.11 and 3.93. This range reflects that students perceive mobile learning positively, while showing a not so strong willingness to adopt it. The answers to the open questions of that are summarized below, give further evidence for the reasons behind students responses.

Advantages

- ✓ More interesting
- ✓ More convenient and interactive
- ✓ Easier access to learning materials
- ✓ Focused study
- ✓ Establish learning groups
- ✓ Convenient delivery and easy to duplicate

Limitations

- ⊗ High costs
- ⊗ Conflict of educational methods
- ⊗ Coverage and hardware issues of 3G network
- ⊗ Lack of self-motivation in learning
- ⊗ Lack of guidance and effective assessment
- ⊗ Lack of governmental support and promotion
- ⊗ Can not replace traditional learning completely
- ⊗ Intellectual property issues

Those limitations, which are stated by most of the students, insulate that students' attitudes towards mobile learning are positive but not strongly positive. If the above-mentioned limitations can be diminished in the near future, mobile learning could be developed and utilised to a larger extent.

Through path analysis, out of the eleven hypotheses, nine hypotheses were supported and two were rejected (Table 4.4).

Table 4.4 Summary of hypotheses testing results

Path coefficient	Hypotheses	Results
PMV→PU	H1	SUPPORTED
PSIV→PU	H2	REJECTED
POQ→PU	H3	SUPPORTED
PE _x →PU	H4	REJECTED
PE→PEOU	H5	SUPPORTED
PE→ATT	H6	SUPPORTED
PEOU→PU	H7	SUPPORTED
PEOU→ATT	H8	SUPPORTED
PU→ATT	H9	SUPPORTED
PU→BI	H10	SUPPORTED
ATT→BI	H11	SUPPORTED

End-users' *Behavior Intention* is affected by their *Attitude* and *Perceived Usefulness*, where the former variable is more influential than the latter. This may be due to that *Attitude* is influenced by *Perceived Usefulness*, *Perceived Ease Of Use*, and *Perceived Enjoyment*. On the other hand, *Behavior Intention* of students is influenced by *Perceived Usefulness* and *Attitude*. Since *Attitude* is also influenced by *Perceived Usefulness* and *Perceived Ease Of Use* (which in turns influence *Perceived Usefulness*), *Attitude* exerts more influences on *Behavior Intention* than *Perceived Usefulness* does. Moreover, the external variables including *Perceived Social Interaction Value*, *Prior Experience*, *Perceived Mobility Value*, *Perceived Output Quality*, and *Perceived Enjoyment* also have influences on *Attitude* and *Behavior Intention*. By drawing influences on *Perceived Usefulness* and *Perceived Ease Of Use*, these external variables indirectly influence students' acceptance of mobile learning.

To summarize, *Perceived Usefulness* has direct influences on *Attitude* and *Behavior Intention*, while *Perceived Ease Of Use* has direct effects on *Attitude*. *Perceived Usefulness* and *Perceived Ease Of Use* mainly decide student's acceptance of mobile learning. Three external variables, namely *Perceived Mobility Value*, *Perceived Output Quality*, and *Perceived Enjoyment*, proved to have significant but indirect influences on student's acceptance of mobile learning. The results indicate that the higher the degrees of these external variables, the more the students are willing to adopt mobile learning. While students are considering if they are going to adopt mobile learning, they may first reflect on their subjective views of mobile learning. And these subjective views are mainly decided by the external variables, *Perceived Mobility Value*, *Perceived Output Quality*, and *Perceived Enjoyment*.

5 Conclusions

This thesis studies and explains students' acceptance towards mobile learning in three top Chinese universities, based on the proposed TAM model. The factors of the proposed model were tested in a questionnaire-based empirical study, with questions constructed as five-point rating scales (Likert scales). The research questions of this study are answered as follows:

Research question 1

How do students perceive mobile devices as a learning tool incorporated in class and what are their attitudes towards mobile learning?

In general, students perceive mobile learning moderately positive. Students are positive towards mobile learning (*Attitude* mean 3.53), but they do not have a strong willingness to adopt it (*Behavioral Intention* mean 3.48). Mobile devices as a learning tool is perceived to be easier to use (*Perceived Ease of Use* mean 3.71) compared to how its usefulness as a means for learning purposes is perceived (*Perceived Usefulness* mean 3.48). Additionally, from students' perspective, mobile learning can provide enjoyable experiences (*Perceived Enjoyment* mean 3.88), and the highest mean value indicates that it is interesting to adopt mobile learning. *Perceived Social Interaction Value* is considered the least positive value (mean 3.13). Other factors, *Perceived Mobility Value* (3.55) and *Perceived Output Quality* (3.60) are around 3.50; therefore, students perceive these two factors marginally positive. As for *Prior Experience*, very few students are fairly skilled at using mobile devices for learning purposes.

Research question 2

What are the motivational factors that affect students' acceptance of mobile learning?

Research question 2 is also answered as a part of the proposed model. The aim of this question is to understand the motivational factors that affect students' acceptance for mobile learning.

In general, students' acceptance is determined by their attitudes and the usefulness they perceived, where *Attitude* is more influential than *Perceived Usefulness*. Meanwhile, *Attitude* is explained by three factors, *Perceived Usefulness*, *Perceived Ease Of Use*, and *Perceived Enjoyment*, and the most influential factor for *Attitude* is *Perceived Usefulness*. *Perceived Usefulness* is explained by two external variables, *Perceived Mobility Value* and *Perceived Output Quality*; meanwhile *Perceived Ease Of Use* has a slight influence on *Perceived Usefulness*. *Perceived Enjoyment* has a direct and positive casual relationship with *Perceived Ease Of Use*.

6 Discussion

The primary purpose of this study was to test and examine the proposed TAM model in explaining students' acceptance of mobile learning in three top Chinese universities. Additionally, to explain the influence on students' acceptance of mobile learning, the perceptions of students were investigated and several factors related to the proposed TAM model were tested. According to the result of this research (*Chapter 5*), two factors (Perceived Social Interaction Value and Prior Experience) were rejected and seven factors were supported.

6.1 Discussion of the proposed TAM

Behavioral Intention

As the result shows, the variance explained on *Behavioral Intention* is 33%, which is lower than compared to a previous study by Huang et al. (2007), which was conducted in the same context and showed that 60% of the variance in results was explained by *Behavioral Intention*. This indicates that there must be some factors other than those proposed in the research model of this study that influence users' *Behavioral Intention* on mobile learning. However, another research by Mao, Srite, Thatcher & Yaprak (2005) studied the mobile service behavior in U.S. and Turkey using a modified TAM model, showed that the variance explained by *Behavioral Intention* varied in terms of the different regions where the data were collected. Hence, the reason for the low explanatory value of *Behavioral Intention* in this study might be factors connected to the region where the data was collected. Additionally, in accordance to the previous study by Huang et al. (2007), *Attitude* exerts a much stronger influence on *Behavioral Intention* than *Perceived Usefulness*. In contrast, Kowitlawakul (2008) found that *Perceived Usefulness* influences *Behavioral Intention* stronger than *Attitude* in a research study conducted in the area of e-healthcare. Thus, different cultural contexts and research areas might lead to different results on end-users' acceptance of information technologies.

Attitude

The variance explained by students' attitudes towards mobile learning is 38%, which is lower than the study conducted by Huang et al. (2007). The study by Huang et al. showed that the explanatory value of *Attitude* was 57%. Still, this might be caused by the different regions of data collection. Moreover, *Perceived Usefulness* has a stronger influence on *Attitude* than *Perceived Ease Of Use*, which implies the similar result as previous studies by Huang et al. (2007), Davis (1989), and Venkatesh & Davis (2000). However, this paper found that the coefficient of *Perceived Ease Of Use* is slightly higher than *Perceived Enjoyment*, which is contradictory to Huang et al.'s result.

Two key determinants (*Perceived Ease Of Use* and *Perceived Usefulness*)

Like in previous research (Huang et al., 2007), *Perceived Ease Of Use* has a significant influence on *Perceived Usefulness*. However, as the factors proposed in External Variables which influence *Perceived Usefulness* are very different from any previous research, it is difficult to compare the results with other research. As for the influence of *Perceived Enjoyment* on *Perceived Ease Of Use*, this paper obtained a similar coefficient as in Huang et al.'s (2007) study.

External Variables (*Perceived Mobility Value*, *Perceived Social Interaction Value*, *Prior Experience*, *Perceived Output Quality*, *Perceived Enjoyment*)

Five External Variables are studied in this paper. *Perceived Mobility Value*, *Perceived Output Quality* and *Perceived Enjoyment* were found to have significant positive influences on *Perceived Usefulness* and *Perceived Ease Of Use*. This finding agrees with the results of previous research (Huang et al. 2007; Davis et al., 1992; Liu, Han & Li, 2010; Kaigin & Basoglu 2006; Mallat et al. 2008; Venkatesh et al. 2000; Liaw, 2008; Yi and Hwang, 2003; Venkatesh et al., 2002). However, the other two factors in External Variables were found to have no significant influences on *Perceived Usefulness*. According to the results in this study, the relationship between *Perceived Social Interaction Value* and *Perceived Usefulness* is insignificant. This contradicts the result of previous study conducted by Dickinger et al. (2008). The reason for this might be that students consider social interaction value is not important in mobile learning, since they may already have other approaches to interact with people. On the other hand, contrary to previous studies (Taylor & Todd, 1995; Joaquín, Carla & Silvia, 2009), *Prior Experience* was found to have no significant influence on *Perceived Usefulness*. This might be due to that students' prior experience on using mobile devices could be either positive or negative, instead of only considering how fruitful their experiences are.

6.2 Implications

Perceived Mobility Value

The result of this study shows that *Perceived Mobility Value* has a strong and significant positive influence on *Perceived Usefulness*, which means that in the context of adopting mobile learning, the more mobility value students receive, the more the students are willing to use it. For advanced users in new technology, they might perceive the mobility value a significant determinant towards attitudes and acceptance. Thus, in order to implement mobile learning successfully, it is essential that the designers of mobile learning systems take the mobility issue into consideration.

Perceived Output Quality

Similar to *Perceived Mobility Value*, *Perceived Output Quality* has a significant positive influence on *Perceived Usefulness*. As consumers and learners of mobile learning, students might perceive *Output Quality* as an essential element. This indicates that when students perceive better result of using mobile learning, they will perceive it more useful, and they will have positive attitudes towards it and accept it. Therefore, mobile learning system designers and universities must collaborate with each other to make sure that the designed mobile learning system can provide appropriate teaching methods to enhance students' experience.

Perceived Enjoyment

As *Perceived Enjoyment* has a positive influence on both *Perceived Ease Of Use* and *Attitude*, it is necessary to address this issue while adopting mobile learning. As consumers and learners, when a mobile learning system provides more enjoyment, users are more willing to use it. Hence, universities should consider possible ways to provide students with an enjoyable learning environment as an intrinsic motivation to attract and entertain students. On the other hand, when it comes to the designing phase, designers must also take this issue into consideration. Both the interface and function of the mobile learning device and software should be able to offer enjoyment.

6.3 Methodology discussion

This study could be improved through better questionnaire design. While summarizing the Empirical Study, the authors realized three issues that could enhance the quality of this re-

search. First of all, Structural Equation Modeling needs three manifest variables for each latent factor, whereas *Perceived Enjoyment* only contains two questions to measure it and *Behavioral Intention* merely has one question to assess it. Secondly, since the questionnaire design is partly based on the semi-structured interviews and partly literature review, the interviews do not cover all the majors of the students. Due to time and resource limitations, the author only selected five students from different majors in each investigated university. The study would have been more comprehensive if the interviewees could come from all the majors. Finally, as for measuring *Prior Experience*, the questions merely measure how fruitful students' experiences are. Whether students are positive or negative regarding *Prior Experience* in mobile learning was not taken into consideration.

6.4 Suggestions for further research

Extend to other top Chinese universities

This research is targeted at three top Chinese universities. More efforts should be required to extend this research to other top universities in order to gain a comprehensive view of acceptance within higher education in China.

Search for other factors

Going back to the proposed model in this research, the external variables were the primary factors that influenced two key determinants (*Perceived Usefulness* and *Perceived Ease Of Use*). Compared with other reviewed studies, the degree of explanation for each dependent factor is not very high, which means that there might have been more than three factors (*Perceived Mobility Value*, *Perceived Output Quality* and *Perceived Enjoyment*) that affected the two key determinants specified in previous chapters. Those unnoticed factors might be Technology Anxiety and Major Relevance. Further investigation on those external variables need to be conducted. Therefore, the model modification needs to be improved in the near future. Furthermore, two factors (*Perceived Social Interaction Value* and *Prior Experience*) issued from previous research within different fields, such as online gaming and e-shopping, have been found to be statistically significant, but were not so in this study. *Perceived Social Interaction Value* and *Prior Experience* might need to be further investigated in other fields.

Extend to other cultural contexts

In future studies, the impact of culture on mobile learning acceptance could be studied in experimental settings. Studying mobile learning within experimental settings would require a similar planned mobile learning environment supported by similar technologies and devices, and it is better to be test it in different countries.

Compare attitudes between students and teachers

Another interesting road for further study is to compare attitudes and acceptance between students and faculty towards mobile learning adoption. It might be interesting to know whether students' attitudes of mobile learning match teachers' attitudes.

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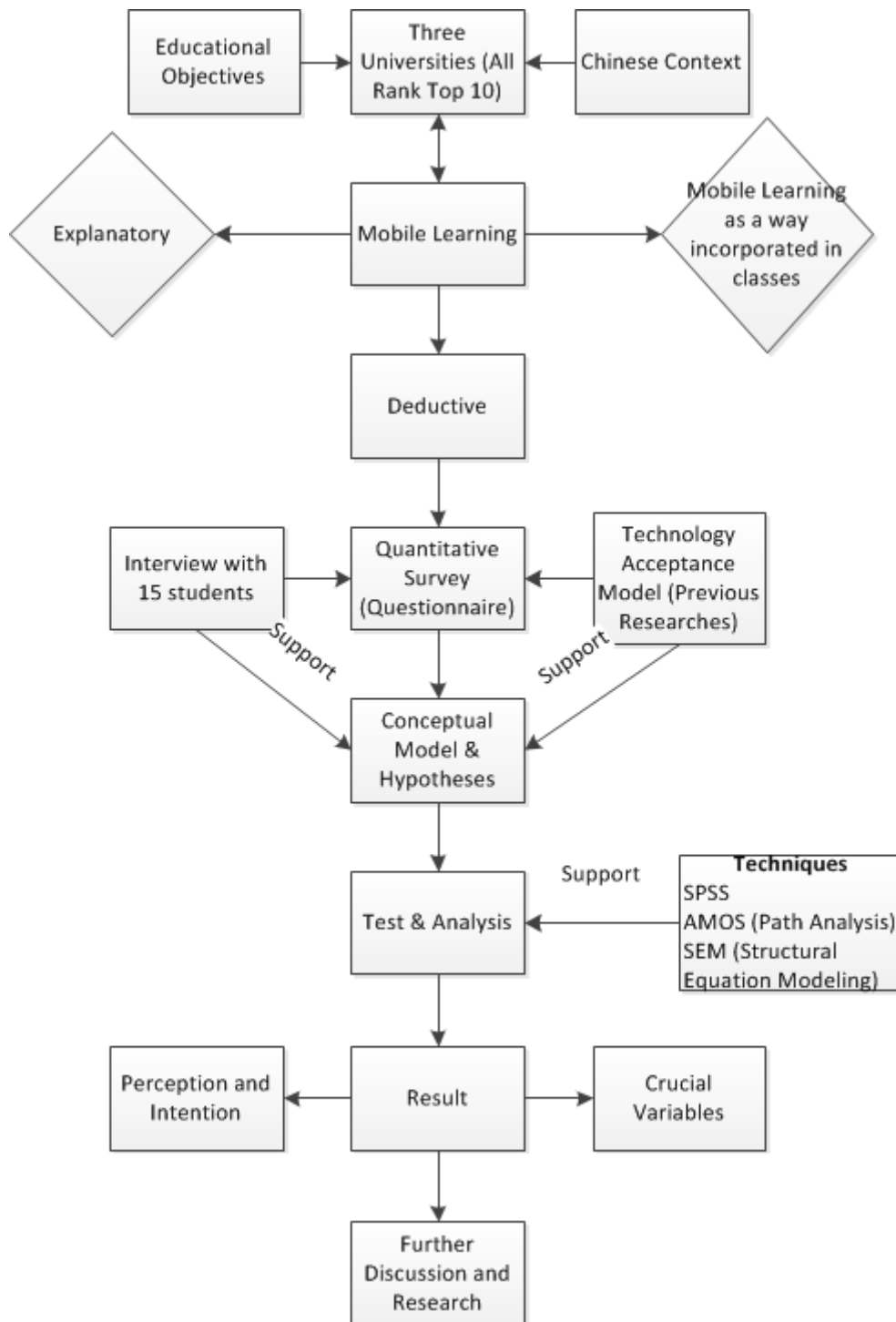
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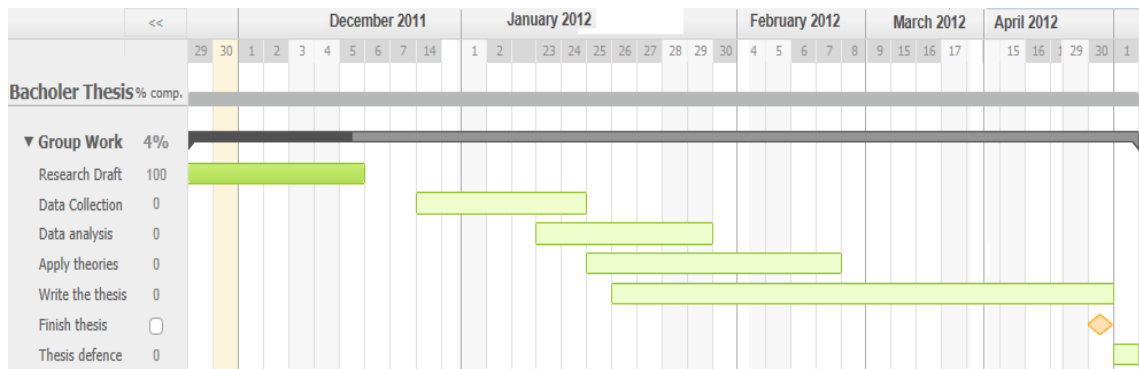
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Appendix I Research design



Appendix 2 Time plan



Appendix 3 Characteristics of studies: What are student perceptions of mobile learning? (n=18) (Pollara & Broussard, 2011, p.28-31)

Author (year)	Technology used	Type of interaction the technology used to support	Learning tasks	Perceptions identified in the study	Outcome measured	Results/ conclusion
Al-Fahad (2009)	Mobile Phone	Student/content, student/instructor	Not defined	Students found m-learning effective and widely embraced the technology, students noted portability	Attitude	Positive
Bottentuit Junior (2008)	Mobile phone	None Specified	None Specified	39% had heard the term m-learning; 25% reported using a mobile device for some sort of learning; vast access to information at any time/place majority believed educational potential of mobile devices & would like to use them in the classroom; students stated that they saw m-learning in the future & was good	Attitude, engagement	Positive
Cavus & Ibrahim (2009)	Mobile phone	Student/instructor	Practice	Students believed that the system brought greater flexibility to their learning; interest of students to use mobile phones has helped them to learn new words; students wanted the system to be used in other classes	Achievement, Attitude	Positive
Cavus & Uzunboylu(2009)	Mobile phone	Student/Instructor, student/student	Individual projects, group discussion, assessment	Students attitudes toward the usefulness of a mobile learning system improved by the end of the experimental	Attitude	Positive

Clarke et al (2008)	Mobile Phone	Student/content	Practice	84% of students found the SMS concept worthwhile & 83% enjoyed it. Students see this as the best medium because of convenience; portable message -no computer needed -preferred method over other methods (WebCT, daily podcast, email, Moodle)	Attitude, Engagement	Positive
Garrett & Jackson (2006)	PDA's	Student/instructor, student/student	Reference tool, practice	Positive attitudes to the use of PDA based tools and portfolio	Attitude, engagement	Mixed
Guenther, Winkler, Ilgner & Herczeg (2008)	PDA's	Student/content, Student/student	Group projects, group discussion	Students reported a high level of competence with handling mobile devices "23 out of 29 students confirmed that different pieces of information, such as sounds, pictures, and shapes come to their mind when they think of the cathedral"	Attitude	Positive
Hsu, Wang, & Comac (2008)	Mobile phone, telephone	Student/content, student/instructor	Individual projects, assessment, practice	76% of students found it easy to audio blog, 76.4% preferred audio blogs to audiotapes, 82.41% believed it was a good language-learning tool, 64.7% reported stronger confidence in using English than before	Achievement, Attitude, Engagement	Positive
Karimi, Hashim, & Khan (2010)	Not defined	Student/content, student/instructor,	Not defined	Students tended to only access the materials via Internet when required	Attitude	Positive
Maag (2006)	iTunes, MP3 player of choice	Student-instructor, student-content	Teacher directed lecture, assessment	79% reported they thought listening to podcasts assisted their learning, 55% reported podcasts as very valuable experiences; 29% valuable experiences; 81% requested enhanced podcasts in the future	Attitude	Positive
Maniar (2007)	Mobile phone, PDA	Student/content	Individualized learning of content	Students had a positive response to questions, believed they could study & learn from this medium, preferred larger screens (saw them as more positive experience); overall positive attitudes to m-learning	Attitude	Positive

Rogers, et al (2010)	LillyPad application on PDAs	Student/content, Student/student	Group projects, group discussion	Student quotes show excitement and interest in this activity	Attitude, engagement	Positive
Shih, et al (2010)	Hyperbook/ Hyperpen	Student/content	Individualized learning of content	Sense of fulfillment, students thought the system could monitor behavior accurately, self-evaluation system helped them	Achievement	Positive
Uzunboylu, Cavus, & Ercag (2009)	Mobile Phone	Student/instructor, student/student, student/content	Individual projects, group discussion, assessment	Majority of students liked using the mobile devices for learning; students realized the potential use of mobile technologies for learning in any subject and perceived importance of using discussion tools with m-learning	Attitude	Positive
Venkatesh, et al (2006)	Mobile phones, PDA	Student/content	Practice	Students who already had the phones were much more excited - expense was a deterrent	Attitude	Positive
Wang, et al (2009)	Mobile phone (text messages)	Student/content, Student/student,	Teacher directed lecture, group discussion, assessment	Students showed strong interest in m-learning, students uncharacteristically provided candid feedback to the instructor in a class forum, students were satisfied with activities conducted in class	Achievement, attitude, engagement	Positive
Williams & Bearman (2008)	Mp3 players, iPods specifically	Student/content, student/instructor	Teacher directed lecture	Students who used the podcasts saw them as beneficial, those who did not use them because it was not required	Attitude, engagement	Positive
Wyatt, et al (2010)	PDAs	Student/content, student/instructor,	Individualized learning of content, group & individual projects, assessment	Little change in PDAs, but did see benefits as resources or collaborative learning tools	Attitude, achievement	Positive

Appendix 4 Questionnaire construct related to proposed TAM

Constructs	Type	Definition	Items	Sources
Perceived usefulness (PU)	Likert scale; Independent/dependent	The strength of individual's belief that using mobile learning will enhance his or her learning performance and experience	3	Davis (1989); Venkatesh & Davis (2000); Davis, Bagozzi & Warshaw (1989)
Prior experience (PEX)	Multiple-choice; Independent	The previous experience of learning or studying by using mobile devices	15	Venkatesh & Davis (2000); Taylor & Todd (1995)
Perceived mobility value (PMV)	Likert scale; Independent	The strength of individual's belief that using mobile learning because of mobility value	4	Seppälä and Alamäki (2003); Huang, Lin & Chuang, 2007
Perceived social interaction value (PSIV)	Likert scale; Independent	The strength of individual's belief that using mobile learning because of social interaction value	3	Lee and Tsai (2010); "Interview"; Joseph Walther (1996)
Perceived output quality (POQ)	Likert scale; Independent	The strength of individual's belief that using mobile learning because of output quality	8	Venkatesh & Davis (2000);
Perceived ease of use (PEOU)	Likert scale; Independent/dependent	The strength of individual's belief that using mobile learning would not require a lot of effort mentally	4	Davis (1989, 1996); Venkatesh & Davis (2000); Davis, Bagozzi & Warshaw (1989)
Perceived enjoyment (PE)	Likert scale; Independent	The strength of individual's belief that using mobile learning will fulfill his or her intrinsic motives	2	Venkatesh, Speier & Morris (2002); Huang, Lin & Chuang (2007); Yu, Ha, Choi & Rho (2005)
Attitude (ATT)	Likert scale; Independent/dependent	The strength of individual's feeling of favorableness or unfavorableness toward using mobile learning	3	Davis (1989, 1996); Venkatesh & Davis (1996, 2000); Davis, Bagozzi & Warshaw (1989); Hu, Chau, Sheng & Tam (1999)
Behavior intention (BI)	Likert scale; dependent	The strength of individual's willingness to use mobile learning	1	Davis (1989, 1996); Venkatesh & Davis (1996, 2000); Davis, Bagozzi & Warshaw; Hu, Chau, Sheng & Tam (1999) (1989)

Appendix 5 Question design in questionnaire related to proposed TAM

Capability

I am able to skillfully use mobile devices...

- To check Internet news (e.g. weather forecast)
- For e-booking and e-shopping
- To download applications
- To download interesting podcasts
- To watch videos and listen to music
- To process pictures
- To deal with calculations
- To set a reminder/alarm for a coming event
- To translate a foreign language
- To send messages and emails
- To access a social network site
- To remotely control personal computer
- To subscribe some services by sending messages
- To search needed information
- To play games

Prior experience for educational purpose

I have...

- Used mobile devices for library services (e.g. check and book studying room, or book request)
- Accessed the university website or system on mobile devices
- Downloaded course documents via mobile devices
- Downloaded an application that helped me learn new knowledge
- Used mobile devices to search for unknown knowledge during class
- Used a social network site for discussion
- Interacted and communicated with lecturers via mobile devices
- Set a reminder on mobile devices to remind me of a certain deadline
- Searched for schedules via mobile devices
- Used mobile devices to interact and communicate with classmates
- Checked study information and feedback from teachers via mobile devices (email or SMS)
- Recorded information during class (by voice recording or taking photos)
- Wrote notes on mobile devices during class
- Read an article or assignment on mobile devices
- Played an educational game on mobile devices

Perceived usefulness (PU)

PU1. To use mobile devices for learning purposes would save me a lot of time

PU2. To use mobile devices for learning purposes would enhance the effectiveness of my learning

PU3. To use mobile devices for learning would be ubiquitous and useful

Perceived mobility value (PMV)

PMV1. Mobility enables me to accomplish tasks quickly

PMV2. I know that mobile devices are the mediums for mobile learning

PMV3. Mobility enables me to access real-time data

PMV4. Unexpected problems could be fixed at the first time by using mobile devices

Perceived social interaction value (PSIV)

PSIV1. I would like to be able to launch a discussion on a learning forum through mobile devices

PSIV2. I would like to be able to interact with teachers and classmates both inside and outside class via mobile devices

PSIV3. I would like to be able to engage in class discussion if I could share my thoughts in real-time through mobile devices

Perceived enjoyment (PE)

PE1. I would feel more interested in study if I could use mobile devices

PE2. I would be entertained in my study by using mobile devices

Perceived ease of use (PEOU)

PEOU1. It would not require me a lot of mental effort to learn because I am skilled at mobile device functions

PEOU2. It would ease my learning because it allows me to study anytime, any place

PEOU3. It would be easy and clear to interact with mobile devices for learning

PEOU4. It would be easier for me to ask help from others through mobile devices

Attitude (ATT)

ATT1. I would be more encouraged to learn if I could access materials anytime, anywhere via mobile devices

ATT2. It would be desirable to use mobile devices as a way for learning

ATT3. I would like to use mobile learning in the future because it will help my study a lot

Behavioral intention (BI)

BI1. I intend to apply mobile learning when it becomes available

Perceived output quality (POQ)

POQ1. More initiative and dynamic

POQ2. More portable device, more flexible learning

POQ3. Enhances daily learning

POQ4. Utilizes the “pieces of time”

POQ5. Broadens the knowledge

POQ6. Enables high engagement

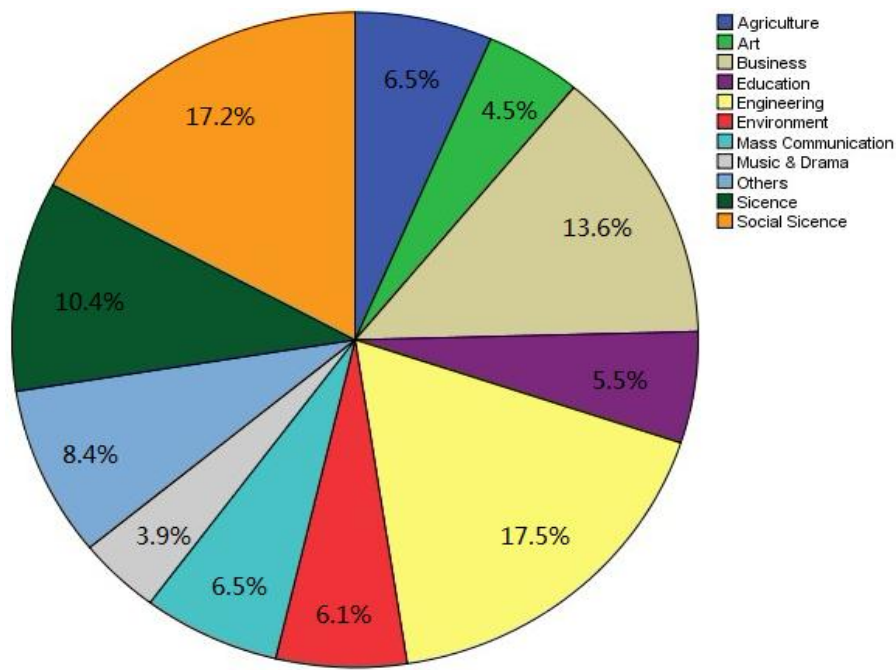
POQ7. Ensures studying effectiveness

POQ8. Provides a better alternative to study

Appendix 6 Breakdown of primary study participants

Demographic categories	Range	Frequency	Percentage
Gender	Male	182	58.9%
	Female	127	41.1%
School	Sichuan University	100	32.4%
	Wuhan University	102	33.0%
	Huazhong University of Science and Technology	107	34.6%
Education degree	Beachelor	255	82.5%
	Master	49	15.9%
	PhD or higher	5	1.6%
Major	Agriculture	20	6.5%
	Art & Design	14	4.5%
	Business	42	13.6%
	Coast and Environment	19	6.1%
	Education	17	5.5%
	Engineering	54	17.5%
	Humanities & Social Science	53	17.2%
	Mass Communication	20	6.5%
	Music & Drama	12	3.9%
	Science	32	10.4%
	Other	26	8.4%

Appendix 7 Pie chart for Major distribution

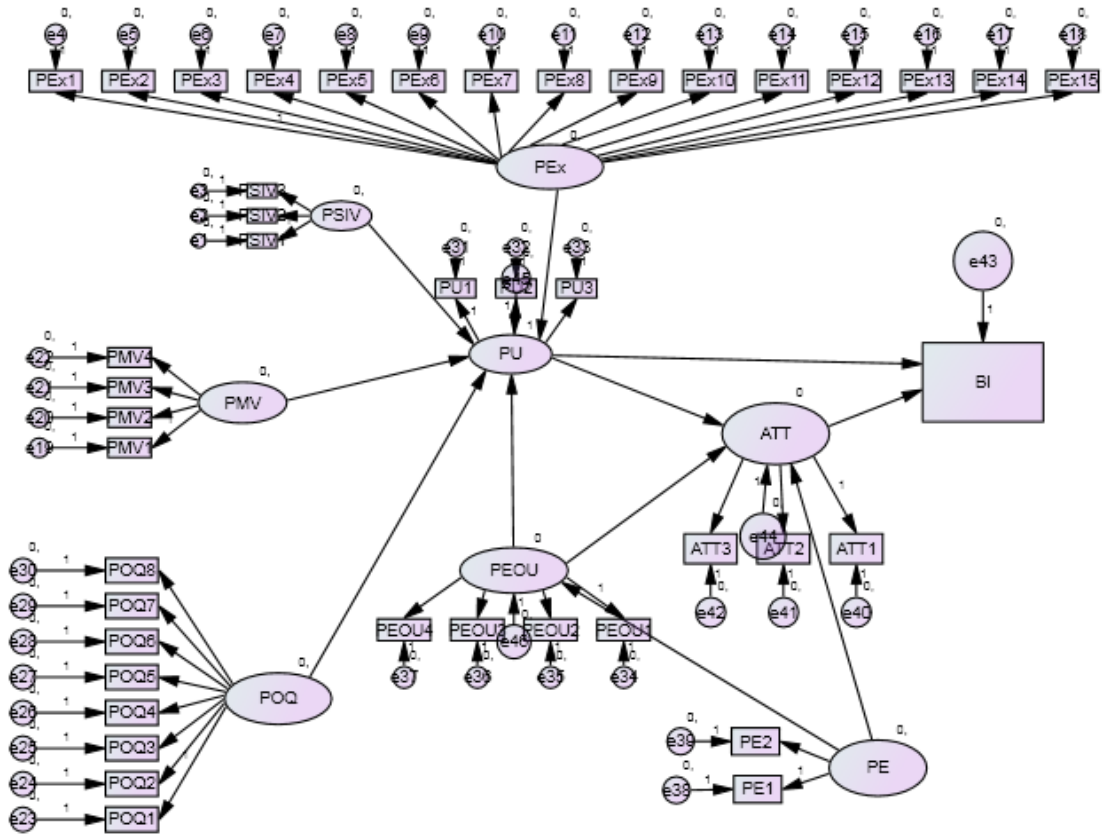


Appendix 8 Summary of Measurement Scales

Constructs items	Code	Mean	Std. Deviation
Perceived Usefulness (PU)		3.48	
To use mobile devices for learning purposes would save me a lot of time	PU1	3.50	.863
To use mobile devices for learning purposes would enhance the effectiveness of my learning	PU2	3.45	.854
To use mobile devices for learning would be ubiquitous and useful	PU3	3.50	.820
Perceived Mobility Value (PMV)		3.55	
Mobility enables me to accomplish tasks quickly	PMV1	3.39	.982
I know that mobile devices are the mediums for mobile learning	PMV2	3.72	1.055
Mobility enables me to access real-time data	PMV3	3.59	1.036
Unexpected problems could be fixed at the first time by using mobile devices	PMV4	3.48	1.024
Perceived Social Interaction Value (PSIV)		3.13	
I would like to be able to launch a discussion on a learning forum through mobile devices	PSIV1	3.11	.874
I would like to be able to interact with teachers and classmates both inside and outside class via mobile devices	PSIV2	3.12	1.021
I would like to be able to engage in class discussion if I could share my thoughts in real-time through mobile devices	PSIV3	3.16	.971
Perceived Enjoyment (PE)		3.88	
I would feel more interested in study if I could use mobile devices	PE1	3.82	.900
I would be entertained in my study by using mobile devices	PE2	3.93	.925
Perceived Ease Of Use (PEOU)		3.71	
It would not require me a lot of mental effort to learn because I am skilled at mobile device functions	PEOU1	3.64	.732
It would ease my learning because it allows me to study anytime, any place	PEOU2	3.69	.795

It would be easy and clear to interact with mobile devices for learning	PEOU3	3.77	.787
It would be easier for me to ask help from others through mobile devices	PEOU4	3.73	.803
Perceived Output Quality (POQ)		3.60	
More initiative and dynamic	POQ1	3.58	.935
More portable device, more flexible learning	POQ2	3.79	.967
Enhances daily learning	POQ3	3.55	1.064
Utilizes the “pieces of time”	POQ4	3.51	.921
Broadens the knowledge	POQ5	3.70	.975
Enables high engagement	POQ6	3.61	.970
Ensures studying effectiveness	POQ7	3.45	1.007
Provides a better alternative to study	POQ8	3.63	1.004
Attitude (ATT)		3.53	
I would be more encouraged to learn if I could access materials anytime, anywhere via mobile devices	ATT1	3.51	.775
It would be desirable to use mobile devices as a way for learning	ATT2	3.52	.754
I would like to use mobile learning in the future because it will help my study a lot	ATT3	3.56	.782
Behavioral Intention (BI)		3.48	
I intend to apply mobile learning when it becomes available	BI	3.48	.808

Appendix 9 Structural Equation Modeling



Appendix I0 Questionnaire for students

This questionnaire is used for a thesis and aimed at exploring students' perceptions and attitudes of mobile learning as a learning tool in three Chinese universities. Within this research, mobile learning is defined as the use of mobile devices for learning purposes incorporated in class. Mobile devices include any handheld device capable of multiple functions, for instance, accessing the Internet, reading articles. Examples comprise smartphones, iPad, or similar devices.

Thanks for your support and participation!

General personal information:

1. Gender:
 - Male
 - Female

2. Please indicate which university you are studying in:
 - Wuhan University (WHU)
 - Huazhong University of Science and Technology (HUST)
 - Sichuan University (SCU)

3. What education degree are you achieving:
 - Bachelor
 - Master
 - Phd or higher

4. What kind of smart mobile devices do you have? (e.g. smart mobile phone, touch pad, or other devices)

5. What is your major area:
 - Agriculture
 - Art & Design
 - Business
 - Coast and Environment
 - Education
 - Engineering
 - Humanities & Social Science
 - Mass Communication
 - Music & Drama
 - Science
 - Other _____

Questions about mobile learning:

Capability

I am able to skillfully use mobile devices... (Please check all that apply)

- To check Internet news (e.g. weather forecast)
- For e-booking and e-shopping
- To download applications
- To download interesting podcasts
- To watch videos and listen to music
- To process pictures
- To deal with calculations
- To set a reminder/alarm for a coming event
- To translate a foreign language
- To send messages and emails
- To access a social network site
- To remotely control personal computer
- To subscribe some services by sending messages
- To search needed information
- To play games

Current uses regarding using mobile devices for learning purposes:

I have... (Please check all that apply)

- Used mobile devices for library services (e.g. check and book studying room, or book request)
- Accessed the university website or system on mobile devices
- Downloaded course documents via mobile devices
- Downloaded an application that helped me learn new knowledge
- Used mobile devices to search for unknown knowledge during class
- Used a social network site for discussion
- Interacted and communicated with lecturers via mobile devices
- Set a reminder on mobile devices to remind me of a certain deadline
- Searched for schedules via mobile devices
- Used mobile devices to interact and communicate with classmates
- Checked study information and feedback from teachers via mobile devices (email or SMS)
- Recorded information during class (by voice recording or taking photos)
- Wrote notes on mobile devices during class
- Read an article or assignment on mobile devices
- Played an educational game on mobile devices

Perceptions and attitudes from students:

Degree questions	Strongly Disagree			Strongly Agree	
1. To use mobile devices for learning purposes would save me a lot of time	0	0	0	0	0
2. To use mobile devices for learning purposes would enhance the effectiveness of my learning	0	0	0	0	0
3. To use mobile devices for learning would be ubiquitous and useful	0	0	0	0	0
4. Mobility enables me to accomplish tasks quickly	0	0	0	0	0
5. I know that mobile devices are the mediums for mobile learning	0	0	0	0	0
6. Mobility enables me to access real-time data	0	0	0	0	0
7. Unexpected problems could be fixed at the first time by using mobile devices	0	0	0	0	0
8. I would like to be able to launch a discussion on a learning forum through mobile devices	0	0	0	0	0
9. I would like to be able to interact with teachers and classmates both inside and outside class via mobile devices	0	0	0	0	0
10. I would like to be able to engage in class discussion if I could share my thoughts in real-time through mobile devices	0	0	0	0	0
11. I would feel more interested in study if I could use mobile devices	0	0	0	0	0
12. I would be entertained in my study by using mobile devices	0	0	0	0	0
13. It would not require me a lot of mental effort to learn because I am skilled at mobile device functions	0	0	0	0	0
14. It would ease my learning because it allows me to study anytime, any place	0	0	0	0	0
15. It would be easy and clear to interact with mobile devices for learning	0	0	0	0	0
16. It would be easier for me to ask help from others through mobile devices	0	0	0	0	0
17. I would be more encouraged to learn if I could access materials anytime, anywhere via mobile devices	0	0	0	0	0
18. It would be desirable to use mobile devices as a way for learning	0	0	0	0	0

Appendix

19. I would like to use mobile learning in the future because it will help my study a lot	0	0	0	0	0
20. I intend to apply mobile learning when it becomes available	0	0	0	0	0

Compared with traditional learning, I believe that mobile learning (is)...

Degree questions	Strongly Disagree		Strongly Agree		
21. More initiative and dynamic	0	0	0	0	0
22. More portable device, more flexible learning	0	0	0	0	0
23. Enhances daily learning	0	0	0	0	0
24. Utilizes the “pieces of time”	0	0	0	0	0
25. Broadens the knowledge	0	0	0	0	0
26. Enables high engagement	0	0	0	0	0
27. Ensures studying effectiveness	0	0	0	0	0
28. Provides a better alternative to study	0	0	0	0	0

Open and in-depth questions about mobile learning:

What do you think about mobile learning? (comments and suggestions can be added here)