Received 28 September 2013
Revised 3 May 2014
Accepted 5 June 2014

The effects of gender differences on the use of annotatable multimedia e-readers

Yi-Fan Liu, Wu-Yuin Hwang and Sherry Chen
Graduate Institute of Network Learning Technology, National Central University, Jhongli, Taiwan

Abstract

Purpose – This paper aims to examine how gender differences influence students' reactions to the use of the annotatable multimedia e-reader (AME). To reach this aim, we develop an AME where various annotation tools are provided to help students learn English in-class and after-class.

Design/methodology/approach – An empirical study was conducted with 63 fifth-grade students from an elementary school. A pre-test and post-test were used to identify their prior knowledge and learning achievement, respectively. A questionnaire was applied to identify participants' perceptions towards the AME.

Findings – The results show that students' post-test scores are significantly related to after-class behaviour, instead of in-class behaviour. Females prefer to use the text annotation and teachers' voice, but it is voice annotation that is beneficial to improve their learning achievement. Conversely, males prefer to use the text-to-speech only, but it is text annotation that is helpful to improve their learning achievement. Additionally, the ease of use affects males' intention to use the AME to learn English after-class while it has no effects on females.

Originality/value – This study not only shows the importance of gender differences but also demonstrates the essence of after-class learning behaviour. More importantly, a framework is proposed to support designers to develop e-readers that can accommodate the preferences of females and males.

Keywords Digital documents, Multimedia, Electronic books

Paper type Research paper

1. Introduction

E-readers, which are becoming an integral tool for our day-to-day lives, have an enormous potential to support teaching and learning (Shurtz and von Isenburg, 2011). An "e-reader" refers to a portable device designed for reading digital materials, including e-books, electronic magazines and the digital versions of newspapers (Wright *et al.*, 2013). Recently, researchers have attempted to examine the impacts of e-readers on student learning. Huang *et al.* (2012) developed an interactive learning system using e-readers for elementary school students. The researchers concluded that the proposed system could achieve better learning experiences for elementary school students. Other research has also demonstrated that e-readers offer many advantages over traditional classroom-based training, including portability (Pattuelli and Rabina, 2010), searchability (Shurtz and von Isenburg, 2011), multimedia capability (Ghaebi and Fahimifar, 2011) and high display resolutions (Siegenthaler *et al.*, 2010).

On the other hand, several studies indicated that e-readers are not more effective than conventional books. Rockinson-Szapkiw *et al.* (2013) found no difference in cognitive

The Electronic Library
Vol. 33 No. 4, 2015
pp. 842-860

0264-0473
DOI 10.1108/EL-09-2013-0174

learning between the electronic textbook and a printed textbook. Likewise, Wright *et al.* (2013) did not find any difference in vocabulary and reading comprehension between an electronic book and a paper-based book. Furthermore, Kang *et al.* (2009) reported that reading a conventional book generated a higher level of reading performance than reading an e-book. These findings suggest that existing e-readers still need to be improved. As suggested by Rockinson-Szapkiw *et al.* (2013), annotations are one of the features that can be applied to improve existing e-readers. The importance of annotations was already demonstrated in early web-based electronic books. For instance, Brusilovsky and Eklund (1998) incorporated adaptive link annotations into the design of their InterBook. Later on, Wilson *et al.* (2003), who conducted a series of evaluations for electronic textbooks on the web, indicated annotating features should be considered for the design of e-books. In addition to such early research, recent studies also found that annotations could improve student learning. For example, Hwang *et al.* (2011) found reviewing students' text annotations can improve their learning achievement, especially when learners marked the annotations actively and voluntarily.

The aforementioned studies demonstrate the essence of annotations. Thus, there is a need to develop an annotatable e-reader, which belongs to a new technology. Previous studies have revealed several factors that affect the use of the new technology. For example, Yi and Hwang (2003) found learning goal orientation affected how students used a web-based learning system. Additionally, Loraas and Diaz (2009) discovered that users with different learning goal orientations emphasized different aspects of new technologies. Such research suggested different goals might have different influences.

Further to goal orientations, another influential factor is gender differences. As suggested by the social role theory (SRT), males and females behave in different ways because the social roles that they play are related to different expectations (Eagly, 1987). Due to such differences, research into gender differences has mushroomed. In particular, several researchers conducted substantial reviews. Among them, Hyde (2005) used a meta-analysis to conduct an extensive review, which covered various aspects, such as mathematical, verbal, spatial abilities, aggression, leadership effectiveness, self-esteem and computer use. Other reviews examined different aspects of coping behaviour (Tamres *et al.*, 2002), cooperation (Balliet *et al.*, 2011) and emotion expression (Chaplin and Aldao, 2013).

In addition to the aforementioned reviews, the results from empirical studies also indicated that males and females show different learning approaches. For example, males tend to be more visual (Mariash, 1983), whereas females tend to be more auditory (Dunn, 1996). Furthermore, Dunn *et al.* (2001) pointed out that females have more self-motivation while males need to be stimulated by peers. Such different learning approaches also affect their reactions to technology-based learning tools. Berigel *et al.* (2012) examined the level of online learning acceptance of university students. They found males had significantly higher acceptance of using online learning systems than females. Kim *et al.* (2011) investigated students' perceptions of four different multimedia types. They found males generally had more positive perceptions towards multimedia content than females, apart from animation. These findings support Teo's (2010) findings, which claimed that males were more willing to accept new technology. Owing to such acceptance, males favour the use of technology-based tools for writing more than females (Comber *et al.*, 1997). On the contrary, inclinations of females were more associated with strong human contact than males' (Gefen and Straub, 1997), which

implies they are better at human communication than males (Johnson, 2011). In summary, gender differences are an essential human factor. Thus, there is a need to examine how females and males react to the design of the annotatable e-reader. To this end, the study presented in this paper aims to address this issue by developing an annotatable multimedia e-reader (AME), of which the details are described in the next section.

2. Development of an AME

The AME was developed to help students learn English in-class and after-class. Prior to implementing the AME, a senior English teacher was consulted to identify learners' requirements, including learning materials and system performance. After the senior English teacher consultation, two additional unique features were added to AME to overcome the shortcomings of existing e-readers.

One is to incorporate usability considerations into the design of the AME while the other is to offer versatility to accommodate students' diverse requirements. Regarding the former, five main criteria proposed by Nielsen (1993) – that is, "efficient to use", "easy to learn", "few errors", "easy to remember" and "pleasant to use" – were taken into account. Table I describes how these five main criteria were implemented in the AME.

Regarding the latter, the AME provides four auxiliary tools: text annotation, voice annotation, text-to-speech and teachers' lectures (Figure 1). These four tools were chosen because they serve different purposes (Table II). Students are allowed to choose an annotation tool based on their own learning styles. For example, the voice annotations support the needs of auditory learners while text annotations match with the preferences of verbal learners (Betts, 1909). Further to differences between auditory learners and verbal learners, gender differences were also taken into account. A framework (Figure 2) is proposed to illustrate how these four tools support the needs of females and males. More specifically, text annotations, which allow students to write down their own ideas via keyboard, may be useful to males because they favour the use of technology tools for writing (Comber *et al.*, 1997). Conversely, voice annotations, which allow students to record what they want by speaking, may be helpful for females because they are good at human communication (Johnson, 2011). Furthermore, text-to-speech and teachers' lectures may be appreciated by males and females, respectively. This is due to the fact that text-to-speech was considered as a new technology, which can match with the preferences of males who tend to use technology-based learning tools (Teo, 2010). On the other hand, teachers' lectures, which recorded a person's voice delivered by the teachers, could facilitate learning by females because of the human contact (Gefen and Straub, 1997).

In addition to the aforementioned tools, both in-class and after-class scenarios were arranged to support females and males. The in-class scenario is suitable to males, who need to have more stimulation from peers, while the after-class scenario is helpful for females, who have more self-motivation (Dunn *et al.*, 2001). In brief, we not only incorporate various tools into the AME but also take into account a variety of scenarios. Having such variety in the auxiliary tools and learning scenarios provides a wider range of learner choices and can help to identify differences between females and males in our empirical study, of which the research question is: "How do gender differences influence students' reactions to the use of the AME in-class and after-class?"

	AME	Interactive e-book learning system (Huang *et al.*, 2012)	E-book reader system (Li *et al.*, 2013)
Easy to remember	Easy to insert an anchor by clicking text or imageIcons designed to match with functionalities to let users feel it is easy to remember	Too complex interface design with many buttons and pages, so users may feel it is difficult to remember	Icons designed mismatch with functionalities, so users may feel it is difficult to remember
Easy to learn	No complex steps so users can easily learn	Too many buttons and functions, so users need to put substantial effort into learning	Icons designed mismatch with functionalities, so users may feel it is difficult to learn
Efficient to use	Related functions integrated into an anchor to let users obtain complete information efficiently	Buttons isolated to cause users' cognitive overloadButtons scattered in different locations so users feel it is inefficient to use	Visual cues provided to make students read fast and efficiently
Pleasant to use	To match with the needs of students with different levels of prior knowledge studentsTo take into account both in-class and after-class	Rich features provided for students	N/A
Few errors	Simplified steps to avoid users encountering problems	Too complex interface so users may easily make mistakes	Icons designed to mismatch with functionalities so users may easily make mistakes

Table I.
AME compared with existing systems

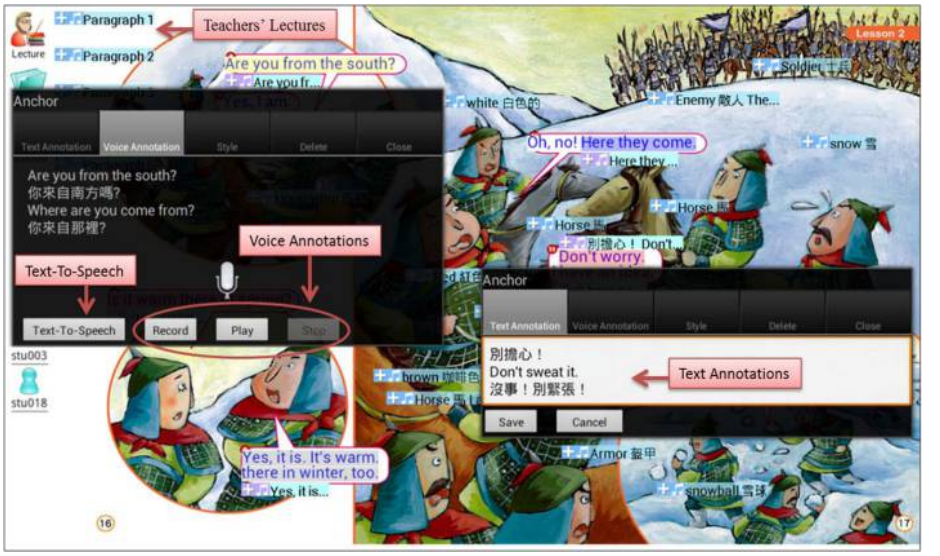

Figure 1.
Four auxiliary tools

Tools	Functionalities	Purposes
Text annotations	To allow students to make additional explanation for anchored text or image	Students can make a record for the supplement provided by a teacher, so students can easily remember and understand the content
Voice annotations	To allow students to record their own voice for anchored text or image	Students can practice pronunciation and then teachers can examine their pronunciation
Text-to-speech	To allow students to broadcast the annotated text or sentences aloud	Students can learn how to pronounce unknown words
Teacher's lecture	To make a note for important concepts delivered by the teachers in the class	Students can review what they have learnt from the teacher after the class

Table II.
The system functions design

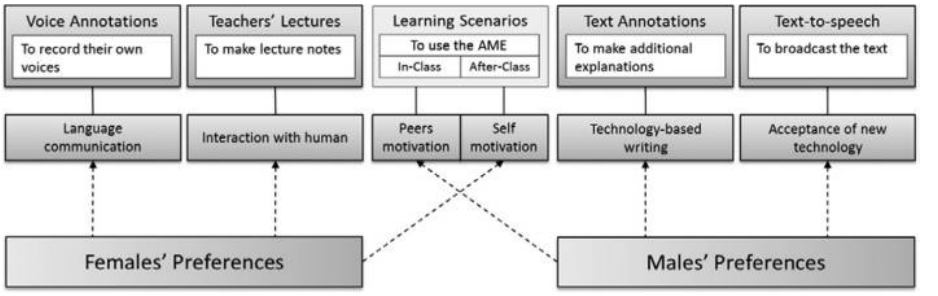

Figure 2.
A framework for the design of e-readers to accommodate females and males

3. Methodology design

3.1 Participants

The participants are selected by convenience sampling, which offers convenient accessibility and proximity (Powell, 1997). To this end, we selected the participants from students who studied in an elementary school nearer the National Central University in Taiwan. More specifically, there were 63 fifth-grade students (31 males and 32 females) whose English courses were taught by one senior teacher with rich experience in the use of information and communication technology (ICT) for teaching and learning. The mean age of the students was around 10 years old (SD = 0.28), their mother tongue was Chinese and English was their foreign language. All participants had the basic computing skills to use computers, but they were unfamiliar with e-readers.

3.2 Procedure

Prior to conducting the experiment, the researcher disabled all functions and applications, apart from the AME. By doing so, the students could concentrate on learning English with the AME. The experimental procedure is composed of five steps as follows (Figure 3):

(1) *Preliminary training*: Students were first trained how to use the AME properly on campus. Two researchers provided assistance throughout the experimental process when the AME was applied in the English curriculum. They were responsible for guiding students to take notes and record the lectures so that students could use the AME smoothly.

(2) *Pre-test*: A pre-test was applied to identify the levels of prior knowledge that the participants had. The pre-test consisted of ten multiple-choice questions, ten fill-in-the-blank questions and ten single-word hearing tests. Students were allotted 50 minutes to take the pre-test and were not allowed to examine the content at the same time.

(3) *Interactions with the AME*: The students were allowed to interact with the AME in-/after-class for six weeks. Additionally, their interaction with the AME was recorded in a database, including the frequencies of using annotations, recording voice and listening to teacher lectures and their own voice.

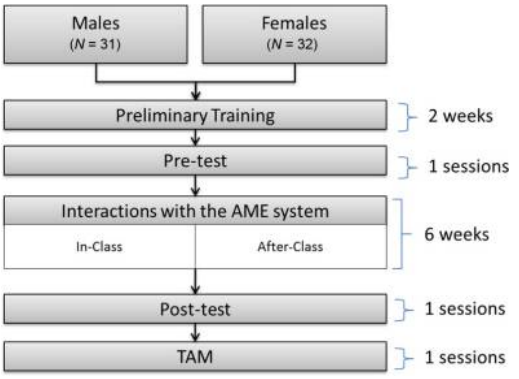

Figure 3.
Experimental design for the AME system integrated in-class and after-class

- *In-class*: Students had four 50-minute sessions per week with the AME integrated into the English course (Figure 4). During this period, the teacher allowed students to freely choose text annotation or voice annotation to make their own records after they delivered explanations. However, only text annotation and voice annotation were provided for in-class because the remaining tools might cause noise in the classroom.
- *After-class*: The AME was not only applied in the classroom but also students could bring their e-readers home. By doing so, they could review learning materials easily and they could access their notes at home. During this period, students could freely use all annotation tools, including text annotation, voice annotation, text-to-speech and listening to the teacher lectures or their own voice.

(4) *Post-test*: How much the students had learnt was determined by a post-test, of which the difficulty level and format are the same as those of the pre-test.

(5) The questionnaire was based on the technology acceptance model (TAM). The TAM aims to evaluate how users come to accept and use a new technology (Davis, 1989). In addition to being applied to assess the acceptance of ICT in general (Agrifoglio *et al.*, 2012), the TAM is also widely used in the evaluation of mobile technology (Hsu *et al.*, 2013), a category to which e-readers belong. This is the reason why the TAM was used to examine students' perceptions towards the AME in this study. Further to original items proposed in the TAM, intention to use after-class, which can be applied to understand student's willingness to use the AME, was also added to the questionnaire. We conducted a confirmatory factor analysis to test the TAM model. The hypothesized four-factor model provided a good fit with all fit indices within acceptable levels ($\chi^2 = 118.84$, df = 98, χ^2/df = 1.21, GFI = 0.81, AGFI = 0.73, CFI = 0.98, NNFI = 0.98, RMSEA = 0. 059 and NFI = 0.93). The definition and Cronbach values of the dimensions are listed in Table III.

Figure 4.
How the AME system is integrated into the classroom

3.3 Data analysis

To answer the research questions presented in Section 2, the data from the 63 participants were analysed statistically by conducting independent *T*-tests. The independent variable of this study is gender differences. The dependent variables include the frequencies of using each annotation tool, the amount of time spent for using the e-reader, the post-test scores and the response to each question in the questionnaire (Table IV). Furthermore, Pearson product-moment correlation method was also used to identify the relationships between learning achievement and learning behaviour. A significance level of $p < 0.05$ was adopted for the study.

4. Results and discussion

The results from the aforementioned analyses reveal students' learning achievement is related to their behaviour, and females and males show different reactions to the use of the AME. The details are discussed in the subsections below.

4.1 An overall picture

To identify whether using annotations is useful to improve students' learning achievement, we examine relationships between the learning achievement and learning

Dimension	Definition	α value
Ease of use	Student perceptions for the AME's ease of use	0.743
Usefulness	Student perceptions for the degree to which the AME enhanced their learning performance	0.918
Intention to use	Student perceptions for their willingness to learn English using the AME	0.830
Intention to use after-class	Student perceptions for their willingness to use the AME to learn after-class	0.902
Overall	Student perceptions for all of the aforementioned items	0.943

Table III. The definition and Cronbach values of the dimensions

Variables	Explanation
All annotations	The frequencies of using all annotations
All annotations (in-class)	The frequencies of using all annotations in-class
All annotations (after-class)	The frequencies of using all annotations after-class
Text annotation (in-class)	The frequencies of using text annotations in-class
Text Aannotation (after-class)	The frequencies of using text annotations after-class
Voice annotation (in-class)	The frequencies of using voice annotations in-class
Voice annotation (after-class)	The frequencies of using voice annotations after-class
Text-to-speech (after-class)	The frequencies of using text-to-speech after-class
Listening to their own voice annotation (after-class)	The frequencies of listening to students' own voice after-class
Listening to teachers' voice annotation (after-class)	The frequencies of listening to teachers' voice after-class
Learning achievement	Post-test scores (the scores obtained from the post-test) and gain scores (the differences between the post-test scores and the pre-test scores)
Learning perceptions	Students' responses to the questionnaire

Table IV. The dependent variables of this study

behaviour, including in-class learning behaviour and after-class learning behaviour. The results revealed that there is no significant correlation between the gain scores and the overall frequencies of using annotations ($p > 0.05$) (Table V). Likewise, there is no significant correlation between the gain scores and the frequencies of using annotations in-class (UAIC) or the frequencies of using annotations after-class (UAAC) ($p > 0.05$). Additionally, the frequencies of the UAIC are not significantly associated with the post-test scores. However, we found that the overall frequencies of using annotations are positively related to the post-test scores ($p < 0.01$) and the frequencies of the UAAC are related to the post-test scores ($p < 0.01$). These findings suggest that the students who use more annotations could achieve better results. In particular, using the AME after-class is particularly helpful for students to enhance their achievement.

Subsequently, we identify the tool that is beneficial to students. As shown in Table V, there is no significant correlation between the gain scores and each tool ($p > 0.05$). However, the post-test scores are related to the frequencies of using the text annotation after-class ($p < 0.01$), voice annotation after-class ($p < 0.05$) and listening to their own voice annotation ($p < 0.01$). It is interesting to note those significant findings belong to after-class learning behaviour only. Once again, this may imply that using the AME after-class plays an important role.

Unlike previous research, which highlights students making annotation in-class as a key determinant for meaningful learning (Nokelainen *et al.*, 2005; Su *et al.*, 2010), our results demonstrate the essence of making annotation after-class. A major difference between previous research and our study lies within the fact that students were not provided with the devices after-class in the former (Chen and Li, 2010) while students could not only use the AME in the class to learn English but also used the AME after-class in the latter. In other words, our work contributes to the knowledge of the importance of using e-readers after-class. As claimed by Sandberg *et al.* (2011), formal school learning can be augmented by learning in an informal context, away from school. In brief, there is a need to achieve seamless learning (Chan *et al.*, 2006) so that the benefits of e-readers can be maximized (Table VI).

4.2 Gender differences

4.2.1 The effects of learning behaviour on learning achievement. This section analyses differences between females and males, in terms of learning achievement and learning behaviour. As shown in Table VII, the frequencies of females using various types of tools in-class were significantly higher than those of males ($p < 0.05$). This may be the reason why females performed better than males, regardless of gain scores or post-test scores, though such differences are not significant (Table VIII). Furthermore, we also examined whether females and males benefit from using different types of annotation. The results showed the females' post-test scores are positively related to the frequencies

Table V.
Correlation statistics about learning achievement and total learning behaviour

Pearson correlation	Annotation		
	In-class	After-class	Total
Post-test score	0.046	0.355**	0.376**
Gain score	0.135	−0.149	−0.111

Notes: *$p < 0.05$; **$p < 0.01$

Table VI.
Correlation statistics about learning achievement and learning behaviour

Pearson correlation	Text annotation In-class	Text annotation After-class	Voice annotation In-class	Voice annotation After-class	Text-to-speech	Listening to their own voice annotation After-class	Listening to teachers' voice annotation
Post-test score	0.015	0.326**	0.094	0.259*	0.160	0.342**	0.197
Gain score	0.136	−0.185	0.053	−0.063	−0.043	−0.139	−0.129

Notes: $*p < 0.05$; $**p < 0.01$

of using voice annotation after-class ($p < 0.05$) and listening to their own voice annotation ($p < 0.05$) while males' post-test scores are only positively related to those of using the text annotation after the class ($p < 0.05$). This may be because females are better at language communication than males (Johnson, 2011), and voice annotations and listening to their own voice annotations belong to language communication tools. Thus, their performance can be improved by using these two tools. Conversely, verbal communication is not males' strengths, so they have to rely on text annotation to improve their performance. In brief, verbal communication is useful to females while written description is helpful to males.

Furthermore, we found that the females' pre-test scores are positively related to the frequencies of using the text annotation after the class ($r = 0.384$, $p < 0.05$) and the use of voice annotations after-class ($r = 0.463$, $p < 0.01$). However, their gain scores are not only negatively related to pre-test scores ($r = -0.817$, $p < 0.01$) but also negatively related to the frequencies of using the text annotation after-class ($r = -0.388$, $p < 0.05$) and voice annotation after-class ($r = -0.368$, $p < 0.05$). These findings suggest females who have a high level of prior English knowledge are keen to use the text annotation after-class and voice annotations after-class. However, they do not have much room for improvement, so using these two tools, after-class cannot further enhance their performance. This is the reason why the gain scores are negatively related to the frequencies of using these two tools.

4.2.2 Preferences for using annotation tools. This section analyses how gender differences affect learners' preferences for each tool provided by the AME (Table IX). We found the frequencies of males using listening to the teachers' voice annotation were significantly lower than those of females ($p < 0.05$), whereas the frequencies of males using text-to-speech was significantly higher than those of females ($p < 0.05$). Teachers'

Table VII. Gender differences in total learning behaviour

	Sex	*N*	Mean	SD	*t*	*p*
Total	M	31	201.74	160.667	−1.146	0.256
	F	32	250.03	173.368		
In-class	M	31	49.74	37.125	−2.132	0.038*
	F	32	76.06	58.786		
After-class	M	31	152.00	172.959	−0.507	0.614
	F	32	173.97	170.990		

Notes: $*p < 0.05$; $**p < 0.01$

Table VIII. Gender differences in learning achievement

	Sex	*N*	Mean	SD	*t*	*P*
Pre-test score	M	31	79.71	18.659	−0.948	0.347
	F	32	83.94	16.704		
Post-test score	M	31	84.03	18.714	−1.462	0.153
	F	32	89.72	11.388		
Gain score	M	31	4.32	9.680	−0.667	0.507
	F	32	5.78	7.581		

Notes: $*p < 0.05$; $**p < 0.01$

Tools	Sex	*N*	Mean	SD	*t*	*p*
Text annotation in-class	M	31	39.16	32.734	−2.094	0.041*
	F	32	61.31	49.750		
Text annotation after-class	M	31	35.74	37.383	−2.125	0.038*
	F	32	65.22	67.874		
Voice annotation in-class	M	31	10.58	12.551	−0.938	0.352
	F	32	14.75	21.431		
Voice annotation after-class	M	31	31.68	56.167	0.116	0.908
	F	32	30.28	38.242		
Listening to their own voice annotation	M	31	29.61	40.651	−1.037	0.304
	F	32	42.81	58.521		
Text-to-speech	M	31	40.90	73.874	2.182	0.036*
	F	32	11.41	14.571		
Listening to teachers' voice annotation	M	31	14.06	16.371	−2.072	0.043*
	F	32	24.25	22.286		

Notes: $*p < 0.05$; $**p < 0.01$

Table IX. Gender differences in each annotation tool

voice annotation involves human contact while text-to-speech is a new technology. Such findings are in line with those of the study by Teo (2010) and Gefen and Straub (1997), which found females are enthusiastic to have human contact whereas males tend to accept new technology. Furthermore, the frequencies of males using text annotation in-class and text annotation after-class were significantly lower than those of females ($p < 0.05$). Once again, these findings, which suggest gender differences, still exist in the era of ICT and echo the view of Moghaddam (2010).

In brief, the aforementioned findings imply that males and females prefer to use different annotation tools provided by the e-reader. Females prefer to use text annotation and teachers' voice annotation. The former requires learners to write down their own ideas based on what they learn, which belong to productive skills. Conversely, the latter only allows learners to listen to the voice content without the chance to make their own annotations, which belong to receptive skills. More specifically, productive skills refer to an ability of how students apply information they have learnt to produce language output. Conversely, receptive skills refer to an ability of how information is stored as language input in students' brains (Harmer, 2001). These findings suggest that females not only actively use productive skills but also make the best use of receptive skills. As mentioned above, females were better at learning second languages than males. This may explain why females are good at using both productive skills and receptive skills. On the other hand, males tend to use the text-to-speech, which lets learners listen to the e-reader's voices. Such an approach also belongs to receptive skills. In other words, males use receptive skills only. Thus, we need to provide more diverse receptive tools for males and stimulate them to practice productive skills as well. This is due to the fact that receptive skills and productive skills are indispensable elements in language learning (Davies, 1976).

4.2.3 Learning perceptions for the use of the AME. Pearson's correlations were used to examine how students perceived the use of the AME for learning English (Figure 5). Within the female group, the intention to use is significantly related to the ease of use ($p < 0.01$) and the usefulness ($p < 0.01$). However, the intention to use after-class is only

related to the usefulness ($p < 0.01$) while there is no significant positive relationship between the ease of use and intention to use after-class ($p > 0.05$). This implies the ease of use was not associated with the females' intention to use the AME after-class. Within the male group, the intention to use is related to the ease of use ($p < 0.01$) and the usefulness ($p < 0.01$). Besides, the intention to use after-class is also related to the ease of use ($p < 0.01$) and the usefulness ($p < 0.01$). This implies that the males who considered the AME as easy to use had relatively strong intentions to learn English after-class.

The aforementioned results indicate that females and males show consistent perceptions for usefulness and intention to use. In other words, students who perceive usefulness have a greater willingness to use the AME, regardless of gender. Such findings support the claim made by Lai and Ulhas (2012), which indicates usefulness is one of the key factors that affects students' intention to use e-readers. However, they show inconsistent perceptions for ease of use and intention to use after-class. More specifically, whether the AME is easy to use affects males' willingness to use the AME after-class, but females do not have such a perception. This issue is essential because males have proficiency in receptive skills only and are not good at productive skills. Thus, there is a need to improve the usability and functionality of the AME so that, in turn, males can then consider the AME easy to use and are willing to use it. By doing so, their productivity skills can also be improved.

5. Implications for system design

Based on the aforementioned results, we extend the framework shown in Section 2 (Figure 2). The extended framework (Figure 6) illustrates how females and males react differently to e-readers. To accommodate the preferences of females and males, several design approaches are proposed and they are discussed in the subsections below.

5.1 Incentive mechanisms

Our results indicate that females prefer to use the text annotation and listening to the teachers' voice annotation. Furthermore, the use of voice annotation and listening to their own voice annotation has positive effects on learning achievement. Thus, we need to encourage females to use voice annotation and listening to their own voice annotation more frequently. Conversely, males prefer to use the text-to-speech, but it is text annotation that is beneficial to improve their learning achievement. In other words, what males prefer is not associated with what is useful to them. Therefore, there is a need to consider how to encourage males to use text annotation so that their learning achievement can be improved. As suggested by Bull and Solity (1987), incentive mechanisms can enhance students' motivation. Thus, an incentive mechanism can be

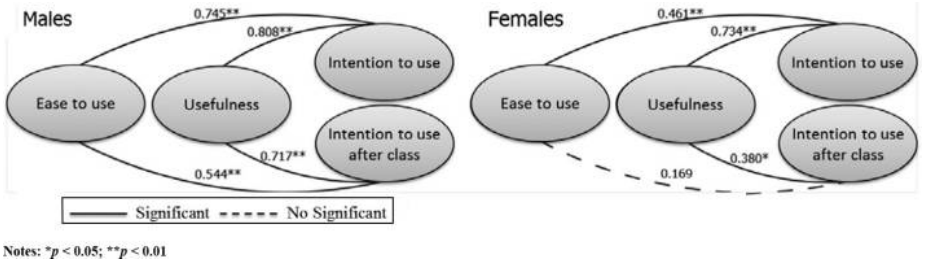

Figure 5.
The perceptions of the AME system: females versus males

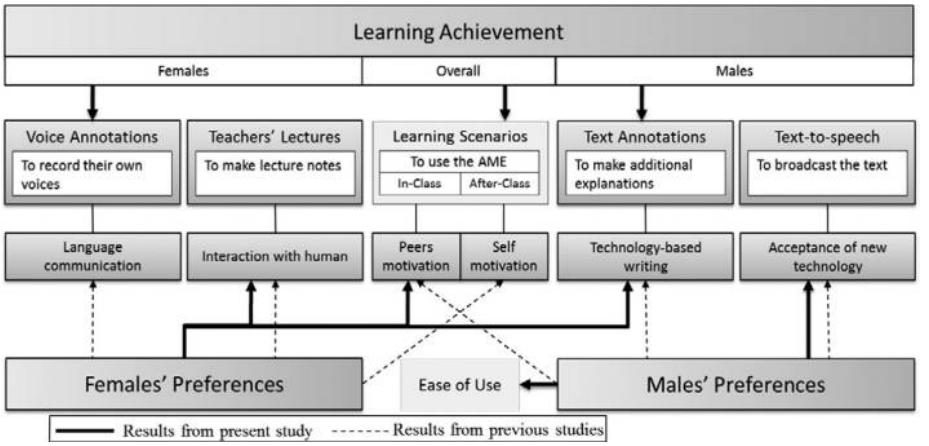

Figure 6.
A framework on note-taking behaviour with the AME

applied to motivate students to use these tools equally. More specifically, rewards should be given to females who use voice annotation and listening to their own voice annotation, and males who use the text annotation. In addition, we can also use different design styles and icons to attract females and males based on their preferences.

5.2 Situated learning activities

Students UAAC, instead of UAIC, has positive effects on learning achievement. That is to say, we need to consider how to motivate students to use annotations after-class. As suggested by Brown *et al.* (1989), specific contexts can offer students useful stimulation that can extend beyond language classrooms. In other words, real-life contexts need to be incorporated into language learning (Ogata and Yano, 2004). Thus, there is a need to provide more meaningful learning activities to promote the use of the annotations after-class. For example, introducing family members is a useful learning activity, where students introduce their family members with simple English sentences (Figure 7A). Such an activity provides students with an opportunity to learn English in real-life contexts so that they can better use the vocabulary and sentence structures learnt in-class.

5.3 Additional guidance

Further evidence suggests that ease of use is an influential factor in determining the intention of males to use the AME. As showed in Section 4.3, males are good at receptive skills only. Thus, there is a need to enhance their productive skills. Several ways can be applied to address this issue (Wood *et al.*, 1976). For example, scaffolding, which is one way to help learners reduce complexity and choices by providing additional structure during the learning process, can help learners decompose a task and organize their work (Reiser, 2004). The other way is to provide additional guidance and explanation (e.g. phonetic interpretation and generative grammar), as shown in Figure 7B. By doing so, difficulties in writing and speaking by males can be reduced so that their productive skills can be improved.

Figure 7.
Proposed design approaches

5.4 Annotation in-class and after-class

The results of our study showed that males make fewer annotations in-class than females. This may be because males do not have a good working memory (Speck *et al.*, 2000) and lack inherent advantages in the process of second language acquisition (Polat and Mahalingappa, 2010). Thus, it may not be easier for males to listen to lectures and to make annotations in a synchronic way in-class. To remove this gender gap, it is necessary to provide males with shortcuts (e.g. quick input method and whiteboard with capacitive pen) so that they can make annotations in the class efficiently (Figure 7C). By using these shortcuts, males can type faster and draw freely. Furthermore, there is also a need to provide males with additional mechanisms after-class, which can compensate their slower progress of making annotations in-class. For instance, an annotation sharing mechanism, which can let learners acquire in-depth knowledge (Goh *et al.*, 2012), facilitate knowledge sharing and improve students' comprehension, as well as learning achievements (Yang *et al.*, 2011). Such a mechanism can help males review the annotations by others after-class so that their understanding can be as good as those of the females. By adding such a mechanism, we not only solve males' problems of making annotations in-class but also promote the use of annotations both in-class and after-class. This is because both in-class and after-class are equally important (Sandberg *et al.*, 2011).

6. Conclusions

A logical relationship can be drawn between this study and previous research. In particular, our results reinforce the understandings of the SRT, which indicates males prefer to work with tools while females prefer to work with people (Eagly, 1987). Text-to-speech can be considered as a new technology tool, which is, thus, valued by males. On the other hand, teachers' voice annotation, which involves human contact, is, therefore, appreciated by females. Further to the SRT, our results also echoed the findings from previous studies, such as Teo (2010) and Gefen and Straub (1997), which indicated males tended to accept new technology, whereas females are enthusiastic to have human contact.

On the other hand, the results indicated that using voice annotation after-class and listening to their own voice annotation are useful for females to obtain high post-test

scores while only using the text annotation after-class is helpful for males to gain high post-test scores. Such differences demonstrate females and males do have different requirements. To this end, this study recognized the importance of versatility in the development of the e-readers. Thus, several design approaches are proposed in Sections 5.1-Section 5.4, and they can be used for developing the next version of e-readers and other applications, such as electronic libraries, which can accommodate the preferences of males and females.

In terms of external validity, the conclusions detailed in the previous two paragraphs should be valid for elementary students with similar English proficiency when they use similar annotation tools. For the same reasons, to a large extent, the conclusions detailed in the previous two paragraphs are likely to be valid for any system that provides similar annotation tools. However, only a small-scale sample was considered so that the statistical inference should be carefully treated. Furthermore, this study takes into account gender differences only. There is a need to examine other human factors, such as cognitive styles or prior knowledge, in future research. The findings from such research and those from this study can be integrated together for the development of personalized AMEs.

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Corresponding author

Sherry Chen can be contacted at: sherry@cl.ncu.edu.tw