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Understanding the Reasons that Hinder Mobile e-book Use of University Mathematics Students

Letchumanan, M. ^{*1}, Mohamad, M. ², and Davrajoo, E. ³

¹*Institute for Mathematical Research, Universiti Putra Malaysia, Malaysia.*

²*Centre for instructional Technology & Multimedia, Universiti Sains Malaysia, Malaysia*

³*SISC+ Kuala Selangor District Education Office, Selangor*

E-mail: malathi@upm.edu.my

** Corresponding author*

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ABSTRACT

This study determined the issues related to usage of mathematics mobile e-book and how these issues affected the learning process of the participants. The study used qualitative case study design. Eight postgraduate Mathematics students from Abstract Algebra research group from a local public university in Malaysia were interviewed and observed. The data were analysed in terms of content analysis and descriptive analysis. The findings showed that, utilitarian, affective and cognitive reasons affected the learning activities of the participants negatively. It is concluded that, this study contributed in terms of expanding readers understanding on the reasons that demotivates the usage of mobile e-books and how it's dampen the learning process of the participants.

Keywords: mathematics, challenges, utilitarian, cognitive, affective.

1. Introduction

Mobile learning is a learning process that involves the utilization of mobile computing which are connected to wireless networks to enable learning to occur anytime and anywhere (Hwang et al. (2014)). The development of mobile learning technologies brought in significant changes to the education industry. However, due to the rapid changes in mobile technologies, education institutions are vigilant about investing in resources to provide access to mobile learning infrastructure. Moreover, conservative organisational culture is also affect the widespread use of mobile learning technologies in education institutions (Asabere (2013)).

Mobile e-book is one of the technologies under the umbrella of mobile learning. Mobile e-book enables the users to access and read e-book via the handheld mobile devices. Students from primary to tertiary education level had experience in using mobile e-book for their learning activities. For instance, in higher learning education institutions level, students from medical, dentistry, engineering, business and management are actively using mobile e-books to support their different learning activities (Littman and Connaway (2004); Ramirez and Gyeszly (2001)). Despite reporting many positive learning outcomes when using the mobile e-book, these students have also suggested many constructive ideas to improve the mobile e-book platform in their fields.

Synthesis of past studies showed that very little research was carried out to explore and understand the use of mobile e-book in higher learning institution settings in the field of pure sciences such as mathematics, physics and chemistry (Jalal et al. (2012); Letchumanan and Tarmizi (2011)). Understanding the use of mobile e-book in these fields would be interesting because the content of learning resources in these areas includes equations, theorems and variety of charts besides text. In addition to that, students who had experience in reading e-book via computer and laptop had registered many problems to read and understand equations, formulas and charts (Letchumanan and Tarmizi (2011)). Hence, it will be interesting to investigate the reading process and understand the problem faced by the students when using mobile e-book. Therefore, this study understands the issues related to mobile e-book reading and how these issues impact the learning process of postgraduate Mathematics students.

1.1 Literature review

1.1.1 Issues with mobile e-book

The main issue reported with mobile e-book is the readability problem. It is understood that the screen size of hand held mobile devices, specially the smart phones are comparatively small. Hence, it may trigger the users to use more time to process and understand the content of the mobile e-book. For instance, studies have reported that they took a slightly longer time to read mobile e-book compared to p-book (printed book) (Connell et al. (2012); Kang et al. (2009)). This contributes to increase in the students cognitive load as it may demand for more attention in reading and understanding the content (Jeong (2012)). In addition, many students still arguing that mobile e-book is not that easy on eyes and causes eye strain when reading continuously for more than 40 minutes (Glackin et al. (2014); Pölönen et al. (2012)). These students believe that reading academic e-book either through computer screen or handheld mobile devices is still not suitable.

Meanwhile, the battery life of the e-book readers is also creating a significant problem to the users (Gibson and Gibb (2011)). Although the battery life of current dedicated e-book readers had been improved to a durability of 2 weeks, the battery life of non-dedicated e-book readers such as tablets and smart phones (<12 hours when used for reading e-book) is still not sufficient to satisfy the students. Short battery life may frustrate many students which may hinder their mobile e-book use. Meanwhile, the hidden and direct cost incurred when buying and using an e-book and handheld mobile device is also perceived to be another factor that inhibits its use (Parsons (2014); Foasberg (2011)). Many students believe that handheld mobile devices are still expensive and usage of mobile e-book causes other hidden expenses such as printing and internet chargers (Parsons (2014); Sloan (2012); Foasberg (2011)).

Another issue pertaining to the reading of e-books via handheld mobile devices is the inability of the readers to construct a cognitive map when reading e-book via these devices (Thayer et al. (2011)). This is due to the lack of contextual cues and ineffective navigation features (Thayer et al. (2011)). P-book provides contextual cues to the readers to recall from their memory and search for information (Morineau et al. (2005)). For instance, readers can feel the thickness of the book, can estimate the approximate location of the important information in the book, can see how much they have read and how much pages are left for reading (Hansen and Haas (1988)).

However, the intangible nature of the mobile e-book could not provide all these details and consequently erase all the spatial and temporal performance of the p-book (Morineau et al. (2005)).

It is also reported that students were unable to follow their normal studying habits and are faced with distraction from other social activities when reading mobile e-book (Mallett (2010)). Students reported that they can't do the same thing that they do when reading p-book such as writing notes, highlighting and bookmark because of the technical problems in the e-book platforms (Mallett (2010)). It is understood that making notes for instance may enhance their critical reading ability and understand the content better (Jensen and Scharff (2014)). Furthermore, university students requested for more advance features such as advanced search features, handwriting ability and embedded word dictionary to ease their learning activities (Alhammad and Ku (2016)). Meanwhile, receiving phone calls and short message service while reading the mobile e-book especially distract the students' attention from the reading materials (Goundar (2014)). This subsequently may lead to serious negative consequences to the students learning.

Moreover, students face difficulties to recall information from mobile e-books (Sackstein et al. (2015); Singer and Alexander (2017)). The authors elaborated that students struggled to answer questions that require recall of details compared to questions that seeking for factual information when using mobile e-books. Olsen et al. (2013) reported that students learning outcome is affected when they unable to recall the information from mobile e-books.

The 21st century learners demands also for digital learning media that is interactive, attractive, socially based and fully integrated. Edyburn (2010) confirmed that the emergence of such digital learning media has the potential to improve the level of affective, psychomotor and cognitive learning. Hence, mobile e-books that failed to incorporate the expected features of the learners may fail to attract their attention. This leads to the drop in the adoption of the mobile e-books. Smith et al. (2013) surmised that failure to incorporate affective elements such as interactivity and attractiveness may demotivate learners in using the mobile technology for their learning activities.

2. Methodology

This study made use of a case study approach to determine the factors and how these factors hinder the use of mobile e-book for their learning activities. Case study design was selected because this study explores in detail the factors

and how these factors inhibit the use of mobile e-book in the Abstract Algebra research group discussion class (Maxwell (2009)). This study was guided by the research question, What factors and how far these factors hinder the successful use of mobile e-book for postgraduate Mathematics students learning activities?

2.1 Participants

The participants of this study consist of eight postgraduate Mathematics students from a local public university in Klang Valley, Malaysia. Mathematics students were selected as the participants because past studies reported that the use of mobile e-books among mathematics students are not that popular (Jalal et al. (2012); Letchumanan and Tarmizi (2011)). Meanwhile, postgraduate students were selected because according to Nam and Choi (2011), higher level education students derive greater satisfaction with e-books and are also claimed to be more contented than the undergraduates. They also state that students would have a clear idea and vast amount of experience with e-book as their education level moves upwards. As this study intended to collect more in-depth and rich information about the use of mobile e-books, these postgraduate Mathematics students were deemed the suitable subject as participants of this study. Furthermore, the participants of this study are from the research group of Abstract Algebra. This group of students was selected as they were the active users of mobile e-books. Furthermore, it assisted in collecting in-depth data. The participants of this study used smart phones and tablets to read e-books. The participants used mobile e-books from online resources, for example, university online library resources and Google web site. The mobile e-book used by the participants were related to algebra.

2.2 Descriptions of the Abstract Algebra mobile e-book

The participants used mobile e-book entitled Abstract Algebra. The researcher selected the Abstract Algebra mobile e-book because the participants actively used this mobile e-book. This mobile e-book is freely available at the university library web site. It is divided into 27 chapters. It has 657 pages. The book has worked-out-exercises at the end of each chapter besides details descriptions about each topic. This Abstract Algebra mobile e-book is available in PDF format. It has white background and black text. The interface is also very static with text, formulas, diagrams, graphs, and tables. It has a table of contents on the front part of the book and index at the back. It provides features such as highlight, annotate, bookmark, underline, search, and share contents, and print, zoom in, zoom out, and change the reading mode from continuous to single mode. The screen capture of this mobile e-book can be

found in Figure 1 and Figure 2.

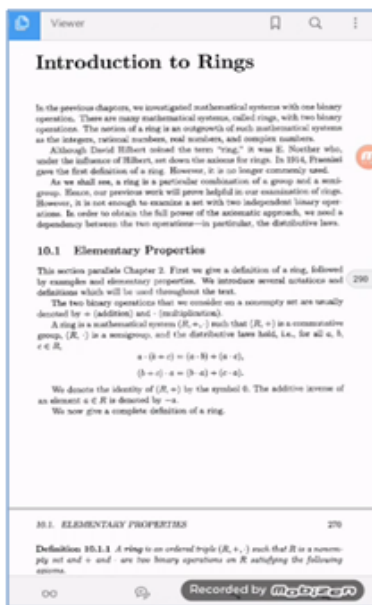


Figure 1: Screen capture of the abstract algebra mobile e-book



Figure 2: Screen shot of mobile e-book with annotation feature

2.3 Data collection

The data for this study was collected via face-to-face interview and non-participant observation in the classroom with the participants. This study made use of semi-structured interview protocols which were derived from the careful synthesis of literature review and constructs from theoretical framework such as Technology Acceptance Model, Pleasure-Arousal-Dominance Model and Diffusion of Innovation Technology.

2.3.1 Interview

The interview guide of this study consisted of two main sections: demographic information of the participants and open-ended questions. The demographic questions included the participants' background information relating to their family.

The second part of the interview guide comprised open ended and semi-structured questions. These questions were designed to capture the details on factors and how far these factors hindered the successful use of the mobile e-book for the participants' learning activities (The second part is also includes other questions. But for the purpose of this study only the relevant part is mentioned). The questions were validated by an expert in the area of educational technology.

One-to-one interview was used to collect data for this study because this enabled the researcher to see the participants face-to-face and understand their perspectives of reading the mobile e-book better. The interviews were conducted at this researcher's room. Before starting the interview, this researcher provided some background information about herself and explained the main purpose of the study to the participants. Furthermore, the participants were informed that the interview would be recorded. The interviews were conducted in both English and Malay languages. This researcher subsequently translated the interviews from Malay into English. The interviews lasted for 45 to 60 minutes. Follow-up interviews were carried out with the participants via e-mail three times to get further clarification and justifications for few questions.

2.3.2 Non-participants observation

In this study, the researcher also observed the behaviour of the participants who were using the mobile e-book. The researcher observed how the participants' behaved when using the mobile e-book and what are the problems that

they encountered during its use. The observation was recorded via a video camera for 14 weeks. The observation protocol was used as a guide to observe the participants' behaviour during the discussion and to analyse the data.

2.4 Data analysis

The interview data was transcribed on the same day of the interview so that the researcher can read through and get a general sense of it before the next interview. The data of this study were analysed by using constant comparative method suggested by Maxwell (2009). The NVivo 11 software was used to analyse the data of the study. The coding process is done based on the research question of the study. The researcher started the coding process by carefully checking the statements that answer the research question to create the relevant code. Then, the researcher grouped the codes that had the same meaning into a category. After that, the researcher repeated the same process to the next set of code/data for the following transcripts by keeping in mind the categories which were formed for the first set of data. After forming the categories for the second set of data, the researcher compared the first set of categories with the second set of categories to select the best category that answers the research question. The same coding process was done for the other interview transcripts and non-participant observation data. Table 1 shows the analysed data based on the categories.

Table 1: Reasons hindering the use of e-book

Reasons hindering the use of e-book	The number of participants who identified this factor
Utilitarian	
Small screen size	6
Unable to write mathematical symbols	4
Eye strain	4
Interruption during reading process (call, sms)	3
Frequent charging required	3
Cognitive	
Lost focus	4
Forgot what had been read	5
Affective	
Not attractive enough	5
Not interactive enough	5

3. Results

3.1 Demographic details of the participants

The participants of the study comprised five male and three female mathematics postgraduate students between the ages of 24-43. Four of the participants were pursuing PhD study and the remaining participants pursuing master degree. All the participants are majoring in Abstract Algebra. They were full time students and used either smart phones or tablets to read e-books. Table 2 shows the demographic details and background of the participants.

Table 2: Biographic information and background of mobile e-book use

	Amin	Chong	Pradeep	Ruhaida	Abdullah	Fatimah	Salmah	Salleh
Age	26	27	27	36	43	37	25	24
Gender	Male	Male	Male	Female	Male	Female	Female	Male
Country of origin	Malaysia	Malaysia	Malaysia	Iraq	Nigeria	Yamen	Malaysia	Malaysia
Program	PhD	Master	Master	PhD	PhD	PhD	Master	Master
Type of mobile device	Smart phone	Smart phone	Tablet	Smart phone	Smart phone	Tablet & Smart phone	Smart phone	Tablet
Year of experience with mobile e-book	2 years	5 years	2-3 years	1 year	1 year	1 year	1 year	1 year
Duration of reading mobile e-book (per use)	30 minutes - 1 hour	2-3 hours	20-30 minutes	1-2 hours	30 minutes - 2 hours	1-3 hours	1-3 hours	1-3 hours

3.2 Reasons hindering the use of the mobile e-book

The result indicated that the reasons that hindered the participants from using the mobile e-books could be grouped into three categories, namely utilitarian, cognitive and affective reasons.

3.2.1 Utilitarian

The participants revealed their concerns about the screen size of the mobile devices used to read the e-book. They claimed that the small screen size

restricted their ability to read the entire text easily and increased the amount of time needed to read as well as to understand the learning contents. Most of the time, they used the zoom in and zoom out function to read the lengthy equations and smaller texts. Sometimes they even missed the connection or link from one part to another when they used this function. Consequently, their understanding of the contents was affected. Salmah, Ruhaida and Amin said:

"A smart phone is small in size...it is very difficult for me to read it for a longer period of time." (Salmah)

"Smart phone is small, so, it is very difficult for me to read more fonts." (Ruhaida)

"Smart phone is smaller in size, hence, it is very difficult for me to read it for longer time" (Amin)

The classroom observation showed that Salmah, Fatimah and Amin would stop reading the mobile e-book for few minutes and continue their reading after that. During the interview they admitted that they took short breaks because they felt uncomfortable reading the mobile e-book for a long time period and also experienced eye fatigue.

The participants in an exasperated manner reported that the annotation feature in the mobile e-book could not be used to write mathematics symbols. They pointed out that this feature in the mathematics mobile e-book should allow the user to write the mathematics symbols and notations. Fatimah and Salmah said:

"I face problem in writing symbols in the note section...if words then no problem but symbols have problem. If got many fonts, I can write symbols that I want but now I can't write it. " (Fatimah)

"Mobile e-book doesn't let me to write symbol." (Salmah)

The classroom observation showed that the participants normally wrote notes on notebooks rather than on the mobile e-book when the head of research group provided explanation. During the interview, the participants claimed that they were unable to write notes on the mobile e-book because they could not write the mathematical symbols.

The participants further regarded reading the mobile e-book as very hectic and tiring. They claimed that their eyes became tired easily when reading it. This condition limits the reading activities and consequently affects the participants' understanding of the subject content. Ruhaida and Salmah expressed their experience of reading the mobile e-book via a smart phone as follows:

"It is not good for eyes...it can harm our eyes." (Ruhaida)

"The reading view of my mobile e-book is not that good, the writing is small because my phone is small. But still can read...my eyes feel very tired when I use it frequently." (Salmah)

The participants also revealed their concerns about receiving phone calls and messages via their mobile devices when reading the mobile e-book. Sometimes they could not avoid the phone calls and needed to answer them. They then expressed their worries of losing focus and needing to read again the same content. For instance, Salmah said:

"It's really interrupts my learning process. I wanted to study but others are disturbing me. I will lost focus also."

Similarly, Salleh agreed that receiving phone calls interrupted his learning process. He worried that he might forget what he had read earlier. However, he clarified that the process was still the same as reading the p-book. After receiving the phone call, one could read again so as not to forget the reading contents. Salleh explained as follows:

"In my opinion, maybe we can forget what we have read when we receive phone call...but no problem, we can read it back...it is same as reading the p-book and suddenly receiving the phone call. After answering the call we read it back...ahh...ahh...the process is same"

In addition, the participants mentioned that they needed to frequently charge their mobile devices when reading the mobile e-book. Although the participants claimed that they could use the power bank, it was observed during the research group discussion that some of the participants stopped using their mobile e-book when the battery power was low.

The classroom observation showed that the participants felt uncomfortable when receiving phone calls and they immediately stop reading the mobile e-book to answer the phone calls. This interrupted their learning process. In addition, the participant Ruhaida also stopped using the mobile e-book several times in the classroom when the battery power was low.

3.2.2 Cognitive

The participants reported that sometimes they lost focus and forgot what they had read before when they read via the smart phone. As the smart phone was smaller in size, they had to scroll left and right and also up and down to read the content. Consequently, they missed the link between one section

and another section, hence affecting their understanding process. For instance, Salmah said:

"In this device, we scroll up and down, we have to focus on one theorem we have to look back the previous page, maybe at the top of the page. I will forget what I have read at the bottom."

The classroom observation showed that sometimes Salmah looked uncomfortable and lost focus when using the mobile e-book. During the interview she answered that she cannot stay focused all the time when reading the mobile e-book because the screen size is very small.

Amin and Pradeep also reported that it is difficult for them to remember or recall the points that they have read via mobile e-book. They claimed that they understand the contents when they read the mobile e-book but failed to recall the important points after some time. The participants also claimed that they can only remain focused for a limited time period when reading mobile e-book compared with p-book. This could be the reason for poor recalling process. For instance Pradeep said:

"I can recall it but I need to go through the information two to three times."

3.2.3 Affective

All the participants revealed their concerns about the appearance and features of the mobile e-book. They felt that the mobile e-book was not attractive or interactive enough. Furthermore, they claimed that no multimedia features, for example, animation, audio and video were included in the mobile e-book. When Abdullah and Amin were asked whether the mobile e-book was attractive, he replied:

"No...I prefer more improvement to be made...maybe can introduce more colours."
(Abdullah)

"No...Because most of the time the mobile e-book doesn't have the interactive features such as sharing notes and multimedia elements. So basically it is just for reading and extracting the information" (Amin)

4. Discussion

A very common problem reported in this study is eye fatigue. It is learnt that handheld mobile devices are smaller in size and reading long content materials such as e-book via these devices needs a higher level of focus. Hence,

the eyes can easily get tired and cause sore eyes. Authors such as (Richardson et al. (2013) ; Hwang et al. (2014)) also argued that their survey respondents' complain of sore eyes when reading mobile e-book and they can only spend less than 30 minutes to read mobile e-book.

Meanwhile, the inability to use the annotation feature to write formulas and equation was reported as another major problem in mobile e-book use. The students claimed that in mathematics they should be given freedom to write notes or derive equations on the book itself. Unfortunately, the students are unable to use the annotation feature for this purpose. The participants felt that writing notes strengthen their memory and at the same time increase their understanding towards the subject materials. Similarly, Jensen and Scharff (2014) asserted that students prefer to use annotation feature during their learning process to enabled them to understand the content better and develop deep learning.

Although the participants claimed that they can remember the points that they read from mobile e-book but sometimes they face difficulties in recalling the important points. However, it is reported that the students can remember better if they read via p-book. It could be because the participants claimed that they can remain focused only for a limited time when reading via mobile e-book. Hence, the ability to recall the important points is reduced when the concentration level is decreased. This inline with Sackstein et al. (2015) who argued that students faced difficulties in recalling information when reading mobile e-book. However, Schugar et al. (2011) reported that there is no significant difference in terms of number of ideas recalled from e-reader compared with p-book. Meanwhile, the inability to construct cognitive map while reading via screen could also explain this poor recalling syndrome. Li et al. (2013) confirmed that it is difficult for readers to form coherent cognitive map of the text when reading via screen compared with reading the p-book. Thus, it affects the effective retention and comprehension of the e-content (Hansen and Haas (1988); Li et al. (2013)) that leads to poor recalling among the learners.

Besides that, distraction from other functions of mobile devices such as receiving phone calls and messages would trigger the participants to lost focus from their leaning activities. Although one participant admitted that this is not a big issue but the rest of the participants stop reading the mobile e-book when receiving phone calls and messages. This implied that reading e-book from multipurpose devices such as smart phones and tablets dampen the learning process of the participants. The finding further support the idea of (Jacob and Issac (2014)) who admitted that students tend to get easily distracted with other function of hand held mobile devices.

Meanwhile, low battery power of the smartphone and tablet is also inhibit the usage of the mobile e-book. It is understood that the battery power consumption of these devices depends on their use for multiple tasks. Hence, it is difficult to control the level of battery power unless the developers take initiatives to improve it. Moreover, the users of mobile e-book are also encourage to use power bank while reading it. It will assist the users to continue reading the mobile e-book without power failure. Parsons (2014) stated that low battery power inhibit the learning process of his participants who were using mobile devices.

In addition to that, it is also reported that the appearance of the mobile e-book which is not attractive and the limited interactivity as well as a lack of multimedia elements discourage the use of mobile e-book. It is understood that these affective factors can leave greater impact on how students feel about the mobile e-book and consequently affect its use. This is inline with previous findings that reported that ignorance towards affective factors may inhibit user from adopting mobile technology (Smith et al. (2013)). In addition to that, participants felt that since mobile e-book is available online, it can maximize the digital elements such as multimedia features to make the mobile e-book more attractive and informative.

The findings also revealed that the participants are not bothered by the cost of the mobile e-book since the mobile e-books are freely available and they can use their hand held mobile devices that they normally used for the communication purposes. This shows a positive improvement in terms of mobile e-book use since past studies mostly noted that cost of dedicated e-book readers are cost very expensive (Chiang and Chen (2014)).

5. Conclusion

The aim of this study was to understand the factors and how far these factors hinder the successful use of mobile e-book for learning activities among mathematics postgraduates students. The findings have expanded our understanding on the reasons that demotivates the usage of mobile e-books as it has been previously discussed in the literature. It also discussed how these factors had hindered the successful use of mobile e-book for learning activities. It is obvious that mathematics postgraduate students are mostly annoyed with the eye strain caused by reading the mobile e-book. They also are mainly looking for more interactive elements in the mobile e-book. Meanwhile, they also want the improved annotation features that enable them to write formulas and equations.

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