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Gender Differences in Chinese EFL Learners' Comprehension When Reading Across Mediums

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Abstract

As the reading medium shifts from paper to digital devices, there is a notable change in readers' habits, moving from traditional printed formats to electronic forms. While extensive research has been conducted on gender differences in traditional print reading, studies focusing on gender disparities in mobile reading comprehension are rather limited. This research employed cross-sectional quantitative methods to explore gender differences in comprehension through both print and smartphone-based reading tests. Data was gathered from 190 undergraduates at a local university in China through reading comprehension tests. Participants' reading results were analyzed using SPSS software for comparison. The findings indicate no significant difference in reading achievements between male and female participants on both paper and smartphone platforms. However, the study found positive trends in female students' performance on both mediums. The disparity in the mean difference between male and female students' reading scores was larger in smartphone-based tests, which indicates that digital mediums could either enhance reading performance in female students or potentially have a negative impact on male students.

Keywords: gender difference, reading comprehension, mobile reading, print reading, comprehension levels

1. Introduction

As one way of language input, reading has been given much emphasis in both language learning practice and research literature. The capacity to understand and interpret what is being read is often referred to as reading comprehension, basically from literal to critical levels (Herber, 1970; Rupley & Blair, 1983; Vacca et al., 2016). When processing a text, readers may understand the text at the surface level, capturing its literal meaning, or they may infer or evaluate, extracting underlying messages from the text. In this process, there are many factors that can influence their reading comprehension, such as the medium of text presentation and the reader's gender (Alderson, 2000; Brantmeier, 2001).

To date, mobile technology has been fully integrated into our daily life (Wang et al., 2016). According to the survey from the National Reading Research Group of China (NRRGC) (2023), smartphones have become the predominant reading medium among Chinese adults, and mobile reading has surpassed traditional paper-based reading and other digital forms in terms of time spent. However, it is notable that despite the widespread development of mobile reading, it differs from traditional paper-based reading in many aspects. Hashim and Vongkulluksn (2018) claim that the reading process on mobile phones might possess different features from what traditional paper reading has. Although reading on mobile devices involves a similar comprehension process to traditional print reading, such as decoding, interpreting, and sentence integration (Lim & Jung, 2019), the digital texts presented on small screens are usually nonlinear. More cognitive load is required from the reader while reading on the screen (DeStefano & LeFevre, 2007; Yang & Hu, 2022). It seems essential to understand whether reading on mobile screens will affect the effectiveness of reading comprehension compared to conventional print reading.

Further, another often discussed influential factor affecting reading comprehension in the literature is gender difference. Although mixed findings are reported between male and female readers' comprehension performances in print reading (Logan & Johnston, 2010), the gender gap in reading becomes narrower with the

widespread usage of mobile reading devices (Brozo et al., 2014). In the print reading context, girls are reported to achieve higher results, but no significant difference between boys and girls in digital reading assessments has been found (Wu, 2014). Whether this is true when learners read on smartphones in an EFL context has rarely been investigated.

Accordingly, to fill the existing gap in the literature, the current study aims to investigate whether gender difference exists in comprehension when reading on paper/smartphones in the Chinese EFL context. Thus, the following research questions are developed:

(1) Is there any difference between male and female students when they read on paper?

(2) Is there any difference between male and female students when they read on smartphones?

2. Literature Review

2.1 Reading Comprehension

Reading comprehension basically involves three levels of text processing: literal, inferential, and critical. Literal comprehension requires the reader to identify what the writer says by decoding words (Herber, 1970). It includes the "identification of factual, explicitly stated information" (Rupley & Blair, 1983, p.215), which means reading the lines and searching for essential information from the text (Vacca et al., 2016). At this level, the reader recognizes or recalls the main ideas, details, and relationships between information. At the inferential level of comprehension, the reader needs to infer main ideas, sequences and details (Rupley & Blair, 1983). It goes beyond explicit information recognition and recall. With the help of background knowledge and experience, the reader determines what the writer intends to convey implicitly. Critical comprehension is considered the highest level of reading comprehension (Vacca et al., 2016). When reading at this level, the reader normally knows how "to evaluate, question the author, think critically and draw additional insights and fresh ideas" (Vacca et al., 2016, p. 197).

Based on the review of the three levels of comprehension (literal, inferential and critical), it is known that literal understanding directs the reader to decode words and the explicit text information while inferencing and critical comprehending involve in-depth understanding. According to King (2007), surface-level decoding and text-based processing may lead to shallow comprehension. Deep comprehension happens only when the reader goes beyond the explicit meaning of the text. However, it is not easy for a reader to move from shallow (literal) reading to deep (inferential and critical) reading, particularly, when reading online. As Wolf et al. (2009) point out, digital reading has greater potential than relatively linear print reading to form a passive reader, who may be frequently distracted by the richness of online information, rather than reading with deep reflection.

2.2 Reading Across Mediums

In the modern era, when reading mediums show a tendency to move from paper to mobile devices, Readers' reading habits are changing greatly from traditional printed format towards electronic forms, such as emails, e-journals and e-books (Shimray et al., 2015). According to one study (West & Ei, 2014) done in developing countries, mobile devices are regarded as the most appealing reading tools to people. They read more if they are allowed to read on mobile devices. The same situation has also been found in China, particularly among young people. According to NRRGC (2019), the percentage of reading through mobile phones rises each year, faster than print reading, and the readers are mainly young people between the ages range from 18 to 29.

Zhang and Ma (2011) define "the reading behaviour based on handhold reading devices (mobile phones, PDA, MID, PSP, MP4, e-readers, etc.)" (p.425) as mobile reading. So far, most studies on mobile reading have been carried out among first language (L1) learners, which primarily focus on learners' reading habits, behaviours, and the reading effect from a small display (Chen & Lin, 2016; Liu & Huang, 2016; Merga & Roni, 2017; Shimray et al., 2015; Zhang & Ma, 2011). Some studies investigate mobile reading from the perspective of application design or phone screen features (Mohammed & Husni, 2017; Öquist & Lundin, 2007). Only a few studies attempt to explore Second language (L2) reading with smartphones (Hazaea & Alzubi, 2016; Huang & Lin, 2011; Yang & Hu, 2022; Yu et al., 2022).

2.3 Gender Differences

The gap in mobile reading comprehension is especially pronounced when considering potential influencing factors like gender differences. To date, researchers have shown great interest in studying gender roles in the context of reading English as a Second Language (ESL) or English as a Foreign Language (EFL). Some of them have investigated the gender differences in reading performances through print format or digital mediums with larger screens, such as computers or tablets, and their research findings are often inconsistent. Specifically, some

studies report that no difference has been found between males and females (e.g., Huang et al.,2013; Koç, 2016), while some researchers find girls outperform boys (Logan & Johnston, 2010; Payne & Lynn, 2011), or boys outscored girls (e.g., Al Asmari & Ismail, 2012; Al-Shumaimeri, 2005).

For example, aiming to investigate whether gender differences exist in e-book reading, Huang et al. (2013) conducted a study among twenty-three sixth-grade students in Taiwan, China. All the students participated in the retrieval test after a period of e-book reading. It turned out that girls outscored boys in the reading outcomes. As the researchers pointed out in their study, although technologies like e-books were used to help reduce the gap between males and females in terms of adapting to technology, the gender differences in how children read e-books were still significant and should be considered.

In other studies, males' excellence in processing digital materials seems to help them lessen their inferiority in reading within an online context. For instance, some research (Sackstein et al., 2015; Wu, 2014) suggests that girls are generally better readers than boys in print reading, but boys show interest in digital texts and relatively excel in the digital format of reading. In a large-scale study conducted by Wu (2014), more than 30 thousand 15-year-old students participated in online and print reading assessments. The findings reveal that girls possess more metacognitive strategies and navigation skills in reading and do better in reading comprehension tests with printed medium, but they did not differ significantly from boys in online reading assessments. Also, Sackstein et al. (2015) have not found a significant difference between male and female students among their participants of both their tenth graders and university students. Besides, no gender difference has been found by Taki and Soleimani (2012) in EFL online reading strategies. The gender gap seems to be narrower with the newly emerging reading medium (Brozo et al., 2014).

The finding of the lessening of the gender gap in the digital reading environment is not surprising. According to Weiser (2000), for a long time, the internet has been recognized as a male-dominated world. Women usually show less need to get access to it, which might cause the phenomenon that women do not perform as well as men when they search for information online. Based on the longitudinal investigation of college students from the year 1997-1999, this gender gap is assumed to continue existing in internet use and would not diminish even if the internet world extends and reaches more people (Sherman et al., 2000).

However, decades have passed since Sherman et al. (2000) reported their findings. In this digital age in which almost every tertiary student has a smartphone (Kwangsawad, 2019), whether the gender gap has already been bridged remains unknown. However, the newly conducted research does find that female learners are more willing to read digital materials (Milal et al., 2021), and to use smartphones more frequently (Elhai et al., 2021) for language learning activities (Şad et al., 2022), which might increase their exposure to familiarity with digital mediums. When girls and boys have the same level of access to digital devices like mobile phones, the advantage that boys might have previously had in using these technologies for educational purposes diminishes or disappears (Shimray et al., 2015). It might be possible to predict that when the performance or advantage in using digital tools for learning becomes similar between the genders, the gender gap in reading comprehension caused by digital mediums could probably be lessened.

As one of the digital reading mediums, the smartphone possesses mobile features such as portability and mobility, becoming increasingly popular among young people. Among studies (Elhai et al., 2021; Milal et al., 2021) that are relevant to smartphone-based reading, there is research focusing on differences between males and females in mobile reading attitudes or strategy use. However, studies concerning gender differences in reading comprehension or reading outcomes are rarely found. Although there are studies reporting that students actively use reading skills in print format as they do with digital reading on big screens like computers (Taki & Soleimani, 2012), the reading performance of males and females on small-sized screens remains unreported. Accordingly, whether reading comprehension levels will differ between genders when reading on smartphones still needs further investigation.

In summary, studies investigating gender differences in reading comprehension across both print and digital mediums have yielded inconsistent results. These varied findings contribute to a more detailed understanding of how male and female learners comprehend text differently depending on the medium. However, these mixed results also highlight potential gaps in research that need further investigation, particularly in smartphone-based reading. This leads to the necessity of the current research, which aims to explore the potential differences in reading comprehension between genders when reading EFL materials via traditional paper-based methods and smartphones.

3. Research Methodology

This study delves into the differences in paper-based and smartphone-based reading comprehension between male and female Chinese EFL learners. The objective is to discern whether gender influences the comprehension of Chinese EFL learners when they utilize paper/smartphone platforms for their reading practices. It attempts to understand gender effects on paper / smartphone-based reading based on learners' literal, inferential and critical reading comprehension levels.

To achieve the research purpose, the study adopts a quantitative method. Participants were invited to participate in two reading comprehension tests, respectively on paper and on their smartphones. The test performance was computed and analyzed through SPSS software.

3.1 Participants

The present study was conducted at a local university in the north of China. In this university, the study targeted nearly 2,000 second-year undergraduates as the population. It might be because it is a university focusing on humanities majors rather than engineering principles, the gender ratio among the students is uneven, with females accounting for more than two-thirds of the overall participants. To achieve the research goal, a stratified random sampling method was adopted. According to Dörnyei (2007), stratified random sampling means "the population is divided into groups, or 'strata', and a random sample of a proportionate size is selected from each group" (p.97). Since the current research aims to investigate gender differences in reading comprehension, both male and female students are needed. We categorized the students into two groups based on gender and then selected male and female participants based on gender proportions on a random basis. Random selection ensures the most probable representative features of samples and thus reduces more subjective factors (Dörnyei, 2007). Consequently, through stratified randomization, one hundred and ninety university undergraduates, 69 males and 121 females, were selected for the study.

By the time participants were enrolled in the university, most of them had learnt English for at least ten years. After they had passed the nationwide standard test, the College Entrance Exam, they were believed to have achieved Level B1 according to the Common European Framework of Reference for Languages (CEFR). At university, 'College English' is a compulsory course for them to take, usually once or twice each week. Since online teaching and learning are becoming integrated into college courses, especially after the outbreak of the COVID-19 pandemic, participants increasingly utilize mobile devices to learn English. Sometimes, they read in English on their phones.

3.2 Instruments

Two tests were administered to examine the differences in English reading comprehension when participants read on paper versus mobile phones. One test was presented to participants in paper format, and the other was taken in the form of digital texts on participants' smartphones through the school course app called "Superstar Study". To better control the similarity of the two tests, we selected all the texts from past exam papers of College English Test Band Four (CET4), which serves as a standardized and nationally recognized metric for assessing Chinese EFL learners' English language proficiency in China, especially among Chinese undergraduates. Each test consists of four passages, including 20 multiple-choice questions to examine participants' reading comprehension abilities. All the question items were classified into three levels (literal, inferential, and critical) based on previous studies (Herber, 1970; Rupley & Blair, 1983). The two sets of passages respectively incorporated in the two tests are approximate in total word count (around 1,400 words), readabilities (Flesh-Kincaid grade level 11.1 or 11.0, equivalent to the Grade level of education in the US), and topics (robot technology, art, health, and feminism).

3.3 Data Collection and Analysis

The two reading comprehension tests were conducted in four large classrooms where all the participants could be seated. Each test was taken with a time restraint of 50 minutes. Before the tests, we informed all the participants of the research purpose and basic procedures of the tasks they were going to go through subsequently. Following the planned procedure, half of the participants (including males and females) took the paper-based test in the first 50 minutes, while the other half of the subjects (including males and females) took the smartphone-based test. After a 30-minute break, each group of participants took the second test on the other reading medium. Different sequences of the tests between the two groups of participants were to counterbalance the treatment-order effects (Kooken et al., 2017). To ensure the authenticity of the student's test results, we invited another three teachers to proctor the exam. At the end of each test, these teachers reminded the students to submit their answers.

When grading students, 20 points were assigned to those 20 multiple-choice questions of each test. Participants attained one point when they filled in the correct answer to one question. Since the questions were categorized into three groups according to the comprehension levels (8 for literal, 9 for inferential and 3 for critical), the results of each participant were given corresponding to these three groups. Thus, participants' comprehension outcomes were logged in the computer with four groups of scores for data analysis: literal, inferential, critical, and total.

For the paper-based test, we collected the test papers and graded the students' answers based on the predetermined grading method and then invited another expert teacher, to have a double check of the grading results. For the smartphone-based test, students submitted to the 'Super Study' learning platform, which automatically scored the results. In case students who first took tests on smartphones saw their grades through the platform and thus influenced their subsequent paper-based test, we set in the system to make the scores invisible to students. Finally, all these participants' scores were output from the platform. Along with the paper test results, they were input into SPSS for the subsequent computation and analysis.

In summary, for the reading comprehension tests, 190 students' data were collected and subsequently imported into SPSS for further comparison. For a detailed look at male and female students' performance, we computed through SPSS software, acquiring the descriptive statistics of the comprehension accuracy of both genders, including the mean value. To determine whether male and female students had a difference in reading comprehension, we conducted an independent sample t-test.

4. Results

We compared male and female students' performance in paper-based/smartphone-based reading by conducting independent sample t-tests, detecting whether gender effects exist in reading comprehension via each medium.

4.1 Gender Differences in Paper-based Comprehension Performance

In the comprehension tests, participants' performance was evaluated by their accuracy in responding to multiple questions. The accuracy rate in paper-based reading is presented in Figure 1, showing that both genders had the highest accuracy rate in literal level comprehension and the lowest at the critical level. Females generally performed better than males in overall performance, inferential and critical levels. At the literal level, male students scored slightly higher than their female peers.

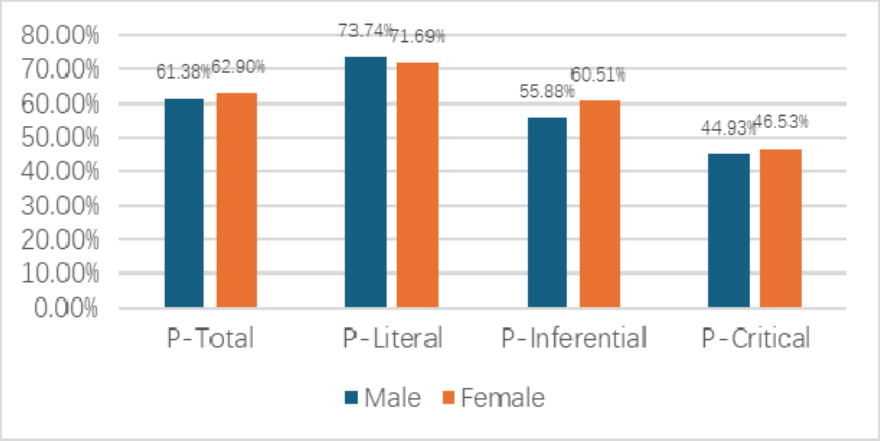

Figure 1. Gender differences in paper-based reading comprehension tests

The statistical results shown in Table 1 indicate that no significant gender difference exists in paper-based reading comprehension. The mean differences for the total score and each level of comprehension results are not significant (sig. =0.408-0.708, P>0.05).

Table 1. Gender differences in paper-based test results

Test level	Gender	Mean	SD	MD	Sig.(2-tailed)
Total	Male	12.275	2.749	-0.303	0.480
	Female	12.579	2.889		
Literal	Male	5.899	1.226	0.163	0.408
	Female	5.735	1.346		
Inferential	Male	5.029	1.774	-0.417	0.147
	Female	5.446	1.970		
Critical	Male	1.348	0.837	-0.489	0.708
	Female	1.396	0.880		

Note. Male: n=69, Female n=121; MD (mean difference) is the difference between the mean scores of males and females. Significance levels were set to 0.05.

The first research question has been answered through the above analysis of the outcomes from the reading tests. It is apparent that there is no statistical difference between males and females in paper-based reading comprehension. However, it is suggested that girls performed slightly better than boys except for the literal level.

4.2 Gender Differences in Smartphone-based Comprehension Performance

Like the way we processed participants' paper-based performance, their performance in smartphone-based reading was also computed through SPSS. As is shown in Figure 2, the comprehension tests' accuracy rate at the literal level is the highest, and the critical level is the lowest. Female students outperformed their male peers in overall achievement and all three comprehension levels.

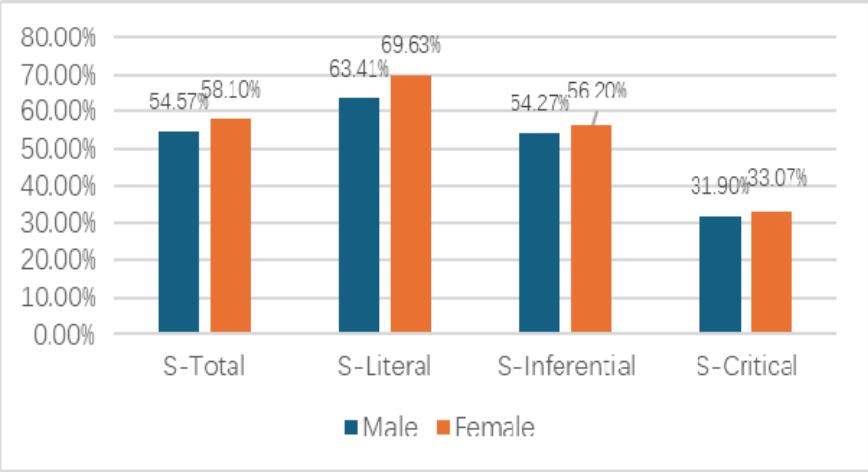

Figure 2. Gender differences in smartphone-based reading comprehension tests

To determine whether girls significantly performed better than boys, an independent sample t-test was conducted through SPSS software. The statistical results (see Table 2) show that no significant gender difference exists in smartphone-based reading comprehension. The mean differences, both for the total scores and for the results at each level of comprehension, are not significant (sig. =0.084-0.787, P>0.05). Accordingly, the second research question has been answered. There is no significant difference between male and female students when they read on smartphones.

Table 2. Gender differences in smartphone-based test results

Test level	Gender	Mean	SD	MD	Sig.(2-tailed)
Total	Male	10.913	3.633	-0.707	0.787
	Female	11.620	3.292		
Literal	Male	5.073	2.032	-0.498	0.172
	Female	5.570	1.632		
Inferential	Male	4.884	1.929	-0.174	0.084
	Female	5.058	1.972		
Critical	Male	0.957	0.865	-0.035	0.557
	Female	0.992	0.861		

Note. Male: n=69, Female n=121; MD (mean difference) is the difference between the mean scores of males and females. Significance levels were set to 0.05.

With the presentation of participants' reading outcomes from both paper- and smartphone-based comprehension tests, a global view of gender differences across mediums can now be established. Although no significant gender difference had been shown, female participants were found to display a marginal capacity in smartphone-based reading, in which they outscored boys at the overall and each level of comprehension tests. Paper-based reading also favored girls except for the literal level.

By comparing the mean difference of the overall achievements between the two mediums, we found that the mean differences are more prominent in smartphone-based reading (MD=-0.707) than in paper-based reading (MD=-0.303). This result may suggest that the disparity between male and female students becomes larger when they comprehend the texts via smartphones.

5. Discussion and Conclusion

The results reported above indicate that gender effects do not exist in paper- or smartphone-based reading among Chinese EFL learners in general. This finding is in line with previous studies that investigate gender differences among EFL university-level students in print reading (Brantmeier, 2003; Koç, 2016; Mehrpour et al., 2011; Phakiti, 2003) and digital reading (Sackstein et al., 2015; Wu, 2014). In these prior studies, no significant difference has been found between male and female students regarding their reading comprehension outcomes.

This finding seems to challenge the traditional notion in the existing literature that gender has a significant impact on language acquisition (Zoghi et al., 2013). Also, it contradicts the Underlying Cognitive Processes proposed by Halpern (2000), who listed major differences between males and females in language learning and spatial mental representations. However, it is possible that both male and female students at the university level become mature and further develop their literacy skills to lessen the gap between them. This possibility is supported by a meta-analysis study conducted by Siddiq and Scherer (2019), pointing out that the differences between boys and girls in language learning could gradually diminish when they grow up.

Although no significant difference was found between boys and girls in the present study, it is worth noting that girls slightly outperformed boys in overall reading achievement across the two mediums. The factors contributing to the better performance of girls are diverse. Besides better reading ability (Logan & Johnston, 2009) and language learning advantages (Halpern, 2000), they are also considered more serious readers (Liu & Huang, 2008) and have a more positive reading attitude than boys (Logan & Johnston, 2009).

More specific differences at the three comprehension levels were also detected in this study. In the paper-based reading tests, although boys fell behind girls in the overall performance, they slightly outperformed girls at the literal level by approximately 0.164 points. This result may suggest that in the traditional format of reading, boys' comprehension capabilities could potentially surpass girls' in certain areas. A possible explanation is that boys may be more efficient in processing explicit and direct information, leading them to perform well on tests of the literal understanding of a text, as indicated by the findings in the previous research (Namaziandost et al., 2020), in which the boys achieved better outcomes in reading accuracy than girls. This points to the need for more comprehensive studies to gain a complete understanding of dynamic gender differences in reading capabilities.

The comparison of the mean difference between genders across the two mediums highlights the result that the disparity of gender difference in smartphone-based reading is more prominent than in paper-based reading. This

trend is inconsistent with the prior study (Brozo et al., 2014), in which the achievement gap between genders was narrower in digital reading, especially in the EFL country Korea, with an average of 35 points on print reading but only 18 points on digital reading. This means the disparity between genders lessened in digital reading outcomes, revealing that digital medium might have some negative influence on girls or a positive impact on boys. Conversely, in the present research, the gender gap in smartphone-based reading was found to be larger, indicating that digital mediums might enhance the EFL reading performance of female students or potentially negatively affect boys.

This inconsistency between the prior study (Brozo et al., 2014) and the present research may be led by different demographics. Participants in the study were university students who may use smartphones every day and were familiar with this reading medium. Whereas the subjects in the study by Brozo et al. (2014) mainly involved 15-year-olds. Their familiarity with computers (reading medium) was not reported in their study. According to previous research, familiarity with reading mediums may contribute to their achievements and decrease the medium effects (Chen et al., 2014).

Additionally, some prior studies reported that boys favor digital mediums (Elwood & MacLean, 2009; Liu & Huang, 2008), but the newly conducted research found that girls were more likely to read digital materials (Milal et al., 2021), and to use smartphones more frequently (Elhai et al., 2021) for language learning activities (Şad et al., 2022), which might increase their exposure to familiarity with digital mediums. When female learners have equivalent access to mobile phones or other digital mediums, boys seem to have lost their advantages in the digital world in the educational context (Shimray et al., 2015). Thus, the gender gap caused by digital mediums might be lessened due to the development of technology and the prevalence of mobile devices. This might be why girls achieved higher results than boys in smartphone-based reading in the current study.

Despite the strengths of this study, we must acknowledge several limitations that warrant consideration. First, the study focused exclusively on gender differences in reading comprehension levels, omitting an analysis of reading processes, such as strategy use, between males and females. Second, it was confined to examining only two mediums and did not explore online reading on larger screens, such as computers or e-readers, which are also prevalent in today's society. Therefore, we recommend further investigations into these two areas in future studies.

In conclusion, the study's investigation of gender differences adds knowledge to the existing gender literature by employing a small-screened mobile reading medium in the examination of EFL reading comprehension. Although no significant difference has been found in this study, some detailed variances are noticed. Girls show marginally superior performance than boys when they read on their smartphones. The results encourage further exploration of the effects of gender on mobile reading, as well as the interplay between gender, reading comprehension ability and digital familiarity. Further, in educational practice, the findings may remind some educators to drop the idea of gender-based stereotypes, particularly within the domain of reading comprehension. They might need to emphasize individual capacities and characteristics in reading comprehension instead of making assumptions based on gender.

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