

Gender Differences in the Reading of E-books: Investigating Children's Attitudes, Reading Behaviors and Outcomes

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ABSTRACT

As indicated by some studies, the problem of “falling behind” often exists when using computer-assisted learning with children, and gender may be a factor in this. While digital contents presented on various e-readers are promising replacements for paper-and-ink books, the question arises as to whether this emerging technology will have the same effect with boys and girls? Conventionally, boys are believed to have more aptitude for using computer and information technologies, and it is of interest to see if this is true when using e-books in an educational context. In this study, two investigations were conducted to explore children's attitudes, reading behaviors and outcomes in order to find out if there were any gender differences in the reading of e-books. The first investigation was conducted with 166 elementary school students to evaluate their attitudes towards reading with an Interactive E-book Learning System (IELS), a tailor-made e-book learning environment for children. The results showed that the gendered attitudes in terms of the Satisfaction dimension and the expectation for the usable functions were different. Twenty-three sixth-grade children then participated in the second investigation, in which they silently read two e-books in the IELS with a reading behavior tracking technique, and a retrieval test was conducted to assess the reading outcome for each e-book. The results show that while the girls mostly had the behavior of Skimming during the reading process, they outscored the boys in the retrieval tests. Although the application of personalized reading technologies in education, such as reading e-books with IELS, tends to diminish the gap in technology adaptation between the genders, however, the gender differences, as revealed in this work, are still substantial and considerable to factor in children's reading of e-books. In practice, the results of this study suggest that these differences may create reading barriers for some children, and thus should be taken into account when e-books are used for formal learning.

Keywords

Gender differences, E-book reading, Reading attitude, Reading behavior, Reading outcome, Elementary school

Introduction

Gender differences in learning

Various studies of gender issues in academic learning show that gender differences are substantial characteristics among students. For example, Meelissen and Drent (2008) pointed out that the participation of females in ICT (Information and Communications Technology) professional careers is not only low, but is also still falling in most western countries. They thus investigated various factors related to elementary schools or teachers that may influence girls' attitudes toward computers. The results showed that girls' attitudes toward computers are less positive than those of boys. Although digital natives tend to have a high level of technology acceptance (Liu, 2005), gender differences still exist among children in their computer attitudes, affecting learning performances and leading to a problem that is known as “falling behind” (Meelissen & Drent, 2008).

Table 1. Findings of gender differences in earlier studies

Research	Issues	Findings	Is the gender gap existed? (Yes/No)
Gömleksiz (2012)	Students' perceptions of science and technology classes by gender in a Turkish elementary school context	Males considered learning science and technology more necessary and important than females did.	Yes
Goh (2011)	Gender differences in a short message service (SMS) library	SMS efficiency has a significant influence on self-efficacy for	Yes

	catalog search service adoption	males, but not for females.	
Tong, Lara-Alecio, Irby, and Mathes (2011)	The effects of an instructional intervention on dual language development	Females demonstrated a faster rate in dual language comprehension than males.	Yes.
Kay and Lauricella (2011)	Gender differences in the using behaviors (on-task and off-task behaviors) of laptops in higher education classrooms	Females reported significantly more note-taking and participation in academic laptop-based activities.	Yes.
Ding, Bosker, and Harskamp (2011)	The effects of gender and gender pairing on students' learning performances and knowledge elaboration processes in CSCL	Females in single-gender dyads significantly outperformed females in mixed-gender dyads.	Yes.
Chiu and Chow (2010)	The associations in culture, motivation, and reading achievement of high school students in 41 countries	Females outscored males in most countries.	Yes.
Prinsen, Volman, Terwel, and van den Eeden (2009)	The effects on participation of an experimental CSCL-program to support elaboration	Males benefited less than females from the program in terms of the quality of their participation.	Yes.
Meelissen and Drent (2008)	Gender differences in computer attitudes	Females' attitudes toward computers were less positive than those of males.	Yes.
Smith, Hardman, and Higgins (2007)	Gender differences in whole class classroom interaction with an interactive whiteboard (IWB)	Males dominate classroom interaction in terms of the frequency of certain discourse moves.	Yes.
d'Ailly (2004)	A distinctive cultural and gender difference in efficacy, interest, and effort	The Canadian boys had a lower efficacy belief and consistently showed less interest and effort than the girls; this gender gap, however, was not evident in a Taiwanese sample.	Canadian: Yes. Taiwanese: No.

Issues related to gender differences have been widely investigated in many fields, such as motivation and interest (d'Ailly, 2004), behavior and emotion (Shih, 2008), language learning (Tong et al., 2011), computer attitudes (Meelissen & Drent, 2008), Computer-Supported Collaborative Learning (CSCL) (Ding et al., 2011; Prinsen et al., 2009), and classroom interactions (Smith et al., 2007). No matter what the learning situation, as shown in Table 1, many previous studies have demonstrated that gender differences are key factors in academic contexts (Chiu & Chow, 2010; d'Ailly, 2004; Gömleksiz, 2012). Smith et al. (2007) noted that as the provision and use of ICT within schools is now increasing, it is important to continue observing the potential impacts of this on both genders when using ICT, and that more studies are needed to examine this issue from various perspectives.

Gender differences in the reading of e-books

A gender gap has also been reported in reading (Chiu & Chow, 2010; Liu & Huang, 2008). For example, Chiu and Chow (2010) reported that the reading test scores (PISA, the Programme for International Student Assessment) of adolescent students showed that girls outscored boys in most of the 41 countries examined. Gender issues can also lead to different reading behaviors. For example, Liu and Huang (2008) explored how Chinese college students' gender differences were related to their online reading behaviors, and the results showed that male and female students' preferences for reading with digital and printed media were significantly different.

Reading e-books involves a different set of reading processes and behaviors to those of reading printed ones. Both digital and printed media have advantages and limitations, and the presentation of each medium tends to meet the needs of readers based on their purposes and preferences, and these diverse reading needs are often due to differences in gender (Salmerón & García, 2011).

Liu and Huang (2008) found that adult readers print out electronic documents to read more frequently than younger ones, a group that is also known as digital natives, who tend to have different expectations and behaviors toward the use of digital media due to the fact that they have grown up using such technology. Liu (2005) also noted that people's reading behaviors have changed over the previous decade, and that screen-based reading is becoming more popular. Several studies (de Jong & Bus, 2004; Grimshaw, Dungworth, McKnight, & Morris, 2007; Korat & Shamir, 2007, 2008) support these views, and further demonstrate that e-books are able to provide individualized and on-demand multimedia features that can promote the learning effectiveness. Therefore, further studies on the use of e-books for reading are needed, especially in the context of a digital learning environment, in which younger students seem to prefer reading e-books (Wood, Pillinger, & Jackson, 2010) to a greater extent than older ones (Woody, Daniel, & Baker, 2010).

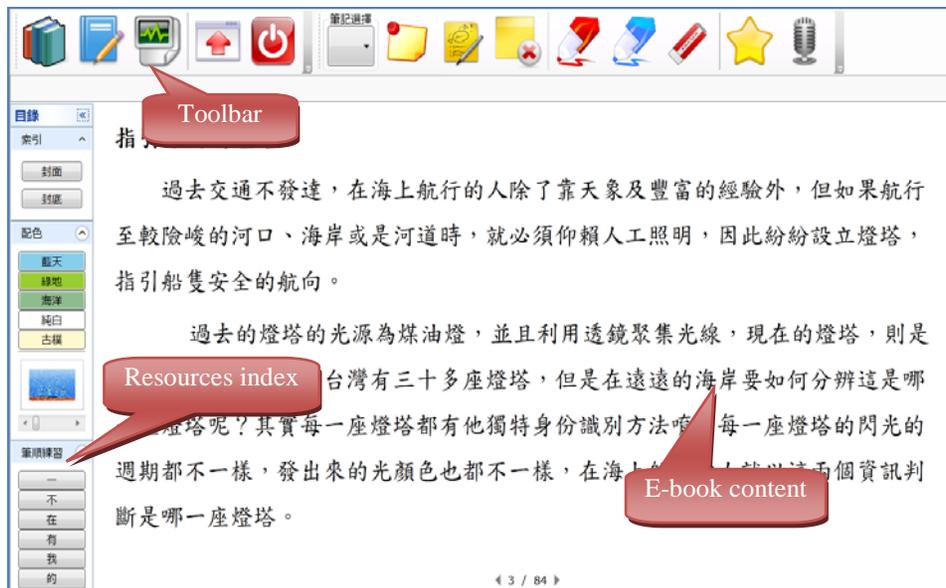
The research question and investigations

Many researchers (Berg, Hoffmann, & Dawson, 2010; Bierman, Ortega, & Rupp-Serrano, 2010; Lam, Lam, Lam, & McNaught, 2009; Pattuelli & Rabina, 2010; Woody et al., 2010) have examined and supported the use of e-books in academic contexts. However, few works have examined whether gender differences are the factors in reading e-books among children. This problem should be properly coped with before e-books become more widely used in formal educational practice. Based on the results of this investigation, both instructional and learning strategies could be adjusted to provide more an adaptive learning experience for children.

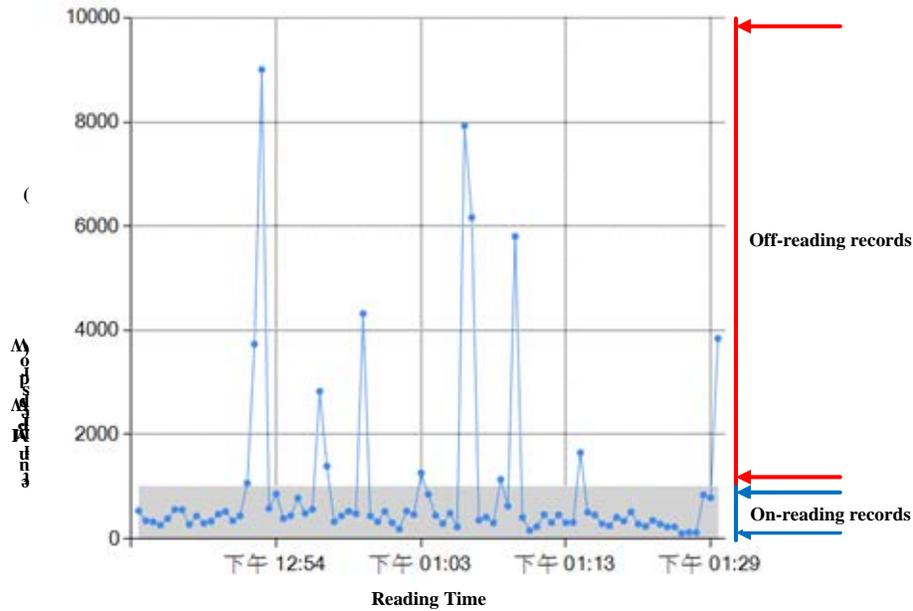
To achieve this goal, this study examined whether there are any gender-related differences with regard to children's attitudes (Lam et al., 2009; Pattuelli & Rabina, 2010), reading behaviors and outcomes (Berg et al., 2010) when reading e-books, carrying out two investigations. The first surveyed the boys' and girls' attitudes towards reading e-books, and the second examined gender differences in reading behaviors and outcomes when reading e-books.

The e-book reading environment and reading behavior tracking technique

As shown in Figure 1a, this study adopted an Interactive E-book Learning System (IELS; Huang, Liang, Su, & Chen, 2012), a tailor-made e-book learning environment for elementary school students.



(a) A screenshot of the Interactive E-book Learning System (IELS)



(b) A line chart of reading rates from the individual real-time report for reading behavior tracking *Figure 1*. The Interactive E-book Learning System and the reading behavior tracking technique

In order to uncover the gender differences in e-book reading behavior, a behavior tracking technique, including the tracking, recording and analyzing functions embedded in the IELS was used. The behavior tracking approach used the reading rate (the words read per minute, wpm) as an indicator to identify various reading behaviors, and all of the students' reading process profiles were collected through the network by the central server. These datasets were then used to examine the variations in reading rates. Finally, the individual reading process report (as shown in Figure 1b) is provided for representing the children's actual reading behavior by analyzing individual reading rate records in real time.

The reading rate, which is positively correlated with reading comprehension (Joshi & Aaron, 2000), can be used to assess students' reading performance (Rasinski, 1999, 2000). As shown in Table 2, this study examined the links between intended and actual behaviors by means of the list of reading rates and statuses associated with reading behaviors in the literature.

Table 2. The reading rates and statuses associated with reading behaviors in the literature

Reading status	Reading rate (wpm)	Reading behavior	Study
On-reading	0-1,000		
<i>Slowing</i>	< 50	Excessively slow Inefficient reading Disfluent Labored Inexpressive Unenthusiastic rendering	(Harris & Sipay, 1990; Rasinski, 2000; Walczyk, Marsiglia, Bryan, & Naquin, 2001)
<i>Memorizing</i>	50-100	Sustained attention	(Carver, 1977, 1990; Duggan & Payne, 2009; Fraser, 2007; Gillett & Temple, 1986; Harris & Sipay, 1990; Liu, 2005; Liu & Huang, 2008; Rasinski, 1999; Reader & Payne, 2007; Reading, 2012; Stroud & Henderson, 1943)
<i>Learning</i>	100-200	In-depth reading Oral reading Concentrated reading Annotation (highlight)	
<i>Rauding</i>	200-400	Silent reading*	
<i>Skimming</i>	400-700	Keyword spotting	

<i>Scanning</i>	700-1,000	One-time reading Reading selectively Browsing and scanning Non-linear reading	
Off-reading	$\geq 1,000$		
<i>Flipping</i>	$\geq 1,000$	Flip page Glance and glimpse	(Carver, 1977, 1984; Harris & Sipay, 1990)

Note. “※” represents the subject of reading behaviors examined in this study.

Investigation one: A survey of gendered attitudes toward e-book reading

The participants and research procedure

The first investigation was carried out to collect the gendered attitudes from six selected classes (one class per grade in a technology-rich elementary school). A total of 166 children (85 boys and 81 girls) participated in the 80-minute activity of evaluating e-book reading with the IELS.

Holzinger’s usability test methods (2005) were used, including thinking aloud, field observation, and questionnaire survey. The process began with the introduction of the IELS (20 minutes), in which the thinking aloud method was carried out by the experimenter. Subsequently, the procedure of IELS operation with a field observation (paired group evaluation, 40 minutes, as shown in Figure 2a) was conducted to evaluate the reading of e-books, with interactive discussions encouraged. To this end, this study typeset six e-books (one book per grade) with content related to classical Chinese poetry taken from the printed books currently used in the school. Finally, a questionnaire survey (20 minutes, as shown in Figure 2b) was used to gather each child’s perceptions of e-book reading. In this phase, the experimenter reminded the children that they should compare their perceptions of reading of e-books with printed books, and the results of the questionnaire were then analyzed.



(a) Investigation 1: Paired group students were testing the IELS.



(b) Investigation 1: The questionnaire survey.

Figure 2. Investigation one conducted in this study

The questionnaire design

The questionnaire consisted of 48 questions designed to assess the children’s perceptions of e-book reading with IELS. The first part of the questionnaire contained 30 questions on system usability, which were adopted from Lund’s USE Questionnaire (2001) and translated into Chinese. The second part of the questionnaire consisted of 15 questions on perceptions of the functionality of IELS. All the questions in the first and second parts used a five-point Likert scale. The third part of the questionnaire consisted of three open-ended questions, which asked the children to briefly describe the advantages and disadvantages of the IELS, and any suggestions that they had about using the system.

The internal consistency and reliability were tested by means of the Cronbach's alpha coefficient, and the result for the sample as a whole was .96. For the various dimensions, the coefficient ranged from .86 to .91 (*Usefulness* = .88, *Ease of use* = .86, *Ease of learning* = .88, *Satisfaction* = .87, *Functionality* = .91), indicating the questionnaire was acceptable with good internal consistency and reliability. The independent sample *t*-test method was then used to analyze if there was any significant differences in the five dimensions in terms of male and female students.

The findings of gendered attitudes to e-book reading

In general, all of the children made very positive comments about the reading of e-books, as shown in Table 3, somewhat different to the findings in Lam et al. (2009), which examined the opinions of older readers. This is not surprising, as the boys and girls in this study are all digital natives, and thus have higher levels of technology acceptance than older individuals (Holzinger, Searle, & Wernbacher, 2011).

Although Meelissen and Drent (2008) suggested that the gender differences in attitudes toward using computer at school are small or even negligible, there was a significant difference in the *Satisfaction* dimension for all children. The results indicated that the girls ($m = 4.48$) were more satisfied with reading an e-book than the boys ($m = 4.20$). Moreover, in the other dimensions the girls also had slightly positive attitudes than the boys, although overall these gender differences were not significant.

The application of personalized reading technologies, such as e-books with IELTS, as used in this work, can better support individualized reading, and thus is likely to reduce the gender inequalities related to the use of the technology in the classroom (Smith et al., 2007). In support of this, both genders represented positive attitudes towards the reading of e-books, rarely negative, as seen in gender related studies (e.g. Lam et al., 2009; Meelissen & Drent, 2008).

Table 3. The descriptive statistics and t-test results of the children's attitudes

Grade	Gender		Dimensions					Average
			Usefulness	Ease of use	Ease of learning	Satisfaction	Functionality	
Grade 1	male	m	4.77	4.46	4.52	4.81	4.58	4.63
		n=11	(s.d.)	(0.19)	(0.51)	(0.72)	(0.25)	(0.48)
	female	m	4.46	4.08	4.14	4.59	4.44	4.34
		n=14	(s.d.)	(0.57)	(0.73)	(0.95)	(0.69)	(0.77)
		<i>t</i>	1.76	1.47	1.10	0.97	0.52	1.39
Grade 2	male	m	4.53	4.26	4.23	4.43	4.50	4.39
		n=15	(s.d.)	(0.54)	(0.59)	(0.62)	(0.57)	(0.55)
	female	m	4.60	4.70	4.69	4.69	4.73	4.68
		n=12	(s.d.)	(0.37)	(0.26)	(0.39)	(0.36)	(0.40)
		<i>t</i>	-0.43	-2.56*	-2.20*	-1.38	-1.20	-1.77
Grade 3	male	m	3.90	3.63	3.81	3.93	3.97	3.85
		n=13	(s.d.)	(0.75)	(0.87)	(1.15)	(0.76)	(0.78)
	female	m	4.10	4.12	3.75	4.54	4.28	4.16
		n=12	(s.d.)	(0.88)	(0.83)	(1.58)	(0.69)	(0.90)
		<i>t</i>	-0.62	-1.44	0.10	-2.06	-0.93	-1.00
Grade 4	male	m	3.94	3.50	3.88	4.12	4.05	3.90
		n=16	(s.d.)	(0.64)	(0.67)	(0.97)	(0.58)	(0.70)
	female	m	4.17	4.07	4.16	4.52	4.40	4.27
		n=14	(s.d.)	(0.55)	(0.55)	(0.96)	(0.42)	(0.63)
		<i>t</i>	-1.07	-2.54*	-0.81	-2.16*	-1.43	-1.92
Grade 5	male	m	3.93	4.08	4.41	3.97	4.03	4.08
	n=16	(s.d.)	(0.84)	(0.69)	(0.75)	(0.77)	(0.34)	(0.49)
	female	m	3.98	4.02	4.33	4.25	4.25	4.17

	n=15	(s.d.)	(0.91)	(0.78)	(0.84)	(0.84)	(0.70)	(0.73)
		<i>t</i>	-0.14	0.21	0.25	-0.95	-1.12	-0.37
Grade 6	male	m	4.15	4.08	4.32	4.08	4.12	4.15
	n=14	(s.d.)	(1.13)	(0.90)	(0.83)	(1.05)	(1.09)	(0.94)
	female	m	4.10	4.09	4.18	4.36	4.38	4.22
	n=14	(s.d.)	(0.93)	(0.81)	(1.12)	(0.79)	(0.64)	(0.81)
		<i>t</i>	0.14	-0.04	0.38	-0.79	-0.76	-0.21
All	male	m	4.18	3.98	4.19	4.20	4.20	4.15
	n=85	(s.d.)	(0.79)	(0.77)	(0.87)	(0.75)	(0.72)	(0.65)
	female	m	4.23	4.17	4.21	4.48	4.41	4.30
	n=81	(s.d.)	(0.75)	(0.71)	(1.03)	(0.66)	(0.68)	(0.67)
		<i>t</i>	-0.40	-1.61	-0.17	-2.57*	-1.96	-1.47

Note. * $p < .05$. “m” represents the mean value of the children’s scores in the related dimension, and “s.d.” means the standard deviation of the children’s scores in the related dimension. “*t*” means the independent sample *t*-test value, and the **bold** values mean that the scores between the male and female children were significantly different.

In the open-ended questions, the children’s feedback was still positive and similar to the findings shown in Table 4. However, by examining their answers to the question as to whether any improvements are needed to IELTS, 27.72% of the children hoped it could have more functions, such as games, drawing and annotation tools. As shown in Table 4, the boys were more likely to feel that the functions of the IELTS fell short of their expectations, especially with regard to games.

Table 4. The descriptive statistics for the children’s suggestions for improving the IELTS

Suggestion	Males		Females	
	N	(%)	N	(%)
Games	9	10.59	1	1.23
Drawing tools	6	7.06	2	2.47
Annotation tools	13	15.29	15	18.52
Total	28	32.94	18	22.22

Note. “N” represents the number of children suggesting the related item, and “%” means the children’s percentage of all gendered participants (males = 85 and females = 81).

These results echo the observation of Kay and Lauricella (2011) that male students played significantly more games during laptop-based learning, whereas the female students carried out significantly more note-taking, while Sim, MacFarlane, and Read (2006) also found that males engaged in more behaviors unrelated to learning in a similar context. Therefore, there were significant gender differences in the functions requested for the e-book platform.

Such usability-oriented requests raised among the children are substantially existed towards the e-book reading. The results thus show that usability does matter to children, although the genders have different ideas about how to improve it, and this issue deserves further investigation.

Investigation two: Identifying gender differences in reading behaviors and outcomes

The research procedure

As shown in Figure 3, the research procedure was designed to investigate whether there were any differences in the reading behaviors and outcomes between genders.

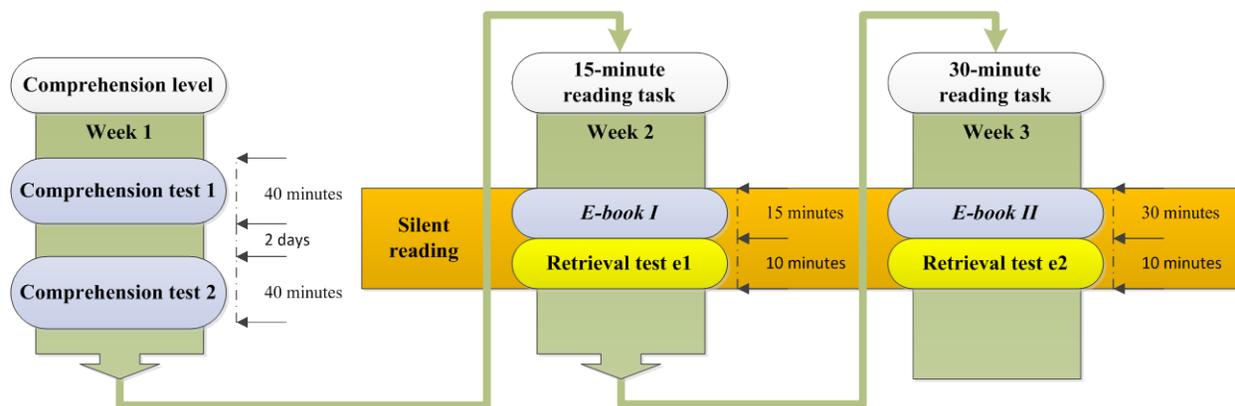


Figure 3. The research procedure of the investigation two for identifying the gender differences in reading behaviors and outcomes

Since silent reading is widely adopted in general classroom practice, it was thus considered the ordinary reading condition in this study. In the silent reading activity, the children were able to read at their own optimal rates, and this is in line with what Fraser (2007) noted about the *Rauding* status, which is an individual's preferred reading rate, at which they can effectively assimilate the ideas across sentences at a pace that follows their own cognitive speed. Moreover, this study adopted two different reading durations (15 and 30 minutes) that conventionally occur in the classes held at Taiwanese elementary schools (40 minutes).

The participants and reading materials

This study recruited 23 sixth-grade children (12 males and 11 females) with the consent of their parents to participate the reading experiment. Before the reading experiment, the children were asked to finish two comprehension levels to ensure that the genders were at similar reading comprehension levels that would not cause significant differences in their reading rates (Joshi & Aaron, 2000). As shown in Figure 4a, every participant was asked to silently read two e-books (one e-book per week) with an e-reader (FIC Tycoon TVB00). Meanwhile, an observer was arranged to unobtrusively sit in as a teacher and assist students if needed.



(a) Investigation 2: the e-book reading task



(b) Investigation 2: the retrieval test.

Figure 4. Investigation two conducted in this study

Two different reading durations (15 and 30 minutes) were used to examine the gendered reading behaviors and outcomes. Two e-books adopted in this study were general science information texts written in Chinese. E-book I (reading time = 15 minutes) consisted of 20 topics, a total of 3,640 words, the average words per sentence was 15 words, and the word frequency was 99.09% within the 5,021 common Chinese words that were selected from the elementary school survey of common words report (Ministry of Education, 2000). E-book II (reading time = 30 minutes) consisted of 24 topics, a total of 5,475 words, the average words per sentence were 14 words, and the word frequency was 99.20% within the above-mentioned set. The use of above level texts was to ensure that the two books

were appropriate with regard to meet the participants' word recognition abilities, so as to avoid a ceiling effect in the experiment.

The reading behavior tracking and reading outcome measuring

In the e-book reading tasks, the reading behavior tracking technique developed in the IELS was used to simultaneously record the reading behavior on the reading process profile of every child (each record comprises reading duration, texts, and page number). These profiles were collected by a central server, and then analyzed to identify any differences in the reading behavior between the genders throughout the reading processes.

Upon completing each reading task, the children were asked to take a 10-minute retrieval test, as shown in Figure 4b. Specifically, they were asked to freely recall some of the knowledge they had just learned by reading (Carver, 1990; Fraser, 2007), and the results were regarded as their individual reading outcomes. If a child did not completely read and understand the text, then the new knowledge may be poorly stored in the long-term memory, or even lost from the working memory, based on the theory of cognitive memory (e.g. Ecker, Lewandowsky, Oberauer, & Chee, 2010; Nation & Cocksey, 2009; Swanson & Howell, 2001).

In every retrieval test the children were asked to write 10 sentences about the scientific information contained in the e-book they had just read. The reading outcomes were then measured according to the correctness of each sentence based on five separate levels (the rating criteria were as follows: four points for completely correct, three points for almost correct, two points for half correct, one point for less correct, and zero points for no answer or completely wrong). Two raters assessed the sentences based on these criteria. The Cronbach's alpha coefficient of their preliminary rating results was .68, showing a good fit for the reliability measure. The raters were then asked to review the results together and reach a consensus through discussion if any discrepancies were found.

The findings for the reading behaviors and outcomes

Gender differences in reading behaviors

To confirm that the students of both genders had similar reading comprehension levels (Joshi & Aaron, 2000), the children took two comprehension tests before the reading experiment. As shown in Table 5, no significant differences were found between genders, and thus the male and female groups had approximately the same comprehension level, and so this did not interfere with the measurement of the reading rate, which was adopted as an indicator of reading behavior in this work.

Table 5. The comprehension test and the t-test results

Comprehension test	Male		Female		t
	m	(s.d.)	m	(s.d.)	
Test1	13.25	(2.09)	13.73	(2.87)	-0.46
Test2	13.92	(3.20)	16.18	(2.44)	-1.89
Total	27.17	(4.32)	29.91	(4.89)	-1.43

Note. "m" represents the mean value of the students' comprehension test scores, and "s.d." means the standard deviation of the students' comprehension test scores. "t" means the independent sample *t*-test value of the comprehension test scores between genders.

A total of 1,566 on-reading records were collected from the participants, and then analyzed to identify the gender differences in their reading behaviors. To understand the fluctuation in reading rate throughout the reading process, this study further examined the reading rate in 5-minute periods, and then converted every reading rate into the corresponding reading status according to the categories listed in Table 2. The independent sample *t*-test method was adopted to identify the significant differences in the reading rates between the genders.

As shown in Table 6, overall, the boys' reading rates were lower than those of the girls. A significant difference was found between the genders in the reading rates for the 30-minute reading task. This supports the finding of Burman,

Bitan and Booth (2008) that the girls tend to acquire vocabulary faster than boys, perhaps reflecting different ways of linguistic processing between genders.

According to Carver's (1977) definition, *Skimming* is used to superficially process a large quantity of text. Duggan and Payne (2009) claimed that while *Skimming* can improve memorization of the important ideas in a text, but may pass over the details within it. Our results show that the girls preferred *Skimming*, which is an important reading strategy essential for acquiring a good comprehension level of the gist of the text, as the reading behavior of spotting keywords shown in Table 2.

Reader and Payne (2007) pointed out that an adaptive reading strategy allows a reader to save more time to allocate to better reading, such as improving memorization of the important ideas by *Skimming*, but which reading strategy is the best relies on a complex set of issues (Lawless, Mills, & Brown, 2002; Salmerón & García, 2011), such as the texts, reading tasks, and reading skills. Salmerón and García (2011) claimed that children, starting at around 11 years old, possess the necessary reading skills to implement reading strategies. Nevertheless, how these strategies affect e-book reading comprehension is still an open question.

Table 6. The reading rate, status, and the t-test results

Time (minutes)	15-minute reading task (nr=584)							30-minute reading task (nr=982)						
	Male			Female				Male			Female			
	m	(s.d.)	st	m	(s.d.)	st	t	m	(s.d.)	st	m	(s.d.)	st	t
5	307.38	(81.42)	Ra	456.61	(164.34)	Sk	-2.72*	336.49	(118.25)	Ra	422.25	(108.48)	Sk	-1.81
10	351.10	(116.05)	Ra	389.21	(119.64)	Ra	-0.78	361.20	(118.12)	Ra	428.11	(87.24)	Sk	-1.53
15	387.32	(135.14)	Ra	481.84	(142.69)	Sk	-1.63	335.12	(101.89)	Ra	406.74	(121.08)	Sk	-1.54
20								348.78	(80.71)	Ra	431.42	(155.63)	Sk	-1.62
25								366.41	(85.56)	Ra	460.67	(136.54)	Sk	-2.00
30								346.01	(188.39)	Ra	448.68	(202.12)	Sk	-1.26
Average	348.60	(106.09)	Ra	442.55	(122.20)	Sk	-1.97	349.00	(53.56)	Ra	432.98	(97.74)	Sk	-2.59*

Note. * $p < .05$, ** $p < .01$. "nr" represents the number of on-reading records. "m" represents the mean value of the students' reading rates in the related period, and "s.d." means the standard deviation of the students' reading rates in the related period. "st" means the corresponding reading status of the related reading rate, "Ra" means the *Rauding* status, and "Sk" means the *Skimming* status. "t" means the independent sample *t-test* value of the reading rate, and the **bold** values mean that the reading rates between the male and female students were significantly different.

The boys' reading rates, all in the *Rauding* status, were very stable throughout the reading process, as expected with the silent reading behavior. However, the girls' reading rates were mainly in the *Skimming* status, which was found for none of the boys.

By contrast, the boys read in the *Rauding* status, at the pace of their cognitive speed (Carver, 1984; Fraser, 2007) throughout the reading process. The reading strategies that were not used by the boys may have been neglected due to their undeveloped reading skills or strategies, if the performance of the girls is regarded as 'the norm'. This is a gender difference in reading behavior when the children were reading e-books. Therefore, instruction in various reading skills and strategies seem to be needed for children, as noted by earlier researchers (e.g., Mayer, 1996; Park & Kim, 2011; Reutzel, Smith, & Fawson, 2005). In practice, teachers can provide a proper instruction of reading skill and strategy towards the gender differences in reading of e-books for promoting them a better reading experience (Park & Kim, 2011; Reutzel et al., 2005; Sung, Chang, & Huang, 2008), and prevent such differences lead to the barrier for children when e-books are used for learning.

Gender differences in reading outcomes

Following the gender difference in reading behaviors identified above, it is unsurprising that significant differences in the reading outcomes of 30-minute reading task were also found between the genders, as shown in Table 7.

Salmerón and García (2011) claimed that the reading strategy used has an effect on comprehension. Therefore, the girls may have used *Skimming* to improve their memorization of important ideas in the e-books, thus gaining better

comprehension of the gist of the text, resulting in the different reading behaviors between the genders. This then had a significant effect on their reading outcomes, leading them to outperform the boys, which is in line with the finding of Chiu and Chow (2010) that most female students did better than the male ones with regard to their reading achievement in high school, and this another example of a “falling behind” problem in reading achievement.

Table 7. The reading outcomes and the t-test results of the reading tasks

Retrieval test	Male		Female		<i>t</i>
	m	(<i>s.d.</i>)	m	(<i>s.d.</i>)	
e1 (15-minute)	14.00	(4.49)	16.09	(4.28)	-1.14
e2 (30-minute)	15.17	(4.80)	21.18	(4.47)	-3.10 **
Total	29.17	(6.73)	37.27	(7.09)	-2.81 *

Note. * $p < .05$, ** $p < .01$. “m” represents the mean value of the students’ retrieval test scores, and “s.d.” means the standard deviation of the students’ retrieval test scores. “*t*” means the independent sample *t*-test value of the retrieval test scores between genders, and the **bold** values mean that the scores between the male and female students were significantly different.

However, this problem is different from the one found for children with regard to their attitudes towards computers, as reported by Meelissen and Drent (2008). In fact, the differences in reading behaviors and outcomes found in the current study may disappear when the development of sensory processing in boys catches up to that of girls, as the adult language processing of both genders relies similarly on the efficiency of the linguistic network, as noted by Burman et al. (2008).

General discussion and conclusion

The gender differences in reading e-books

Although screen-based reading is becoming more popular and has changed the reading behaviors of digital natives (Liu, 2005), gender differences in reading may still exist (Chiu & Chow, 2010; Liu & Huang, 2008). However, our results reveal that these differences when reading e-books may not be directly related to those found in students’ computer-assisted learning.

In fact, Meelissen and Drent (2008) emphasized that gender difference in attitudes towards using computers leads to a “falling behind” problem between genders. Based on our experimental results, the effect of gender was against expectation with regard to reading e-books. In addition, the reading process is individualized and varied, as reflected in the gender differences in reading behaviors revealed by this work. Moreover, the students’ use of reading skills and strategies also seemed to be gendered, leading to the gap in reading outcomes between the girls and boys. Therefore, restructuring the understanding of gender differences in reading of e-books is a critical issue before this technology is more widely used for formal learning.

In general, our results for the attitudes, reading behaviors and outcomes of reading e-books show the significant differences between genders. The girls expressed more satisfaction attitude to demonstrate a tactical reading so as to represent better reading outcomes. By contrast, the boys also had the positive attitude but emphasized a higher expectation of versatile functions, and did not read in an active manner, like the girls, leading to their worse reading outcomes. Nevertheless, the generalizability of our findings may be somewhat limited, mainly because the experiment was conducted with a relatively small sample size. More empirical studies are thus needed to disclose a more complete picture of the gender differences that arise when reading e-books.

Conclusion

Since the “falling behind” problem between genders has been shown to affect children’s computer-assisted learning, it is worth examining whether this problem also applies to e-book reading. This work thus examined gender differences among children reading e-books, serving as a preliminary study of this issue.

In this study, we presented the evidence obtained from two investigations to identify the related gender differences, including attitudes, reading behaviors and outcomes towards the e-book reading. Based on the results of both investigations, the gender differences are considerable factors in children's reading of e-books. Our findings revealed that the boys did not have the better performance, against expectations. One possible reason for this is the boys may have been distracted by the e-book itself due to their greater technology acceptance, and this meant they were less good at reading task. Nevertheless, a large experiment is required to confirm this assertion.

With the aim of further dealing with the gender differences in e-book reading, our future work will focus on the use of the adaptive scaffolding when the "falling behind" problem occurs due to gender differences, as this will help children to better use e-books in an academic context.

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