

EXPLORING AND UNDERSTANDING THE USE OF MOBILE E-BOOK AMONG MATHEMATICS POSTGRADUATE STUDENTS

MALATHI A/P LETCHUMANAN

UNIVERSITI SAINS MALAYSIA

2017

**EXPLORING AND UNDERSTANDING THE USE
OF MOBILE E-BOOK AMONG MATHEMATICS
POSTGRADUATE STUDENTS**

by

MALATHI A/P LETCHUMANAN

**Thesis submitted in fulfilment of the requirements
for the degree of
Doctor of Philosophy**

November 2017

ACKNOWLEDGEMENT

Firstly, I would like to express my sincere gratitude to my supervisor Prof. Dr. Balakrishnan Muniandy for his continuous support and motivation throughout my Ph.D study. His guidance helped me in all the time of writing of this thesis.

I would also like to thank my co-supervisor, Dr. Mariam binti Mohamad, and my thesis committee members for their insightful comments, valuable discussions and encouragements. Their support assisted me in finding right direction for my thesis. Special thanks goes to Universiti Putra Malaysia which have provided financial assistance to complete my studies.

Last but not the least, I would like to thank my family: my husband, my children, my parents and to my brother and sister for supporting me spiritually throughout the journey of this thesis.

TABLE OF CONTENTS

Acknowledgement	ii
Table of Contents	iii
List of Tables	ix
List of Figures	x
Abstrak	xii
Abstract	xv
CHAPTER 1 - INTRODUCTION	
1.1 Overview of the Study	1
1.2 Background of the Study	3
1.3 Problem Statement	9
1.4 Research Objectives	13
1.5 Research sub-objectives	13
1.6 Research Questions	14
1.7 Conceptual Framework	15
1.8 Significance of the Study	16
1.9 Limitations of the study	19
1.10 Operational Definitions	20
1.11 Summary	22
CHAPTER 2 - LITERATURE REVIEW	
2.1 Introduction	23
2.2 E-book in Malaysia	23
2.3 Mobile Learning	31

2.4	Past Studies on Mobile E-book Use in Higher Learning Environment	33
2.4.1	Awareness, Usage and Acceptance Level of Mobile e-book	33
2.4.2	Pattern and Activities of Mobile e-book Use	35
2.4.3	Factors that Encourage Mobile e-book use	36
2.4.4	Factors that Inhibit Mobile e-book use	42
2.4.5	Purposes of Using Mobile e-book	51
2.4.6	Effects of Using Mobile e-book	52
2.5	Culture of E-book Reading among Mathematics Graduates	54
2.6	Mathematics E-book	56
2.7	Mathematics Argumentation	58
2.8	Research gap	60
2.9	Related Theories Guiding the Study	61
2.9.1	Technology Acceptance Model(TAM)	62
2.9.2	Pleasure Arousal and Dominance Theory (PAD)	64
2.9.3	Diffusion of Innovation Theory (DIT)	65
2.10	Summary	68
 CHAPTER 3 - RESEARCH METHODOLOGY		
3.1	Introduction	70
3.2	Research Design	70
3.2.1	Qualitative Case Study Design	72
3.3	Research Setting	73
3.4	Selection of the Participants	74
3.4.1	Participant Selection Design	74

3.4.2	Criteria for Recruiting the Participants	75
3.4.3	Participants' Selection	75
3.5	Mobile Devices and Mobile E-book Platforms Used by the Participants of the Study	76
3.6	Description of the Mobile e-book used in the Discussion	77
3.7	Researcher as the Instrument	79
3.8	Pilot Test	81
3.9	Data Collection	85
3.9.1	Interview	85
	3.9.1(a) Interview Guide	85
	3.9.1(b) Conducting the Interview	86
3.9.2	Non-participant Observation	88
3.9.3	Screen Capture of Mobile e-book Use	89
3.9.4	Writing Memos	91
3.10	Data Analysis	92
3.10.1	Data Management and Data Organisation	94
3.10.2	Analysing the Data	96
3.10.3	Coding Process	97
3.10.4	Category Constructing	99
3.11	Validity and Reliability (Trustworthiness)	101
3.11.1	Internal Validity	102

3.11.1(a)	Triangulation	103
3.11.1(b)	Member Check	103
3.11.1(c)	Expert Examination	104
3.11.1(d)	Reflexivity of the Researcher's Position	104
3.11.2	External validity	104
3.11.3	Reliability	105
3.11.3(a)	Audit Trail	105
3.11.3(b)	Triangulation	106
3.11.3(c)	Reflexivity	106
3.11.3(d)	Peer Examination	106
3.12	Ethical Consideration	107
3.13	Summary	107
 CHAPTER 4 - DATA ANALYSIS		
4.1	Introduction	109
4.2	Biographical Profile of the Participants	110
4.2.1	Fatimah	111
4.2.2	Salleh	113
4.2.3	Salmah	115
4.2.4	Abdullah	116
4.2.5	Ruhaida	117
4.3	Findings	119
4.3.1	Research Question 1: How Mathematics Postgraduate Students Used the Mobile e-book	119

4.3.2	Research Question 2: Main Purposes of Using the Mobile e-book	131
4.3.3	Research Question 3: Factors and How Far these Factors Promote or Hinder the Use of the Mobile e-book for Learning Activities	133
4.3.3(a)	Factors Influencing the Use of the Mobile e-book	133
4.3.3(a)(i)	Utilitarian	135
4.3.3(a)(ii)	Cognitive	138
4.3.3(a)(iii)	Affective	140
4.3.3(a)(iv)	Social norm	143
4.3.3(a)(v)	Content quality	144
4.3.3(b)	Reasons Hindering the Use of the Mobile e-book	144
4.3.3(b)(i)	Utilitarian	145
4.3.3(b)(ii)	Cognitive	149
4.3.3(b)(iii)	Affective	149
4.3.4	Research Question 4: Mobile e-book Adoption Affecting the Way the Mathematics Postgraduate Students Learn	150
4.3.5	Provide information to develop guidelines for designers and academicians to design future mobile e-book	155
4.4	Summary	157
CHAPTER 5 - DISCUSSION AND CONCLUSION		
5.1	Introduction	159
5.2	Summary of Main Findings	159
5.3	Discussion	165
5.3.1	Theme: Patterns of the Mobile e-book Used and Activities Performed	165
5.3.2	Theme: Purpose of Using the Mobile e-book	170

5.3.3	Theme: Factors and How these Factors Promote or Hinder the use of the Mobile e-book for Learning Activities	170
5.3.4	Theme: Effect of the Mobile e-book on the Participants’ Research Activities	178
5.3.5	Theme: Provide Information to Prepare Guideline for the Mobile e-book Designers and Academicians to Develop Future Mobile e-book	181
5.4	Implications	182
5.4.1	Practical Implications and Recommendations	182
5.4.2	Policy Implications	188
5.4.3	Theoretical Implications	189
5.5	Limitations and Strengths of the Study	191
5.6	Recommendations for Future Studies	191
5.7	Conclusion	193
	REFERENCES	195
	APPENDICES	
	LIST OF PUBLICATIONS	
	AWARDS	

LIST OF TABLES

		Page
Table 2.1	Factors that promote or hinder mobile e-book use	46
Table 2.2	The meaning of each constructs and its associated variables	48
Table 2.3	Value of books and journals to researchers depending on the stage of the research workflow	51
Table 3.1	Devices used by the participants	77
Table 3.2	Demographic details and mobile e-book use background of pilot study participant	82
Table 3.3	Strategies used to enhance internal validity, external validity and reliability	102
Table 4.1	Biographic information and background of mobile e-book use	111
Table 4.2	Categories of reading pattern	119
Table 4.3	Categories of mobile e-book activities	123
Table 4.4	Categories for purpose of using mobile e-book	131
Table 4.5	Factors and how they influence the use of the mobile e-book by the participants	134
Table 4.6	Reason hindering the mobile e-book use	145
Table 4.7	Effects of the mobile e-book on how the participants learned	150

LIST OF FIGURES

	Page	
Figure 1.1	Conceptual framework	15
Figure 2.1	Technology Acceptance Model	63
Figure 2.2	Diffusion of Innovation Theory	68
Figure 3.1	Screen capture of the abstract algebra mobile e-book	79
Figure 3.2	Annotation feature used by the participants	90
Figure 3.3	Highlight feature used by the participants	91
Figure 3.4	Zoom in zoom out feature used by the participants	91
Figure 3.5	Component of data analysis: Interactive model	93
Figure 3.6	Summary of data management and organization	96
Figure 3.7	Data analysis process in NVivo	99
Figure 3.8	Visual model of coding process in qualitative research	101
Figure 4.1	Nodes created for the reading pattern of the participants	119
Figure 4.2	Bookmark feature used by the participants	124
Figure 4.3	Highlight feature used by the participants	126
Figure 4.4	Annotation feature used by the participants	128
Figure 4.5	Search feature used by the participants	129
Figure 4.6	Zoom in zoom out feature used by the participants	130
Figure 4.7	Nodes for the activities performed by the participants	131
Figure 4.8	Nodes for the purpose of using the mobile e-book	133
Figure 4.9	Nodes for the factors motivating the use of the mobile e-book	135
Figure 4.10	Nodes for the factors hindering the use of the mobile e-book	145
Figure 4.11	Nodes for the effects of mobile e-book on how the participants learned	155

Figure 5.1	Summary of reading pattern used by the participants	160
Figure 5.2	Summary of active learning methods used by the participants	161
Figure 5.3	Summary of purpose of using the mobile e-book	162
Figure 5.4	Summary of factors motivating the use of the mobile e-book	163
Figure 5.5	Summary of reasons hindering the mobile e-book use	164
Figure 5.6	Summary of effects of mobile e-book	164

**MENEROKA DAN MEMAHAMI PENGGUNAAN BUKU ELEKTRONIK
MUDAH ALIH DALAM KALANGAN PELAJAR PASCASISWAZAH
MATEMATIK**

ABSTRAK

Objektif kajian ini adalah untuk meneroka dan memahami penggunaan buku elektronik mudah alih oleh pelajar pascasiswazah matematik. Kajian ini secara khususnya meneliti pengalaman para pelajar pascasiswazah matematik menggunakan buku elektronik mudah alih bagi aktiviti penyelidikan mereka. Kajian ini telah dilaksanakan berdasarkan lima persoalan kajian seperti: (a) bagaimana pelajar pascasiswazah matematik menggunakan buku elektronik mudah alih?; (b) apakah tujuan utama mereka menggunakan buku elektronik mudah alih?; (c) apakah faktor dan sejauh manakah faktor-faktor ini mendorong atau menghalang penggunaan buku elektronik mudah alih dalam proses pembelajaran mereka?; (d) bagaimana penggunaan buku elektronik mudah alih ini memberi kesan kepada proses pembelajaran mereka?; dan (e) apakah maklumat yang diperlukan oleh perekabentuk dan pendidik untuk mereka bentuk buku elektronik mudah alih pada masa akan datang? Kajian ini telah menggunakan reka bentuk kajian kes kualitatif. Seramai lima orang pelajar pascasiswazah matematik telah mengambil bahagian dalam kajian ini secara sukarela. Kajian ini menggunakan persampelan bertujuan bagi memilih para peserta kajian. Data untuk kajian ini telah dikumpul melalui kaedah temubual semi-struktur, pemerhatian tanpa-penglibatan dan penilaian dokumen. Data yang diperolehi melalui transkrip temubual telah dianalisis dengan menggunakan kaedah perbandingan dalam aplikasi NVivo 11. Kajian ini menggunakan tiga teori iaitu *Technology Acceptance Model*, *Pleasure, Arousal and Dominance Model* and *Diffusion Innovation Theory* sebagai

panduan bagi menjalankan kajian ini. Keputusan kajian menunjukkan bahawa para peserta menggunakan tiga jenis kaedah pembacaan seperti memilih topik yang hendak dibaca dari senarai kandungan buku atau penanda buku, membaca keseluruhan kandungan dan selepas itu memilih kandungan tertentu untuk dibaca. Hasil kajian juga menunjukkan para peserta menggunakan pembacaan aktif seperti penanda buku, *highlight*/menggaris, menulis nota, mencari dan membesar serta mengecilkan saiz buku elektronik mudah alih ketika membaca. Di samping itu, mereka juga berpendapat buku elektronik mudah alih ini sangat sesuai digunakan sebagai sumber rujukan bagi kajian mereka dan juga boleh digunakan sebagai buku teks. Keputusan kajian juga menunjukkan bahawa sebab-sebab yang mendorong penggunaan buku elektronik mudah alih boleh dibahagikan kepada lima kategori iaitu *utilitarian*, kognitif, afektif, norma sosial dan kualiti kandungan. Kategori-kategori ini menyebabkan para peserta menggunakan buku elektronik mudah alih dengan mudah, gembira dan secara berkesan bagi menjalankan aktiviti kajian mereka. Manakala, kategori-kategori *utilitarian*, kognitif dan afektif juga didapati menghalang para peserta daripada menggunakan buku elektronik mudah alih. Selain itu, hasil kajian juga menunjukkan bahawa buku elektronik mudah alih ini boleh meningkatkan interaksi pelajar dengan kandungan buku elektronik mudah alih, menggalakkan interaksi pelajar dengan ketua kumpulan penyelidikan, membantu para peserta dalam memahami subjek daripada perspektif yang berbeza dan mengubah cara pembelajaran. Selain itu, kajian ini juga memberi maklumat kepada para pereka bentuk dan pendidik untuk mereka bentuk buku elektronik mudah alih yang bersesuaian. Di samping itu, kajian ini juga memberi panduan kepada perkebentuk dan pendidik untuk mereka bentuk buku elektronik mudah alih pada masa akan datang. Secara keseluruhannya, kajian ini memberi kesan daripada aspek praktikal, polisi dan teori. Kajian ini secara khususnya membolehkan

pihak berkepentingan untuk memahami kepentingan faktor afektif dalam penggunaan buku elektronik mudah alih. Faktor afektif ini membolehkan para peserta berasa gembira, teruja dan tidak hilang arah ketika menggunakan buku elektronik mudah alih ini. Faktor afektif dianggap sebagai faktor baru yang perlu diterokai dalam penggunaan buku elektronik mudah alih ini dan semakin mendapat perhatian daripada pereka bentuk buku elektronik mudah alih.

EXPLORING AND UNDERSTANDING THE USE OF MOBILE E-BOOK AMONG MATHEMATICS POSTGRADUATE STUDENTS

ABSTRACT

This study aimed to explore and understand the mathematics postgraduate students' experience with mobile e-book. In particular this study presents appreciation of meaning and experience of mathematics postgraduate students in using the mobile e-book for their research activities. This study was guided by five research questions: (a) how do the mathematics postgraduate students use the mobile e-book?; (b) what are their main purposes of using the mobile e-book?; (c) what factors and how far these factors promote and hinder the use of the mobile e-book for learning activities; (d) how does the adoption of the mobile e-book affect the way the mathematics postgraduate students learn?; and (e) What are the information needed to develop guidelines to design future mobile e-book for the designers and academicians? The study employed qualitative case study design. Based on the purposive sampling method, five mathematics postgraduate students were voluntary participants in the study. The data were collected through semi-structured interviews, non-participant observations and document reviews. The data derived from the transcripts were analysed by using constant comparative method in NVivo 11 software. The study used three theories namely Technology Acceptance Model, Pleasure, Arousal and Dominance Theory and the Diffusion Innovation Theory as the guiding theory of the study. The findings showed that the participants adopted reading patterns such as selecting the topic of interest from the table of contents or bookmark, read the entire contents and then read the specific information. The findings also showed that the participants bookmark,

highlight/underline, annotate, search and zoom in and zoom out the mobile e-book. In addition, the participants found that mobile e-book is appropriate for research work and also can be used as textbook. The results also indicated that utilitarian, cognitive, affective, social norm and content quality factors emerged as the reasons for using the mobile e-book. These factors motivated the participants to use the mobile e-book easily, happily and effectively for their research activities. On the other hand, utilitarian, cognitive and affective reasons are also found to hinder the participants from using the mobile e-book. The findings also showed that the mobile e-book can increase student-content interaction, promote student-head of research group interaction, assist in understanding a subject from different perspectives and change the way of reading or learning. The study also provides information to aid in the design of future mobile e-books for designers and academicians. Also, it contributes to a number of practical, policy and theoretical implications. The study mainly contributes to understanding the influence of affective factors in mobile e-book use. The affective factors allows the participants to experience enjoyment, arousal and be in control of using the mobile e-book. These affective factors are considered new in mobile e-book use aspect and gaining popularity as one of the important factors in designing the mobile e-book.

CHAPTER 1

INTRODUCTION

1.1 Overview of the Study

The individual learning model is foreign territory for most Net Geners, who have grown up collaborating, sharing and creating together online (Tapscott, 2008, p.137).

The above quote has alarmed educators and curriculum developers about the need for an improvement in the current learning model by looking into the chance of integrating technology in education in an effective manner. As stated by Palfrey and Gasser (2008), the younger generation of today is not learning or working the same way as the older generation. The young people not only obtain information from hard bound materials but also from the web-oriented world where the information they need is instantly available at their fingertips at a fraction of the time.

The integration of technology into higher learning institutions is perceived to be vital in this global economic environment. Educators need to alter the subject content and delivery medium according to the students' needs so as to increase the latter's engagement with the learning materials (Lynch, 2010). Electronic book (e-book) is one of the revolutionary ideas which is believed to deliver and fulfil the information needs of the current generation. The term *electronic book* is believed to be coined by Andries van Dam in the early 1960s and it is known widely now as e-book. The printed book (p-book) is the core reference material for any course offered at any level in academic institutions. A paper book refers to a printed book consisting of a set of written or printed sheets made of ink, paper or other materials which are normally fastened together. The term *printed book* is normally referred to as p-book. Although the

benefits of the p-book cannot be questioned, its characteristics such as poor portability, difficulty in accessibility and high cost are now perceived to be a strong barrier for the adoption of the p-book (Anuradha & Usha, 2006; Carlock & Perry, 2008). To overcome the challenges posed by the p-book, the e-book was introduced into the market. Since then, the e-book has undergone tremendous changes. As with other technologies in the market, the e-book has experienced revolutionary changes in terms of its design, features, integrated media and mediums used to access it (Blades, 2005). The current development in e-book technology enables the e-book to be accessed and read via handheld mobile devices such as smart phones and tablets (mobile e-book).

The mobile e-book provides many benefits to the academic community and is widely accepted in western countries such as America and United Kingdom (Geist, 2011; Weisberg, 2011). It is also obvious that the mobile e-book is certainly more popular and widely used in areas, for example, business, management, engineering and medicine in these countries (Broadhurst & Watson, 2012; Geist, 2011; Weisberg, 2011). Their higher learning institutions have benefitted in many ways by using the mobile e-book. The mobile e-book enables the students to save cost by not buying the p-book, reading the e-book anytime and anywhere, and having multi-users to access the facility and situated learning (Geist, 2011; Martinez-Estrada & Conaway, 2012; Weisberg, 2011).

The mobile e-book is also effective in improving the students' academic performance and changing their learning practices. Olsen, Kleivset and Langseth (2013) and Weisberg (2011) claim that university students who use the mobile e-book can achieve similar or better academic results compared to those who use the p-book. Furthermore, the mobile e-book enables them to have the same or better feelings towards learning

(Rockinson-Szapkiw, Courduff, Carter & Bennett, 2013). In addition, the use of the mobile e-book encourages more communication among the peers on subject content and enhances efficiency, satisfaction as well as the students' independent learning skills (Glackin, Rodenhiser & Herzog, 2014; Richardson, Dellaportas, Perera & Richardson, 2013).

The concept of the mobile e-book is still considered new in Malaysia and other Asian countries (Hwang, Kim, Lee & Kim, 2014). Academicians and students at higher learning institutions in these countries are still not fully aware of the significance of using the e-book and mobile e-book in an academic context (Hwang et al. 2014; Jalal, Mohd Ayub & Tarmizi, 2014). Although some of the academic students in engineering and medicine are using the mobile e-book like those students in the western countries, their use of either the e-book or mobile e-book in pure science courses such as mathematics, physics and chemistry is still low (Hwang et al. 2014). When the mobile e-book is widely adopted as an alternative or a complement to the p-book in these fields of study, it must provide better user's experience to the students. Understanding the real user experience with the mobile e-book is crucial in order to design user friendly and useful mobile e-book. Hence, this study explores and understands the mathematics postgraduate students' experience with the mobile e-book.

1.2 Background of the Study

The book has always been perceived as a symbol of knowledge and wisdom. The evolution of books revealed that, in the olden days, speech and hand symbols were used as means of communication (Öquist, 2006). Later, written language was introduced. This written language is considered as a new invention that has immense impact on the

human community (Öquist, 2006). It enables us to store and disseminate information to the entire human community around the world. As early as the 3rd millennium, written language was crafted or recorded on clay tablets, papyrus scrolls, metal and parchment (Liesaputra & Witten, 2012; Öquist, 2006; Baines, 1983). Then, in about CE 105, paper was used to record the written language (Öquist, 2006). The utilization of paper was considered as a new revolution for the written language. It then continues to evolve quickly around the world.

Now with the advent of new and modern technologies, the mediums and methods used to record and access writings have dramatically changed from print to digital form. One such technology which leaves an immense impact on the human community especially on the knowledge community is the electronic book or e-book. The e-book is simply referred to as a digital text which is delivered and accessed through mediums such as the Internet, computer and handheld mobile devices. The e-book inherits the morphology of the p-book with some added advantages of digital features such as multimedia elements and hyperlinks (Vassiliou & Rowley, 2008). The e-book became popular when Michael Hart started the world's first e-book library in 1971 via Project Gutenberg (Lebert, 2009). The project aimed to provide free e-texts, mostly fictional books to those living in America, Australia, Europe and Canada (Lebert, 2009).

When the e-book was introduced, the personal computer (PC) was used to access and read the contents. Later, when the life-styles and expectations of the consumers changed, more portable and user friendly devices were invented to read the e-book. Consequently, dedicated e-book readers such as Kindle and Sony readers were introduced to the market. The qualities of these readers were further improved by the

introduction of e-ink technology (Siegenthaler, Schmid, Wyss & Wurtz, 2012). This e-ink technology delivers the same experience as reading a conventional book but in a black and white format (Godwin-Jones, 2007).

After the introduction of the dedicated e-book readers, handheld mobile devices, for example, smart phones and tablets were introduced to the market for the purpose of reading the e-book. For instance, iPad released by Apple can be used to browse the web, check e-mail, view photos or videos, play computer games and read e-books (Halpern, 2010). However, for a user to download and read the e-book via Apple iPad, the user needs to download a special program known as iBook. iPad is considered a suitable alternative to the e-book for a mobile environment. However, factors such as LED display, short battery life and cost of the device often create negative e-book reading experience for the readers (Halpern, 2010; Valstad & Rydland, 2010). Besides tablets, smart phones, handheld mobile devices that are mainly used as mobile phones are also made available to read the e-book. Due to the size and mobility, currently smart phones are the popular alternative device to read the e-book (Picton, 2014). However, the small screen size of the smart phone can create difficulties for reading the e-book.

The e-book that is delivered through handheld mobile devices (mobile e-book) is made available for two purposes: leisure and academic purposes (Wong, Liong, Lin, Lower & Lam, 2011; Wu, Chatfield, Hughes, Kysh & Rosenbloom, 2014). The e-book for leisure is well accepted by readers of different generations although some users have revealed their concerns about ownership, self identity and the issue of lending the books to other friends (Chen & Granitz, 2012; Nicholas et al., 2008). The trend in the academic circle shows that e-books in the areas of business, management, engineering and medicine are

more popular for reading via handheld mobile devices, compared to other areas, for example, mathematics and pure sciences (Littman & Connaway, 2004; Ramirez & Gyeszly, 2001).

For instance, Weisberg (2011) reported that students in the management strategy class became more receptive towards the mobile e-book as it could increase the students' learning efficiency by reducing the amount of time and effort to accomplish a task. Furthermore, Weisberg (2011) also reported that there was no significant difference in terms of the learning outcome between the students who used the mobile e-book and p-book in class. The students show interest in the mobile e-book because it is convenient, cheap and recommended by their instructors, besides enabling them to search for contents easily.

Similarly, Rockinson-Szapkiw et al. (2013) noted that there was no significant difference in terms of cognitive learning and grades between the education students who used the mobile e-book and those who used the p-book. The authors also found that the students who used the mobile e-book exhibited significantly higher affective learning and psychomotor learning. Apparently, the students who used the mobile e-book took more notes than those who used the p-book. Lin, Li, Lin and Lai (2014) also reported that nursing undergraduates had greater intention to use the mobile e-book and were ready to accept its use for their learning activities. These students believed that the mobile e-book could provide greater benefits for their learning purposes. However, they preferred to use the e-book via tablets, rather than smart phones.

Mathematics is considered to be the foundation for all science subjects. Past studies reported that university students still faced difficulties in understanding mathematical concepts (Ferrer, 2016; Lithner, 2011). It is believed that mobile technologies such as mobile e-book opens the door for these students and allows for learning to occur anytime, anywhere and to be influential in a variety of learning contexts (Taleb, Ahmadi & Musavi, 2015). In addition to that, these students are also experiencing problems in obtaining appropriate resources for their learning activities (Taleb et al., 2015). In order to overcome the accessibility problems, learning resources in the area of mathematics were made available in electronic versions such as e-book (Littman & Connaway, 2004). However, it is found that the use of the e-book in mathematics is still not popular (Littman & Connaway, 2004; Ramirez & Gyeszly, 2001). Existing literature has reported on the use of the e-book via computers and laptops but there is limited research on user interaction with mathematics mobile e-book. For instance, Jalal et al. (2014) conducted research on e-book use via laptop among mathematics teachers in Terengganu, Malaysia. The results indicated that although the mathematics e-book was readily available, the teachers were sceptical in using it for the purposes of teaching and learning. Furthermore, they needed more mental efforts to operate the e-book. Similarly, Letchumanan and Tarmizi (2011a) reported that mathematics students showed more resistance using the e-book via the computer although they realized that it could benefit their learning process. Lim, Hong and Aziz (2014) also reported that statistics e-book (with access via the computer) with animation and multimedia elements promised good results for students' achievements. Their study further indicated that the students liked the experience of reading the e-book and enjoyed the learning environment. However, they still preferred to read the p-book rather than the e-book. Therefore, the e-book still faces problems in winning the hearts of mathematics

educators and students. The main reason for this situation can be that mathematics e-book involves many formulae, equations and graphs that demand high quality display. However, the computer can create difficulties in reading formulae, equations and graphs. Furthermore, the lack of technical support also demotivates the users' intention to use the e-books (Jalal et al., 2014).

In Malaysia, it can be seen that both schools and higher education institutions are widely subscribing to the use of the e-book. In schools, Terengganu state government introduced the e-book to their primary school children, whereas the Federal government via the Centralised or Customised Education and Learning Exchange (CELEX), with portal (Digital Malaysia project), introduced the e-book to school students between the ages of 6 and 17 years. A few selected schools in Klang Valley in Malaysia participated in this project (Asian Publishing Network, 2012). Meanwhile, Fairview International Schools in Malaysia also introduced iPad project to their students. Upper junior students from Fairview International Schools in Malaysia are allowed and encouraged to use iPad as their learning tool mostly outside classroom wall (The Expateducation, 2012/2013). More public and private higher learning institutions in Malaysia are also subscribing to the e-book services and this effort is further supported by the Ministry of Higher Education (MOHE). The amount of Ringgit Malaysia 1.04 million was given to assist the local universities in Malaysia to subscribe to netLibrary platform that provided access to the e-book in various fields including mathematics via various devices (Letchumanan & Tarmizi, 2011a).

It can be seen that there is a growing interest in e-book in Malaysia. The higher learning institutions show a positive attitude towards subscribing to more e-book services from the various subject areas that can be accessed via the computer, laptop, e-reader and handheld mobile devices (Letchumanan & Tarmizi, 2011a). However, past studies have shown that scholars captured only user interaction with the e-book use via the computer, laptop and e-reader (Jalal et al., 2014; Letchumanan & Tarmizi, 2011a; Lim et., 2014). It is obvious that studies that investigate user interaction with the mobile e-book is still lacking. Therefore, this study aims to explore and understand the mobile e-book use among mathematics postgraduate students.

1.3 Problem Statement

Many types of devices have been introduced to access, read and store e-books (Glackin, et al., 2014; Weisberg, 2011; Woody, Daniel & Baker, 2010). Devices such as the dedicated e-readers and multipurpose handheld mobile devices can enable the end users to read the e-book in a mobile environment. The current scenario in e-book industries reveals that academic e-book that can be accessed and read via these devices has a positive growth in terms of its production and sales record (Association of American Publishers, 2012). The e-book in the areas of business, management, engineering and medicine has captured university students' attention as they like to read e-books via mobile devices (Bailey, 2006; Corlett-Rivera & Hackman, 2014). It is also noted that the mobile e-book use varies among the undergraduates and graduates in various disciplines, for example, business, management, engineering and social sciences (Corlett-Rivera & Hackman, 2014). Graduate students show more interest and preference to read the mobile e-book compared to undergraduates due to the cost of the devices (Corlett-Rivera & Hackman, 2014). However, the e-book in the area of

mathematics has not received positive responses from the university students (Littman & Connaway, 2004; Ramirez & Gyeszly, 2001). In addition, those university students who read mathematics e-books prefer to read them via the e-reader, computer and laptop, compared to handheld mobile devices (Pinto, Pouliot & Antonio Cordón-García, 2012). This shows that the use of mobile e-book among university mathematics students is still not popular. As such, this scenario is considered as a waste of resources as the facilities are readily available. Hence, it is important to explore and understand the mathematics students' use of the mobile e-book for learning activities to create a balanced platform between its production and adoption. Meanwhile, there is also a call for research to examine exactly how users interact with the e-book (accessed via all devices) including mathematics e-books during learning activities to understand exactly how users work with it (Muir & Hawes, 2013). Previous studies indicate that research that examines user interaction with e-book and mobile e-book is still lacking (Muir & Hawes, 2013), hence there is a need to expand the study. Moreover, it was also noticed by Letchumanan and Tarmizi (2011a) that mathematics postgraduate students are avid users of the e-book compared to undergraduate students. However, this study did not capture how these postgraduate students use e-book, for what purpose they use the e-book and how e-book affects the learning process of the postgraduate students. Therefore, this study fills in the gap by exploring how mathematics postgraduate students use mobile e-book, for what purpose they use the mobile e-book and how mobile e-book affects the learning process of the participants.

Studies have been conducted based on academic e-books which can be used via personal computers, Personal Digital Assistant (PDA) and e-readers. The studies related to the e-book which can be accessed via the handheld mobile devices were conducted in

countries, for example, America, United Kingdom, South Korea, Taiwan, China and Australia (Chang, Yan & Tseng, 2012; Lee, 2013; Gao & Deng, 2012; D'Ambra, Wilson & Akter, 2012). Majority of the studies related to e-books in Malaysia focusses on user interaction with computer, laptop and e-reader (Letchumanan & Tarmizi, 2011a; Letchumanan & Tarmizi, 2011b; Lim et al., 2014; Roesnita & Zainab, 2005). However, very limited studies have been conducted in Malaysia regarding the use of the e-book via handheld mobile devices. Similarly, the studies related to mobile e-book use among mathematics students are also scarce. This leads to insufficient knowledge on how the adults in Malaysia regard the use of the e-book particularly mathematics e-book via handheld mobile devices. Hence, there is a need to explore the use of e-books via handheld mobile devices among mathematics students in Malaysia as many users nowadays have access to this facility.

The current situation in the academic environment reveals that academic e-books including mathematics e-books have been already integrated into the syllabus of higher learning institutions (Letchumanan & Tarmizi, 2011a; Littman & Connaway, 2004). However, most of these e-books are merely the scanned copies of the printed materials (Coyle, 2008). Besides, the e-book industry has overlooked the issue of developing and using the e-books that can support learning activities in an adequate manner on handheld mobile devices (Coyle, 2008). These mobile e-books are usually having problems in terms of readability, design and technical aspects for the user (Coyle, 2008). In the academic context, the e-book developers for handheld mobile devices should understand that it is not sufficient for the developers to deliver the technological factors (convenience, compatibility and portability) alone through this medium. These e-books should include other necessary factors that are deemed relevant in the current academic

context: cognitive factors (perceived usefulness) and affective factors (fun and sensory elements, ownership and identity, aesthetics, immersion and escape). Therefore, any failure to incorporate the cognitive and affective factors into the e-book for handheld mobile devices can impede the learning process and reduce the use of mathematics e-book. Hence, there is a need to identify the reasons and ways these cognitive and affective factors can lead to the use of the e-book in the mobile environment.

Most of the studies relating to the mobile e-book employed quantitative approach (Chang et al., 2012; deNoyelles & Seilhamer, 2013; Lin, et al., 2014; Parson, 2014; Sloan, 2012-2013). However, these studies failed to provide an in-depth understanding of the current situation of the users when using the mobile e-book. Moreover, past researchers (Chou, 2016; Muir & Hawes, 2013) expected more qualitative based studies for the e-book related research to understand better the e-book use in detail by relating to the participants' viewpoints rather than just the statistical interpretations of the situation. Hence, a qualitative approach which has the ability to offer more precise reflection of the participants' situation is considered to be the adequate approach for this study (Merriam, 2009).

1.4 Research Objectives

The main objectives of this study are to:

- a) Explore the experience of the mobile e-book use by mathematics postgraduate students.
- b) Understand how the use of the mobile e-book contributes to the mathematics postgraduate students' learning activities.
- c) Provide information to develop guidelines for designers and academicians to design future mobile e-books.

1.5 Research Sub-Objectives

The sub-objectives of this study are to:

- a) Explore the pattern and activities of the mobile e-book use by mathematics postgraduate students.
- b) Explore the purposes of using the mobile e-book.
- c) Unveil the factors and how far these factors promote or hinder the use of their mobile e-book for learning activities.
- d) Unveil how the mobile e-book adoption affects the way the mathematics postgraduate students learn.
- c) Provide information to develop guidelines for designers and academicians to design future mobile e-books.

1.6 Research Questions

This study examines the following research questions:

- a) What are the patterns and activities of the mobile e-book used by mathematics postgraduate students ?
- b) What are their main purposes of using the mobile e-book?
- c) What factors and how far these factors promote or hinder the use of the mobile e-book for their learning activities?
- d) How does the mobile e-book adoption affect the way the mathematics postgraduate students learn?
- e) What are the information needed to develop guidelines to design future mobile e-books for the designers and academicians?

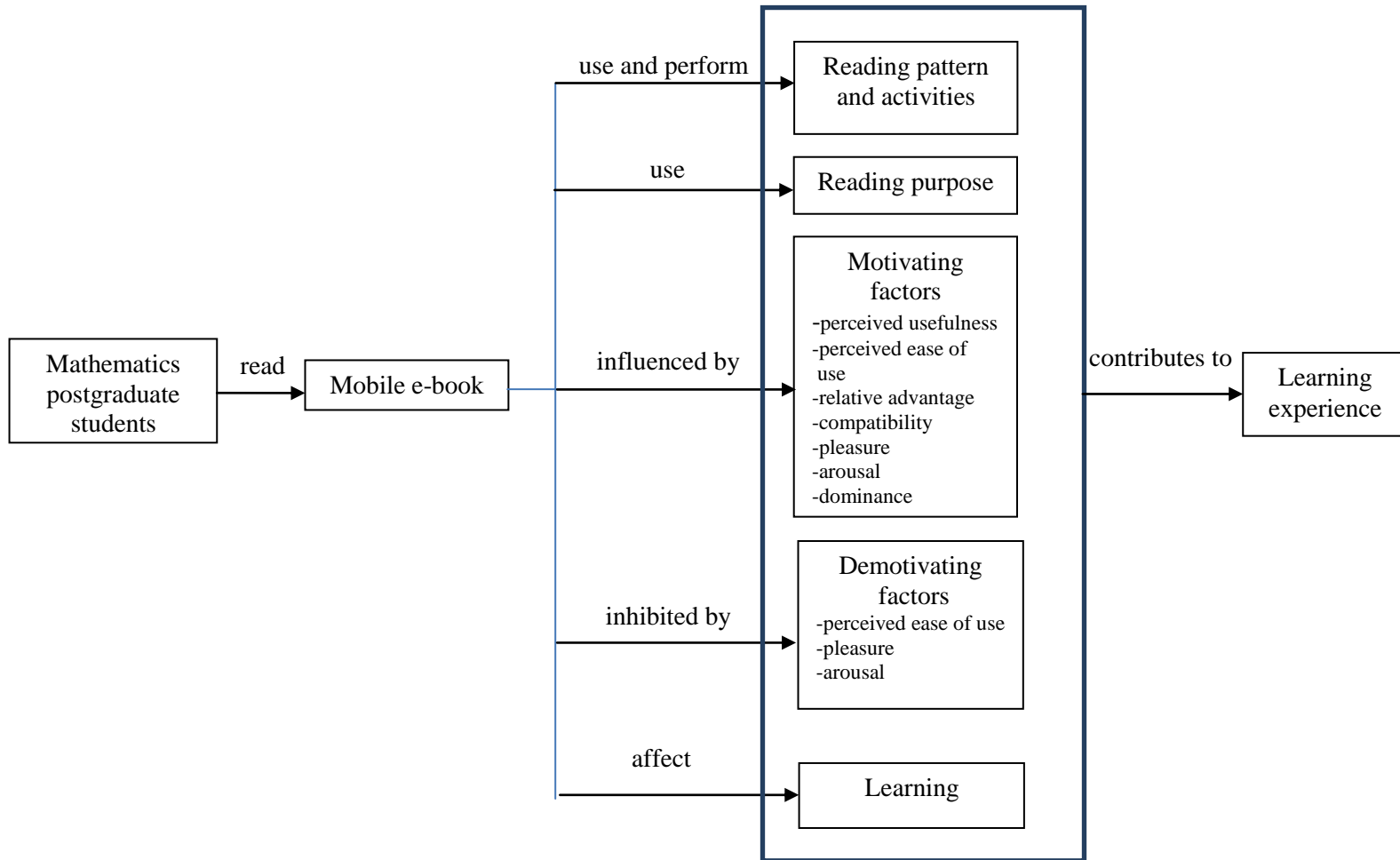


Figure 1.1 Conceptual framework

1.7 Conceptual Framework

The aim of the research is to understand mathematics postgraduate students experience with mobile e-book. In order to understand the mathematics postgraduate students' experience with mobile e-book, the research explores the pattern and purpose of using mobile e-book. In addition, it also explores the activities performed by the students on the mobile e-book and how it affects the learning activities. Furthermore, the factors that promote and discourage the use of mobile e-book for learning activities are also described. These factors are adapted from of Technology Acceptance Model (perceived usefulness and perceived ease of use), Diffusion of Innovation Theory (relative advantage and compatibility) and Pleasure, Arousal and Dominance Model (pleasure, arousal and dominance). Besides that, a description on how mobile e-book adoption affected the way the mathematics postgraduate students learn is also highlighted. Figure 1.1 illustrates the research framework of this study.

1.8 Significance of the Study

This study is important for a number of reasons. First, the academicians who are the direct contact persons of the participants can enhance their understanding and obtain clear insights into the participants' perceptions of the mathematics mobile e-book and the way they use the mobile e-book. Then, the academicians can also understand the factors that promote or hinder the use of mathematics mobile e-book and the involvement of the mobile e-book in the participants' learning activities. This aspect is important as the academicians are involved in designing the appropriate content of mathematics mobile e-book to suit learning needs, styles and purposes of their students as well as the devices used to read the materials. The academicians then can realize that with the use of technology as a channel to deliver the learning materials to their

students, they not only should pay attention to the quality and process of the creation of content, but also other factors, for example, utilitarian, cognitive, affective and social norm. Subsequently, their students can reap the benefits from the materials created. Hence, this study also provides feedback to the academicians about the appropriate amount of information which should be channelled to the small screen devices in the form of mathematics mobile e-book. Furthermore, the academicians will be aware whether the mobile e-book can really assist the students in their learning activities before taking appropriate steps either to motivate the mobile e-book use or find other alternatives to deliver their materials.

The e-book designers or developers who are the major stakeholders of the mobile e-book industry are also believed to benefit from this study. These designers or developers hold the main responsibility in designing the mobile e-book tailored to the consumers' needs, context of the contents and delivery channel. As the students are the main consumers of academic mobile e-books, these designers must understand the real needs of mathematics students who refer to the mobile e-book for their learning activities. Besides the cognitive factor which mainly involves the content developers' role, these designers should gain an understanding of the technological factor and affective factor that can influence the development of mathematics mobile e-book. Through this study, the designers can get a better picture about the technical aspects of the mobile e-book, for example, aspects of interactive elements and convenience, such as multimedia features, accessibility, portability and searchability. The compatibility aspect of the e-book can be examined to further improve mathematical mobile e-book. The designers can gain further insights into the hedonic or affective aspect and assess to what extent these factors can be incorporated into this phenomenon of mobile e-book.

An unclear aspect of the mobile e-book technology is whether the e-book technology should imitate the look and feel of the p-book or it should have its own identity. This study can pave the way to explain this issue. The designers can gain knowledge on designing of the mobile e-book for academic purpose by involving non-linear reading strategy as compared to leisure purpose which normally involves the linear reading process. Furthermore, the designers can understand the different aspects of developing mathematics mobile e-books that have more formulae and equations. Therefore, this study can provide information to the designers about the appropriate design features and technical affordability for the mobile platform through which the e-book is channelled.

This study has significant implications for considering the policy options to promote the use of academic mobile e-book for learning activities among mathematics postgraduate students in Malaysia. So far, based on the literature review discussed in chapter 2, most of the studies relating to the mobile e-book were conducted in developed nations, for example, America, United Kingdom and Australia. Some of the countries in Asia, for example, South Korea, Taiwan and China were also seriously involved in e-book research and development. However, not many research studies have been conducted in Malaysia about the use of mobile e-book which can contribute to the nations' literacy rate where it encourages more reading habits among the students (Jalal et al, 2014; Letchumanan & Tarmizi, 2011a). As this study explores and understands the mathematics postgraduate students' mobile e-book use, it can provide a foundation for policy mediation involving education policy makers to administer plans to support and improve the mobile e-book use among mathematics students. This is also in line with the Malaysia Education Blueprint 2015 – 2025 (Higher Education) which plans to

actively pursue technologies and innovations that can cater to students' needs and deliver personalised learning experience. Moreover, it can also support the strategies of higher education blueprint which intends to make online learning as an integral component of higher education and provide the required cyber infrastructure to strengthen the capability of academic community to deliver online learning facilities to the students.

Finally, integrating technology elements, in this case, the mobile e-book in higher learning environment is an important agenda in this global economic era. As such, this study adds to the existing literature on the use of the mobile e-book with particular reference to mathematics graduate studies. Therefore, it enhances and extends the existing literature by relating the empirical and practical experience to stimulate discussion on mobile e-book use.

1.9 Limitations of the study

This research was conducted among five mathematics postgraduate students from abstract algebra research group from Institute for Mathematical Research (INSPERM), Universiti Putra Malaysia. Hence, this researcher made no claims that the data and conclusions derived from this study could reflect all mathematics postgraduate students in Malaysia. Additionally, these participants might have different learning approaches and exposure to the selected academic e-book.

Another limitation was related to the research devices which were used in this study. The research was conducted based on handheld mobile devices and algebra mathematics mobile e-books. Therefore, this study's results could not be generalized to

other similar studies which used different academic e-books, leisure e-books or mobile devices.

1.10 Operational Definitions

1.10.1 E-book

The e-book refers to the electronic version of the printed book which is read via the handheld mobile device, e-book reader, computer and laptop. The e-book has features, for example, bookmark, annotation, zoom-in and zoom-out, print, search, copy and paste. It also has multimedia elements, for example, text, audio and video. Other electronic materials, for example, journals and lecture notes are not considered as e-books (Vassiliou & Rowley, 2008). In this study, the e-book refers to only the electronic book which can be accessed and read by a handheld mobile device, but not journals and lecture notes.

1.10.2 Mobile e-book

The e-book is accessed and read via a multipurpose handheld mobile device. The mobile e-book is normally available in PDF, HTML and ePUB formats. It has features, for example, bookmark, annotation, zoom-in and zoom-out, print, search, copy and paste (Lucia, 2001). The mobile e-book in this study refers to only the electronic version of the printed book which can be accessed via the multipurpose handheld mobile device. This study focused on only mathematics mobile e-book.

1.10.3 Smart phone

The smart phone is a mobile phone with an advanced mobile operating system which combines the features of a personal computer operating system with other useful features of a mobile phone. It can be used to capture videos, take photos, play music, explore web sites, check e-mail, play games and engage with social networks. Furthermore, it has GPS navigation tool and other applications to read e-books (Halpern, 2010). In this study, the smart phone refers to mobile phone with the stated features and is used mainly to read the e-book.

1.10.4 Tablet

A tablet is a wireless and portable personal computer with a touch screen interface. It is smaller than a notebook computer but larger than a smart phone. A tablet can be used to read books, newspapers and magazines, browse the web, play games, watch TV, send and receive emails and make video calls (Halpern, 2010). In this study, the tablet refers to wireless and portable personal computer with the stated features and is mainly used to read the e-book.

1.10.5 Explore

Explore means to investigate and inquire systematically the focus area of a research (thefreedictionary, 2002). In this study, explore refers to the activity of investigating and describing in depth the process of using the mobile e-book.

1.10.6 Unveil

Unveil means to reveal the findings that are discovered in a research (Oxford dictionary, 2003). In this study, unveil refers to revealing the factors that promote or hinder the mobile e-book use which can affect the learning output and practices.

1.10.7 Learning activities

Learning activities are academic related activities that enable students to engage with the subject content. The examples of learning activities are book report, brainstorming, case study, discussion, debate, essay writing, field trip, lecture, test, tutorial, student presentation, reading and writing of research paper or literature review (Educause, 2005). This study investigates the mobile e-book use for research activities.

1.10.8 Mathematics postgraduate students

Mathematics postgraduate students are students from higher learning institution who are pursuing master and PhD.

1.11 Summary

This study on exploring and understanding the mobile e-book use by mathematics postgraduate students is important as the mobile e-book has become one of the alternative reference materials for students' learning activities. This study mainly focused on understanding the mathematics postgraduate students experience with the mobile e-book. It analysed how and why mathematics postgraduate students used the mobile e-book and how their behaviour was affected by such use.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature regarding e-book and mobile e-book. The first section describes the status of e-book in Malaysia, opportunity for e-book market in Malaysia and some of the past studies related to e-book that was conducted in a Malaysian context. This chapter also reviews the uses of mobile e-book in higher learning institutions followed by description about mathematics e-book and the research gap that led to this study. The following section described the three theoretical frameworks namely Technology Acceptance Model (TAM), Pleasure-Arousal-Dominance (PAD) model and Diffusion of Innovation Theory (DOI) which were used as the guideline to conduct this study and not to test the theory.

2.2 E-book in Malaysia

The inaugural ASEAN e-book conference in 2012 had opened a new chapter in e-book publishing and marketing in Malaysia. Former Deputy Minister for International Trade and Industry, Datuk Mukhriz Mahathir hoped that with the interest and commitment showed by the local publishers, Klang Valley will emerge as the e-book hub in Southeast Asia and the Asia Pacific region (The Malaysian Insider, 2013). Moreover, in April 2013, the National Book Council had set up the Kuala Lumpur Trade and Copyright Centre (KLTCC) to increase the quantity of e-books in the local markets (The Malaysian Insider, 2013).

In Malaysia, the e-book initiative was first launched among school children (Chan, 2002). In the year 2001, Malaysia Education Ministry introduced the usage of e-textbook and allowed access to the internet by using the same e-book reading device. The main aim of the ministry is to determine whether the usage of e-textbook can improve teaching and learning and to find the opportunity to replace conventional textbook. This project was conducted among 35 schools for five months which involved 2491 e-books. The initial findings revealed that the project was able to increase students' engagement with teaching and learning (Chan, 2002).

Among the local higher learning institutions, Universiti Sains Malaysia, Universiti Utara Malaysia, University of Malaya, International Islamic University, Universiti Tun Abdul Razak, Open Universiti Malaysia, Universiti Teknologi Mara and Universiti Kebangsaan Malaysia are among the first universities that offer e-book services to its patrons (Primalani, 2004). In order to help the local higher learning institutions in subscribing to e-book services, Ministry of Higher Education (MOHE) had initiated a local fund worth RM 1.04 million to subscribe to netLibrary services (Letchumanan & Tarmizi, 2011a). Moreover, more local higher education institutions were also showing their interest in purchasing and subscribing to e-books rather than p-books (Country Report Malaysia, 2011). This in turn caused local publishers to face tight competition from international e-book publishers.

Roesnita and Zainab (2005) carried out research among 250 undergraduate students of the faculty of Computer Science and Information Technology in University of Malaya. Their research mainly identified the e-book (via computer) usage pattern, factors of using and not using e-book and preferences towards e-book. The authors used self-