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Using an E-book in the secondary English classroom: Effects on EFL reading and listening

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Abstract

This study investigated the effects of incorporating e-books into instructional material on reading and listening development among secondary school students with different levels of English proficiency. The experimental group utilized an e-book in regular English class, and the control group used a print version with the same content. An achievement test and focus-group interview followed the six-week e-book intervention. The test results showed that the e-book had a positive impact on listening comprehension, particularly for low-proficiency students. For these students, multimedia input combined with a standard accent seemed more effective for the development of listening skills than access to only the foreign-accented English spoken by the teacher. Furthermore, the use of visual aids, such as images and captions, might support listening comprehension by helping the students visualize auditory input and providing contextual information. Audio-only input might not be enough for low-proficiency students, who have relatively limited capability to recognize words from speech. With regard to reading, the e-book intervention resulted in higher test scores compared to the print book, but the between-group difference did not reach statistical significance. Possible reasons include a small sample size in each proficiency group as well as technical restrictions and distraction caused by multimedia material. The interview data indicates that the use of technology was not perceived as particularly beneficial for learning. Instead, diverse classroom activities and interactions were considered more important than the technology itself to draw students' attention and sustain their motivation. Pedagogical implications of the results are discussed.

Keywords E-book · EFL learning · Reading · Listening · Secondary school

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1 Introduction

When the Ministry of Education began to promote technology-integrated instruction, technological applications spread across Taiwan at all levels of education (Ministry of Education 2008). Among these, e-books have the potential to change the way students learn and use information because of their portability and multimedia capabilities. An e-book is defined as "… a digital object with textual and/or other content [that] … typically has in-use features such as search and cross reference functions, hypertext links, bookmarks, annotations, highlights, multimedia objects and interactive tools" (Vassiliou and Rowley 2008, p. 363). E-books are easy to update and provide user-friendly search functions. They also offer built-in multimedia applications providing a variety of visual and acoustic stimuli. Hyperlinks connect related information together like a data bank; therefore they have the potential to change reading habits by allowing for non-linear reading and flexible access to information. E-books can also motivate unwilling readers, as well as support comprehension, by providing exposure to diverse stimuli, such as carefully-designed animations and sound effects (Larson 2010; Shamir et al. 2018). It has been noted that e-books could exert some adverse effects on learning, including eye strain caused by extended use of electronic screens and a sense of disorientation induced by access to a large amount of information (Tosun 2014).

The effectiveness of technology-integrated instruction has been highly debated. Macaro et al. (2012) review of 47 studies provided limited and inconclusive evidence on the effectiveness of technology-integrated learning in second-language (L2) English classrooms, although there was stronger evidence that technology use positively influenced learner attitudes. Likewise, Cheung and Slavin's (2012) meta-analysis of 84 studies based on over 60,000 K-12 participants indicated positive but small effects of technology applications on reading relative to traditional methods. Students' achievement gains in a technology-assisted environment could be due to the novelty effect or strategies applied by teachers rather than the educational technology itself, which is merely a medium for delivering instruction (Clark and Feldon 2005; Selwyn 2011). Also, the multimedia features of e-books, if not appropriately customized to learner needs, will not promote language learning (de Jong and Bus 2003; Roskos et al. 2009). There is still a need for further research on the effectiveness of e-books as tools for learning, taking into account both the educational context and learner characteristics (Hsu et al. 2013a). For example, using e-books in the context of formal education might be very different from reading in an after-school program. Learner characteristics could also potentially affect learning processes and outcomes.

This study investigated the effects of incorporating an e-book into instructional material on reading and listening development among secondary school students with different levels of English proficiency. Unlike most previous works, which are conducted in an elementary school or a university setting (e.g., Huang 2013; Korat et al. 2014; Segal-Drori et al. 2010; Yoon 2013), this study utilized an e-book as the main source of learning material in a regular secondary school curriculum, where students and teachers face high levels of stress due to exam-oriented education in Taiwan. Moreover, while most previous research focused on reading skills, the multimedia resources of e-books also have the potential to support listening comprehension. This study therefore extended existing research by examining the effects of e-book use on both the listening and reading skills of learners at different levels of English

proficiency. This study serves as valuable reference for teachers and researchers by allowing for a more comprehensive understanding of students' opinions on e-book use in the specific context under consideration.

1.1 Literature review

This section reviews previous research regarding the effects of e-books on learning performance and attitudes and ends with a summary highlighting unresolved issues in the literature. Overall, there has been no conclusive evidence on the efficacy of e-book use, which appears to depend on such factors as individual learner characteristics and contexts of reading purpose.

E-book use and learning performance Shamir and colleagues conducted a series of studies utilizing e-books to enhance emergent literacy skills (L1) in children aged 5–7, particularly those at risk for learning disabilities and from poor socioeconomic backgrounds (see Shamir and Korat 2015 for a review). Shamir et al. (2012) found that e-book reading was more effective than teacher reading of the same print book in terms of improving the vocabulary of children at risk for learning disabilities. The multimedia features of e-books supported multisensory learning, which compensated for the children's deficiencies in perception and memory. For example, illustrations clearly visualized auditory explanations of new words, which was more beneficial than the exclusively verbal explanations given by a teacher reading the print version. In addition, self-initiated activation of the e-book dictionary might promote learner attention to new words and thus better support meaning retention as compared to teacher-led vocabulary instruction. Shamir et al. (2018) provided further evidence on the long-term effects of e-book reading on language retention among children at risk for learning disabilities. The children who read e-books retained new words better than those who participated in the regular kindergarten program, as measured by a word-picture matching task both immediately after reading and seven weeks after the intervention. It is likely that the e-book readers exhibited better retention because they were exposed to new words repeatedly through reading and listening to explanations multiple times, both in dictionary mode and within the context of the story. Moreover, e-book reading facilitated recall of the main ideas of the story not only immediately after the intervention but also after seven weeks. Although the e-book reading groups recalled fewer exact words and quotes from the story over time, they exhibited a significant improvement in recalling main ideas seven weeks after the intervention. The text illustrated with closely related animations and sounds could contribute to understanding and recall of the story over time. The authors noted the importance of the frequency and relevance of multimedia elements in e-books.

Although the research of Shamir and colleagues indicated the benefits of multimedia on the reading comprehension and vocabulary of L1 children at risk for learning disabilities and from poor socioeconomic backgrounds, their findings may not be generalizable to other populations. For example, in the work of Smeets and Bus (2015), the multimedia and interactive features of e-books did not affect the reading comprehension of normal L1 children aged 4–6 years. These children comprehended and recalled a story equally well after independently reading static e-books, animated e-books, and interactive animated e-books. An explanation of the finding was that the

sample of participants had had long experience of listening to oral text accompanied by static pictures during traditional adult-led book-reading. Thus, they were able to understand and infer story elements without additional information sources, such as animations and sounds. Moreover, Korat et al. (2014) observed that normal L1 preschool children learned new words from e-books with adults' help and by using a built-in dictionary, either static or dynamic. Adults' vocabulary support during e-book reading led to the most significant progress (from the pre- to the post-test) in all measures of receptive word comprehension, expressive word explanation, and word production in story retelling. The dynamic dictionary was more effective than the static dictionary only for productive (but not receptive) vocabulary learning. This could be due to the fact that dynamic illustrations present explicit simulation of the meaning of verbs, including movements and processes, allowing young children to more easily understand and internalize new verbs, as opposed to inferring word meaning from static visuals. However, since the target words were all verbs, it is unclear whether animations would benefit the learning of other syntactic categories.

In short, the multimedia elements of e-books appear to benefit different types of learners to different degrees. Korat et al. (2009) was one of the few e-book studies that compared L1 kindergarteners with high and low initial literacy levels. The children's progress in emergent literacy was influenced by not only the type of intervention (e-book versus e-book with adult support and versus print book with adult support) but also their initial literacy level. Both the low- and high-level children progressed more after reading e-books with adult support relative to the other two conditions. The high-level children also benefited more from reading print books with adult support in comparison with reading e-books without assistance. These findings suggest that the effects of e-book use depend on learners' proficiency as well as the availability of adult assistance, at least for young children. E-books appear to be particularly beneficial for low-proficiency children, and adult support seemed necessary during either e-book or print book reading for the development of emergent literacy. Nayak and Sylva (2013) reported similar findings in an EFL setting. Guided e-book reading (with reading strategy instruction and peer/teacher interaction for meaning negotiation) was effective at improving the reading comprehension of Chinese learners of English, aged 9–10 years, compared to a no-intervention control. However, independent e-book reading (reading computerized stories with sounds and text-related games but without any interaction or guidance) did not significantly increase reading comprehension relative to no intervention. This further confirms that the effectiveness of e-books in language learning is susceptible to the influence of learner proficiency and the availability of interaction/guidance.

E-book use and learning attitudes Research has shown that learners hold mixed attitudes towards the use of e-books, depending to some extent on reading purposes. Yoon (2013) investigated the use of online animated e-books as the main reading material in an after-school English program for fifth-graders, who were accustomed to reading e-books. The 12-week e-book instruction was found to enhance the students' reading motivation, as measured by the pre- and post-surveys. The participants preferred e-books over paper-based materials particularly for out-of-class English learning. They reported that the easy access to multimedia resources and self-controlled learning environment provided by the e-books made them fun, which motivated the participants

to increase their English reading. Likewise, Huang (2013) reported that EFL university students with an intermediate level of proficiency had positive perceptions of an e-book reading program, where students read at least one e-book weekly during a one-year experiment. In this program, e-books were perceived as having potential to foster reading motivation and habits mainly because of the e-discussion function of the e-book program, which provided opportunities for social interaction within a virtual community. Seeing what others are reading, sharing thoughts on texts, and receiving feedback could be an important part of being motivated to read. Multimedia components in e-book, such as animations and audio effects (read-aloud and background-music functions) were perceived to improve text comprehension and reduce anxiety.

In contrast to the positive findings of Huang (2013) and Yoon (2013), Woody et al. (2010) revealed that university students preferred paper-based textbooks over e-books for learning and that this preference did not vary with familiarity with the medium. Despite their familiarity with computers and interactive technology in their daily lives, students reported to be more likely to utilize special features, such as captions and graphics, and answer study questions in print books than in e-books. E-books with hyperlinks also did not lead to more engagement with online learning resources compared to print books. Shepperd et al. (2008) had similar findings in a university course setting. While using an electronic or a print textbook resulted in similar course learning outcomes, the university students generally had unfavorable evaluation regarding the convenience of an e-textbook and reported spending less time reading an e-textbook for class than reading a print textbook. These findings echoed those of Lam et al. (2009), who found that EFL university students' satisfaction with e-book reading decreased as they spent more time on the technology, suggesting that initial reactions were the result of the novelty effect. While the students benefited from the e-book functions of note-taking and text-highlighting, the use of e-books for academic learning were not considered helpful or practical. Reading was inhibited by difficulties with navigating lengthy text and viewing graphics on the small screens of mobile devices, as students complained about not being able to quickly scan through a whole page.

In short, learners' attitudes towards e-book reading were found to be positive in the studies conducted by Huang (2013) and Yoon (2013), but were negative in the research of Woody et al. (2010), Shepperd et al. (2008), and Lam et al. (2009). These contradictory findings might, in part, be due to different contexts, which involved different reading purposes. E-books were utilized as supplementary material for out-of-class learning in the studies by Huang (2013) and Yoon (2013), and as the main course material for academic learning in the research conducted by Woody et al. (2010), Shepperd et al. (2008), and Lam et al. (2009). Different reading purposes might therefore engender different expectations from learners. For example, there is a growing sense that reading material needs to provide interactive and multi-sensory experiences. The lively and attractive features of e-books could potentially support young learners' literacy and language development by holding their interest and reinforcing comprehension of a story. The same features, however, might not be considered necessary for university students. Some research has shown that students prefer print books over e-books for academic reading because of the perceived ease of navigation (e.g., Strother et al. 2009). Although the current generation of undergraduate students in general have some experience reading e-books, they are unlikely to have an intuitive sense of how to navigate academic e-books. Since students need to extract information

from academic e-books for study and research purposes, the demands on the interface to support effective navigation and information retrieval are higher (Berg et al. 2010; Zhang and Niu 2015).

Gaps in previous research Despite the ubiquity of the technology, learners' performance and attitudes towards e-books are affected by implementation of course material and their individual needs. Thus, considering individual learner factors, such as language proficiency and learning objectives, are essential in e-book research. The factor of learner proficiency has not been looked at specifically in relation to e-book reading. E-book research has mostly been conducted in a preschool or elementary school setting, where a main purpose of e-book use is to develop early literacy skills, and in a university setting, where e-books serve as sources for learning within an academic discipline. The use of e-books in a regular secondary school curriculum remains underexplored. Moreover, failure to control for or to disclose information regarding learners' prior experience with e-books makes it difficult to rule out the novelty effect as an explanation for improvement when determining a technology's potential for application in an educational context. Another concern that might influence study results is the equivalence of learning material available for experimental groups (i.e., those with exposure to e-book intervention) and control groups. Since e-books contain applications such as hyperlinks and games unavailable in print books, it was unclear whether achievement gaps between e-book and print-book readers, if any, were due, at least in part, to unequal access to learning resources. Finally, while one important advantage of e-books is provision of multimodal visual and acoustic stimuli, much less attention has been given to the use of e-books for listening comprehension relative to reading comprehension.

1.2 Research questions

To fill gaps in previous research, the current study examined the effects of incorporating an e-book into instructional material for English language learning in a secondary school setting, taking into account the learner factor of language proficiency. Secondary school education in Taiwan differs from elementary or university level education in terms of students' attitudes towards learning. Most secondary school students are highly concerned about their exam grades, which directly affect their future opportunities for higher education. E-book use in such an exam-orientated context presumably would be distinct from that in a preschool/elementary school or a university setting. Comparisons were made between the learning outcomes (listening and reading skills) of two groups of seventh-graders who utilized an e-book and a print book as their main in-class learning source. The effects of e-book use on English learning were investigated across proficiency levels (high, medium, and low) to see if students at a certain level benefited more than the others. Additionally, focus-group interviews were conducted with students of different levels of proficiency to explore their attitudes towards e-book use in this context. The following two research questions were addressed:

(1) Does the use of an e-book exert a differing influence on the English learning (reading and listening skills) of students of different levels of proficiency?

(2) What are students' attitudes towards the use of an e-book for L2 in-class learning?

2 Methods

2.1 Participants

The participants comprised 49 seventh-graders—24 in the experimental class and 25 in the control class—at a junior high school in Taipei, Taiwan. The gender distributions of the students were similar in the two classes. All the participants had prior experience using print books and e-books. All the students in the experimental class had experience learning with e-books as well as PowerPoint slides and animations in class when they were fifth- and sixth-graders; thus, the novelty effect could be excluded.

The two classes had similar levels of English proficiency before the experiment according to their average scores on the three English exams in the first semester of the seventh grade. There were no significant differences in terms of the participants' listening and reading abilities between the two classes ($ps > .05$). The two classes were further divided at the 30th and 70th percentiles into three proficiency levels: high, medium, and low. The two high−/medium−/low-proficiency groups in the experimental and the control classes did not differ in their listening and reading abilities ($ps > .05$).

2.2 Material

The e-book was an electronic copy of the textbook, Hanlin Junior High School English Textbook Book Two, and was equipped with content-related multimedia applications. For example, there were animations related to the reading texts, PowerPoint slides with explanations of sentence patterns, and computer games for unit review practice. The e-book had two main interactive features in addition to the typical interactivity of an e-book (e.g., searching and highlighting). One feature was that the user could interact with multimedia material by clicking on hotspots, which then activated audios and animations. The audio application allowed playing and pausing native-speaker recordings of words and sentences whenever needed. Learner-controlled access to animations provided visual aids (e.g., dynamic images and captions) that facilitated listening comprehension. The other interactive feature allowed the user to practice through computer games, which contained the same content as that of the worksheets used in the control class. The game application recorded user responses to given questions and then provided feedback, including answers and cumulative points earned during and at the end of a game.

Three units were covered during the experiment (Unit 1: *My Cat Can Catch a Ball*, Unit 2: *What Do You Do After School?*, and Unit 3: *He Has Brown Eyes and Nice Hair*). The experimental class utilized the e-book version and the control group the print version with the same content and layout. The major difference between these two versions of the textbook was the access to multimedia and interactive features. The content of the e-book was projected to a big screen. In the control class the teacher implemented worksheets and blackboard-and-chalk exercises, as well as auditory material, flashcards, and posters provided by the textbook publisher to ensure comparable provision of learning resources. Table 1 shows the hardware devices and the software applications used in the experimental and the control classes.

Table 1 Hardware Devices and Software Applications

	Control Class	Experimental Class
Classroom Equipment	blackboard and chalk, CDs, stereo	computer, projector, screen, stereo
Learning Aids	print book, worksheets, posters, flashcards, audios	e-book, computer games, animations, PowerPoint slides, e-flashcards

2.3 Instruments

2.3.1 Achievement test

The achievement test contained two sections focusing on receptive English language skills. The first section included 15 multiple-choice listening comprehension questions. The second section comprised 25 multiple-choice questions, including cloze, vocabulary, and grammar questions, as well as reading comprehension questions. The achievement test was designed by two experienced teachers and checked by another two experienced teachers to ensure validity. The achievement test measured the learning outcomes for the three units in the e-book/print book covered during the intervention.

2.3.2 Interview questions

Focus-group interviews were conducted with the experimental class to gain insights into the students' attitudes towards e-book use. The interview questions targeted three objectives. First, the students' opinions on the e-book itself (e.g., word size, sound effects, text highlighting) and its associated facilities (e.g., hardware devices such as the projector and the stereo) were elicited. Then, the interviewer addressed the students' learning experience, for example, in-class activities, teacher-student interactions, and the delivery of lessons. Finally, the students were asked about their thoughts on the learning aids provided as part of the e-book, such as the animations, games, e-flashcards, and PowerPoint slides.

2.4 Procedures

This study was conducted during the second semester of the seventh grade and lasted for 6 weeks. The teaching procedure of a unit was the same in the experimental and the control classes, with different kinds of material applied as described in Table 1. Figure 1 illustrates the procedure of teaching a lesson. The teacher began a unit by motivating the students with warm-up material. Theme words were then introduced and reinforced through sentence-building exercises, followed up by sentence patterns with explanations and exercises on grammar rules. The teacher taught theme words using vocabulary flashcards (control class) or e-flashcards (experimental class) and asked the students to make sentences with target words. More example sentences were either read out loud by the teacher (control class) or played in audio (experimental class). Sentence patterns were taught with the blackboard (control class) or PowerPoint slides (experimental class) and practiced in pairs using worksheets that contained examples to

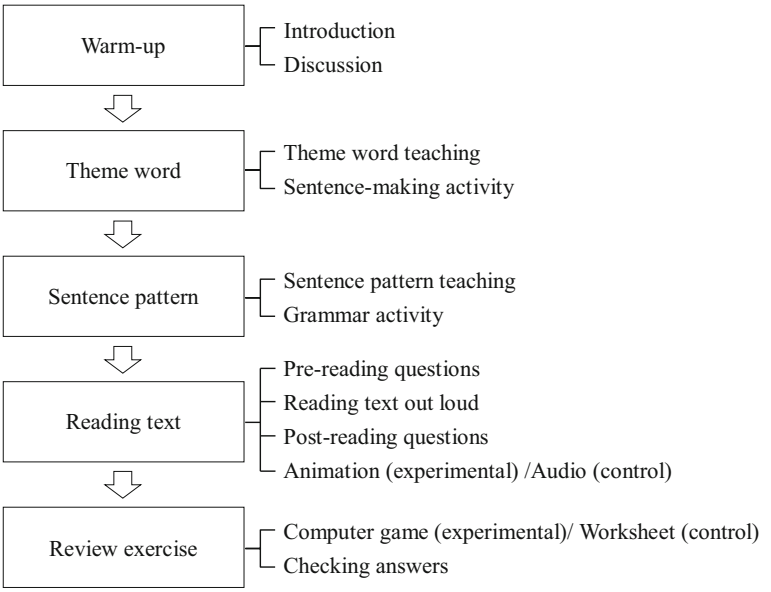

Fig. 1 Teaching procedure of a lesson

illustrate the use of rules in context. Afterwards, a reading text was taught through pre-reading questions, reading the text out loud, post-reading activities, as well as animations (experimental class) and audios (control class) that extended discussion of the text. Finally, the teacher asked the students to finish review exercises through computer games (experimental class) or worksheets (control class). The instruction emphasized both language (i.e., words and sentence patterns) and content of a text, with slightly more text-level activities to create a meaningful setting of reading. The students extracted and responded to information in a text, and the text also provided a context in which the previously taught linguistic elements functioned as meaningful units.

After the 6-week intervention, the experimental and the control classes took the achievement test. Focus-group interviews were then conducted with the experimental class to gain insights into the students' attitudes towards e-book use. The interviews lasted for approximately 30 min and were recorded for later analysis.

3 Results and discussions

3.1 Effects of E-book use on English learning performance

Research Question (1): Does the use of an e-book exert a differing influence on the English learning (reading and listening skills) of students of different levels of proficiency?

Average scores of the high−/medium−/low-proficiency groups in the experimental and the control classes were calculated for the achievement test. The maximum total score of the test was 80 points, 30 for the listening section and 50 for the reading section. The

experimental and the control classes gained a total score of 66.79 (SD = 10.52) and 64.56 (SD = 15.11), respectively. In terms of listening, the average score was 27.17 (SD = 3.33) for the experimental class and 25.60 (SD = 5.54) for the control class. As for reading, the average score was 39.63 (SD = 7.92) for the experimental class and 38.96 (SD = 10.72) for the control class. Table 2 presents an overview of the descriptive statistics of the achievement test by learning material and by learner proficiency.

To answer our first research question, generalized linear mixed models were performed to determine the effects of material (e-book/print book) and proficiency (high/medium/low) on English learning, with material and proficiency functioning as independent variables and achievement test scores representing the dependent variables (Nelder and Wedderburn 1972). Since the dependent variables (total, listening, and reading scores) were non-normally distributed, statistical tests such as analysis of variance (which requires a normal distribution) were not appropriate.

In analysis of the total scores of the achievement test, proficiency was a significant predictor ($p < .001$), indicating that learner proficiency significantly influenced test performance, which was expected. Although the variable of material was not significant ($p > .05$), there was a significant interaction between the two variables of proficiency and material ($p < .01$). That is, the effects of e-book use depended on learner proficiency, highlighting the importance of taking learner proficiency into account when evaluating the usefulness of e-books.

In analysis of the listening scores of the achievement test, both proficiency ($p < .001$) and material ($p < .05$) were significant predictors. There was also a significant interaction between the two variables of proficiency and material ($p < .05$). In other words, the e-book was more effective than the print book for developing listening skills. Crucially, the effectiveness of the e-book varied according to learner proficiency. In analysis of the reading scores of the achievement test, only the variable of proficiency was significant ($p < .001$). There was neither a main effect of material nor an interaction between proficiency and material ($ps > .05$). Although the low-proficiency students in the experimental class obtained a much higher average reading score (M = 29.29) than their counterparts in the control class (M = 24.71), the main effect of material did not

Table 2 Descriptive Statistics of Achievement Test

Learning Material	Learner Proficiency	Total (Max = 80)		Listening (Max = 30)		Reading (Max = 50)	
		M	SD	M	SD	M	SD
E-book (Experimental class) ($N = 24$)	High ($N = 7$)	76.86	1.57	29.43	0.98	47.43	1.51
	Medium ($N = 10$)	69.40	4.22	28.00	1.89	41.40	3.41
	Low (N = 7)	53.00	6.61	23.71	3.90	29.29	4.42
Print book (Control class) ($N = 25$)	High (N = 7)	78.57	1.51	29.43	0.98	49.14	1.57
	Medium ($N = 11$)	69.18	3.37	27.64	2.34	41.55	2.51
	Low (N = 7)	43.29	9.79	18.57	5.50	24.71	8.75

reach statistical significance, possibly due to the small sample size and/or the large within-group variance.

In short, the e-book intervention was particularly effective in improving listening skills, but the effect depended on learner proficiency. To know how the e-book impacted different proficiency groups, Mann-Whitney U tests were used to conduct pairwise comparisons of the listening test scores of the high-, medium-, and low-proficiency groups of the experimental and control classes. The results showed that the low-proficiency students in the experimental class scored significantly higher on the listening test compared to their counterparts in the control class ($p < .05$). No significant difference was found for the high-proficiency and the medium-proficiency groups ($ps > .05$). In other words, the low-proficiency students benefited the most from the e-book, especially in terms of listening.

In sum, the e-book helped the low-proficiency students develop listening skills, but it did not affect the high- and medium-proficiency students. As for reading, the e-book and the print book produced no significant difference in the test performance across the proficiency groups. The better listening performance of the low-proficiency students in the experimental class could be accounted for by the voice principle that "people learn better when words are spoken in a standard-accented human voice than in a machine voice or foreign-accented human voice" (Mayer 2001). The built-in audio support in the e-book allowed the teacher to easily play recordings of the text. In contrast, for the sake of convenience, the non-native-English-speaking teacher herself often read sentences from the print book aloud to the control class. Compared with the foreign-accented voice of the teacher, multimedia input with a standard American accent seemed more effective for the development of listening skills. Furthermore, the multimedia resources in the e-book enhanced listening materials by providing visual aids, such as images and captions. Audio-only input (as in the control class) most likely did not provide sufficient cues for the students to comprehend the information, particularly for low-proficiency students. In contrast, the use of audio-visual materials such as animations might better support listening comprehension by helping the students visualize auditory input and understand the context, as evidenced by the interview responses. It has been shown that auditory input supported by corresponding images and/or captions could facilitate listening comprehension (e.g. Hsu et al. 2013b; Winke et al. 2010). The benefits of visual aids for the development of listening skills were particularly evident for the low-proficiency students, who had relatively limited capability to recognize words from speech. Additionally, some of the students pointed out in the interviews that the audio-visual material provided a more interesting and engaging experience than print and audio material. These motivating components might be especially beneficial for low-proficiency students, who presumably experience more frustration in class due to a lack of linguistic knowledge, to maximize their exposure to the target language.

The finding that e-book instruction did not improve reading performance might result from distraction or extraneous cognitive load induced by multimedia material. Multimodal input (e.g., a combination of video, audio, and text) could benefit vocabulary learning (e.g. Aldera and Mohsen 2013; Montero Perez et al. 2013; Sadeghi et al. 2017) because processing information through multiple channels can help with memorization. However, multimedia materials can also become seductive details that distract students from key objectives and interfere with their learning. If the students

in the present study only paid attention to the animations rather than the content of the texts in class, their reading would not improve. In addition, the e-book provided quick access to annotations, such as written and pictorial annotations for difficult words. While the annotations could potentially assist text comprehension and vocabulary learning, the students had to process additional information, which imposed extra load on limited cognitive resources. Thus, the benefits of e-book use could be reduced by an increased risk of distraction and demands for information processing.

3.2 Students' attitudes towards E-book

Research Question (2): What are the students' attitudes towards the use of an e-book for L2 in-class learning?

The data from the focus-group interviews were analyzed to understand the students' attitudes towards using the e-book in class. Regarding the e-book and its associated facilities, the students perceived benefits of technology-enhanced learning, such as easy access to auditory and visual support, which facilitated understanding and recall of written text, and the highlighting tools, which helped them quickly locate the text under discussion. However, technical restrictions, including hardware and environmental constraints, were present during the implementation, which might have lowered the effectiveness of the e-book. Images on a screen cause eye strain more easily than those in a print book due to prolonged exposure to low-resolution images. It was mentioned that if the projector had worked better, it would have been more helpful for learning, especially in the reading aspect. Some students felt sleepy when using the e-book due to the dim lights in the classroom required for proper viewing. Complaints were also directed at the small size of the font, which was restricted by the screen size. Though the teacher enlarged the words, the students, especially those sitting in the back and next to the windows, still felt the words were difficult to read.

Regarding the e-book learning experience, the students generally thought that the classroom activities were suited to their needs. However, most students reported no perceived difference between using an e-book and a print book because they were already used to multimedia instruction. In particular, some hoped to have more interaction with the teacher and they felt that the e-book itself did not contribute to classroom interaction. For instance, while the students liked the games in the e-book, which made doing English exercises fun and relaxing, they emphasized the need for interactive learning activities in class to sustain their learning motivation. As the students had played computer games since elementary school, diverse in-class activities involving human interaction were perceived as more helpful. Traditional question-and-answer activities could also be engaging if appropriately carried out. Some of the students preferred going up front and writing answers on a blackboard or answering questions verbally in order to receive immediate feedback from the teacher and peers. These findings highlight the importance of the ways in which e-books are used in class. While the e-book in the present study contained interactive features, such as games and embedded quizzes, these applications were not fully implemented in the secondary school context, where the teacher was under time pressure to cover the material required for semester exams. The use of an e-book within a regular secondary school curriculum is distinct from that in contexts such as an after-school reading program (e.g., Huang 2013; Yoon 2013). This differing context might be one of the reasons why the

students in the present study did not show a significantly positive attitude towards the interactivity of e-books, which contradicts the findings of Huang (2013) and Yoon (2013).

Regarding the learning aids in the e-book, the students generally recognized that the e-book provided more stimuli than a print textbook and integrated a variety of multimedia resources (e.g., videos, pictures, texts, quizzes, and related websites), making the class run smoother. For instance, most students stated that they looked forward to the animations, which were perceived as motivating and as facilitating listening comprehension given the availability of visual images that supported understanding of auditory input. In addition to convenient access to audio-visual stimuli, the e-book provided possibilities for learner-controlled listening, which might have been helpful for listening development. In particular, a few low-proficiency students liked to do listening practice via computer games on a personal computer because they could replay and pause when needed, which is consistent with the findings of Yoon (2013) and Verdugo and Belmonte (2007). Unlike input controlled by the teacher, who decides when and how often audio recordings were played, learner-controlled input might help to increase understanding and therefore learning of the target language. This could be one reason why the e-book enhanced the listening performance of the low-proficiency students. Listening tasks and grammar/vocabulary activities turned into games were also perceived as motivating because the students received immediate rewards (e.g., points) and felt a sense of achievement after accomplishing game objectives. They also reported to experience lower anxiety during the process of completing a task.

As for the learning aids like PowerPoint slides, the students' opinions were mixed. The high-proficiency students held fairly similar attitudes that whether a PowerPoint presentation or handwriting on a blackboard was used, their ability to learn remained constant, because they found it easy to concentrate in class no matter which medium was utilized. In other words, PowerPoint slides and a blackboard were perceived as equally effective in the presentation of information by the high-proficiency students. The low-proficiency students, on the other hand, had mixed opinions on the learning aids provided in the e-book. They favored the legible writing and clear highlights on the PowerPoint slides over handwriting on a blackboard. Having the text highlighted while the teacher or narrator read it aloud was considered helpful for improving concentration. Nevertheless, the low-proficiency students generally preferred a blackboard over PowerPoint slides for learning grammar and sentence patterns in class. One reason was that a blackboard is big enough to have all the grammatical concepts and example sentences written on it, allowing the students to look back and check previously-discussed material when they felt confused or lost concentration. Relatively, they felt the PowerPoints could convey much less of the lecture material within a single slide and could not show links between current and previous items due to the linear nature of presentation and the inaccessibility of a slide after the teacher moved forward. The limitations of PowerPoint presentation also made note-taking more difficult for those who write slowly or struggle to concentrate in class. The low-proficiency students in particular expressed their need to see all the key points at once and to refer back to the content the teacher had taught, which they considered beneficial for their understanding. The findings suggested that the low-proficiency students might be less capable of building connections between related information and might need more time to process and digest the material they had learned than the other students did.

The other learning aids such as text/vocabulary annotations also elicited mixed responses from the students with different levels of English proficiency. The high- and medium-proficiency students generally perceived annotation material as a useful supplement to reading, which was not very different from paper-based handouts provided separately by the teacher. They agreed that annotations facilitated their understanding of texts and vocabulary and that it was convenient to refer to annotations displayed on the same page as the main text. A few of the low-proficiency students, however, held the opposite view that the annotations often distracted them and even confused them. They felt confused if the teacher did not explain annotated content word by word and had trouble with the teacher's faster teaching pace given a convenient access to the e-material. Additionally, some of the low-proficiency students had difficulties going back and forth between the main text and annotations, and they did not appreciate the additional cognitive load represented by the extra content (i.e., annotations). It seems that flexibility of information access might affect the low-proficiency students negatively because processing supplementary material demands extra cognitive effort during the learning process. This confirms the findings of Sakar and Ercetin (2005), who indicated that the frequency of access to annotations negatively correlated with the text comprehension of non-advanced learners. As suggested by one interviewee, effective use of e-material depended largely on the teacher's capacity to identify student learning needs in the classroom.

4 Conclusions

The results of the achievement test showed that using the e-book had a positive impact on listening performance, particularly for low-proficiency students. The high- and medium-proficiency students were relatively unaffected by the use of different materials. As for reading, the e-book intervention resulted in higher test scores compared to the print book, but the between-group difference did not reach statistical significance. The test score data were triangulated with learner responses in the interviews. Overall the findings demonstrated the importance of taking into account of individual difference factors, such as learner proficiency, when investigating the effectiveness of technology for EFL learning. These findings could shed light on e-book use for different proficiency groups in a formal secondary school setting.

The high- and medium-proficiency students generally did not perceive the e-book to be influential to their learning, consistent with their similar test performance after the e-book and the print-book intervention. The multimedia features, such as animations and games, were perceived as entertaining but not particularly helpful for learning purposes. Relatively, the low-proficiency students benefited more from the e-book, particularly in the listening aspect. As evidenced in the interview data, possible reasons include convenient access to standard-accented listening input, availability of visual aids (e.g., images and captions) supporting the understanding of auditory input, and an option for learner-controlled listening activities during practice sessions. In terms of reading, the e-book intervention seemed to affect the test outcomes positively, although the effects failed to reach statistical significance, possibly due to the small sample size and large within-group variance. Moreover, while the e-book could support reading through multimedia content like audio and annotations, the potential benefits of the e-

book might be reduced as a result of technical restrictions (e.g., screen size, image resolution, and nature of presentation), as well as increased distraction and information load, which were perceived as interfering with learning processes, particularly by the low-proficiency students.

In short, while the high- and medium-proficiency students seemed able to adapt to a range of learning environments, the low-proficiency ones appeared to be more susceptible to the influences of the peripheral environment and learning material. Nevertheless, the students, regardless of L2 proficiency, generally agreed that using technology or not was not really crucial to their learning. Instead, diverse classroom activities and interactions were considered more important than technology itself to draw the students' attention and sustain their motivation to learn. Technology itself was not perceived as effective for enhancing classroom interaction. The students would rather be taught with different kinds of activities and materials with the aim of providing interactive learning experiences, indicating that the novelty effect of new technology has only a short-term influence.

Pedagogically, our findings suggest that learning materials, electronic or not, should be carefully applied to meet learners' objectives and needs. Multimedia can provide access to relevant resources that would otherwise be inaccessible, for example, standard-accented input in an EFL context and verbal information presented in two modalities (visual and auditory) to help with memory recall. An e-book with assistance functions could scaffold English learning, especially for low-proficiency students, and compensate for individual differences. However, multimedia applications or any reference materials, if not closely relevant to the main content of lessons, might in fact distract learner attention and impose an extra cognitive load that interferes with the primary task.

While evidence was found for interaction between individual learner proficiency and type of learning material, this study had a number of limitations that warrant further research. One limitation was the small sample size in each proficiency group, which reduces the generalizability of the findings. Future research could increase the sample size by implementing an intervention in multiple classes so as to uncover how an e-book affects formal learning at different levels of proficiency. Moreover, the achievement test was administered immediately after the intervention. Follow-up tests may help to understand the long-term effects of e-book use. For instance, the dual-coding theory postulates that verbal information presented along with a relevant visual aid facilitates learning and recall in comparison to text-only information (Paivio 1990). Therefore, it would be interesting to investigate whether the use of multimedia content improves long-term memory retention. Additionally, the images of unsatisfactory quality and brightness due to facility restrictions might have affected learning negatively, as reported in the student interviews. Facility factors should be carefully controlled in further investigations on technology-integrated learning. Finally, in this study, part of the learning material was delivered through PowerPoint, which is limited by the small amount of information that can be fit into one slide as well as its lack of interactive features. It would be worth exploring the use of an e-book with an interactive whiteboard to accelerate communication and collaboration in the classroom.

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