JCSHD

COGNITIVE SCIENCES AND HUMAN DEVELOPMENT

The Effects of Gender and Reading Mediums on Reading Comprehension

Corrin Alicia Nero[1] and Norehan Zulkiply[2*]

[1,2] Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

ABSTRACT

The present study examined the effects of gender and different types of reading mediums on reading comprehension among students. Forty undergraduates were asked to read four psychopathology texts (two digital texts and two print texts). Results showed that there was no significant difference in reading comprehension between gender. However, the mean scores obtained by females were slightly higher than males. Results also showed that reading comprehension between the two groups (print versus digital) was not significantly different. Nevertheless, the mean scores revealed that participants' performance in print reading was slightly better than digital reading, suggesting that participants may have benefited a bit more from print reading. The present findings shed further light on the effects of digital reading and print reading on reading comprehension.

Keywords: Digital reading; Gender differences; Print reading; Reading comprehension

INTRODUCTION

Reading is the essence of acquiring knowledge and gaining information, and the process requires mental and cognitive efforts. Due to the important roles of reading in learning, many studies have been carried out to examine various aspects of reading process, including word reading and comprehension skills (Oakhill & Yuill, 1996; Seymour & Evans, 1994; Wagner, Torgesen & Rashotte, 1994). Recently, several studies have been conducted to examine the influence of print and digital text in reading comprehension (Singer & Alexander, 2017; McCrea-Andrews, 2014; Proaps & Bliss, 2014; Sun, Shieh & Huang, 2013). A typical experiment that examines the effect of print text versus digital text involves the participants in reading printed text which is presented on paper, and on-screen text which is presented via digital devices. Later, participants are tested on their comprehension by answering some questions regarding the texts.

ARTICLE INFO

E-mail address:
znorehan@unimas.my (Norehan Zulkiply)
*Corresponding author
https://doi.org/10.33736/jcshd.1704.2020
e-ISSN: 2550-1623

Manuscript received: 17 July 2019; Accepted: 23 October 2020; Date of publication:31 March 2020.

In Mangen, Walgermo and Brønnick's (2013) study on the tenth-grade students, significant differences were observed across different reading mediums concerning the speed of processing, text recall as well as reading comprehension. Mangen et al. (2013) concluded that students who learned using print texts scored remarkably better in reading comprehension tests as compared to students who learned using digital texts. Ackerman and Goldsmith (2011) examined the undergraduate students in terms of encoding competency and the precision of metacognitive monitoring in which the study time was manipulated. The results from Ackerman and Goldsmith's experiment showed that participants' test performance did not differ between the two mediums under fixed study time. Nevertheless, when the study time was self-regulated, participants' performance in print reading was better than on-screen or digital reading. In addition, Singer and Alexander (2017), reported that participants were able to recall the main ideas and other related information in the passage better when they were previously engaged in print reading rather than in digital reading during the study phase.

According to Wallis (2010), the readers have the tendency to scan through the on-screen texts rather than to engage with the texts and its content deeply even when are under the full attention condition, or when there are switching activities expected of them. Participants created different perceptions of the digital text and print text which could be due to several factors such as size of text, screen resolution, backlighting as well as luminance differences (Lee, Ko, Shen & Chao, 2011). The Liquid-Crystal Display (LCD) screens that are found in desktops, laptops, computers and handheld devices are the most common displays for digital reading. Such screens might lead to visual fatigue in users as a result of the lighting source (Mangen et al., 2013). The additional features of an LCD screen, such as the refresh rate, contrast levels and shifting lights may contribute to interference in the text recall process, hence providing further explanation as to why some people found it unpleasant when reading on-screen compared to reading in print (Garland & Noyes, 2004). Furthermore, other perceptual aspects involved in processing the differences between on-screen text and print text are related to sequential versus continuous reading respectively. In other words, readers must scroll regularly between portions of each text or read in an uninterrupted manner (Proaps & Bliss, 2014). It is argued that frequent scrolling increases readers' cognitive demands which in turn might result in lower performance in recalling the learned materials (Wastlund, 2007).

Conversely, a recent study conducted by Singer and Alexander (2017) found that students had a strong preference for digital reading than print reading, and the students self-predicted that they had better comprehension skills in digital reading. It is argued that this pattern of preference may be linked to the students' motivation as they experienced digital reading. Most people read twice as many digital books on average as compared to those who read only in print and this is because the readers find that digital texts are a speedier option and more portable than printed texts (Zickuhr, Rainie, Purcell, Madden & Brenner, 2012). Besides the liking for digital texts, students perceive themselves as digital natives, armed with the essential skills in satisfying the demands of digital reading.

Furthermore, this self-efficacy verdicts would also appear to foresee students' engagement pertaining to learning from on-screen texts, and there is some proof to endorse students' self-judgements (Farah & Maybury, 2009). Farah and Maybury's study examined the use of the digital computer-generated microscopy technology in the learning of the syllabus of the School of Dentistry at the University of Queensland (UQ). Farah and Maybury (2009) found that learning through virtual microscopy and computer-assisted learning of pathology seemed to improve the learning experience of the students with regard to its efficiency in assisting students to interact with the course materials.

Kerr and Symons (2006) observed that participants in their research (i.e., children in their fifth grade) were able to navigate digital texts more competently compared to printed texts. However, the results from the study also showed that the children read the text slower on computers compared to on paper, but they remembered more information when reading from the computer than from paper. When the testing time was fixed, the children were found to be more competent at understanding the texts when reading from paper (Kerr & Symons, 2006). In another research, McCrea-Andrews (2014) examined the reading process in adolescents, with the intention of determining whether digital reading (using Nook, an e-reading device) and print reading (using book) resulting in a difference experience in the adolescents. The results showed that the participants in the Nook group outperformed those in the book group after reading a moderately challenging text.

In terms of gender factor, there have been only a few studies that have incorporated the investigation on gender differences in reading comprehension. In Sun, Shieh and Huang (2013)'s study, it was found that male participants performed better in on-screen reading whereas females outperformed males in print reading. In another study, Wu (2013) investigated gender differences in an online reading activity, metacognitive strategies, navigation skills and reading literacy among students from nineteen countries. Wu (2013) found that there were gender differences concerning the knowledge of metacognitive approaches, navigation skills, as well as in electronic reading assessment (ERA) and printed reading assessment (PRA), showing that females exhibited reading prominence in printed reading assessment as compared to males. However, in terms of electronic reading assessment, no significant difference was observed between gender. Additionally, a survey by Liu and Huang (2008) examining Chinese students' preference towards the online reading environment revealed that female students have clear preferences for paper based-reading whereas males students show a greater sense of fulfilment with online reading than females.

With all the varying findings documented in past studies that have examined reading comprehension using different types of reading mediums, further exploration is needed to investigate the effects of different types of reading mediums on comprehension, and to find out if there are any gender differences in reading comprehension between the two reading mediums. It is important to note that, past studies have been using reading materials that the participants were familiar with, such as passages on general knowledge. For example, Singer and Alexander (2017) used materials that appealed to participants'

interest but were not directly related to their course and it was found that a few of the participants were highly knowledgeable in the topic chosen. This may create bias in the findings because a few of the participants had pre-existing knowledge about the topic chosen. It was the intention of the present study to further examine reading comprehension and the different reading mediums by using a topic that participants were not familiar with. In addition, the present study aimed to further explore the role of digital and print reading in reading comprehension especially among digital natives. Most students in this era of the 21st century are generally considered as digital natives (because they have been brought up during the age of digital technology and are likely to be familiar with computers). Therefore they may be able to achieve better reading comprehension scores when reading through the digital medium rather than the print medium. Pertaining to the gender factor, it is an established finding that females outperform males in verbal tasks (e.g., reading and object recall), whereas males tend to do better in spatial tasks (e.g., abstract visual and mental rotation) (Kimura, 2002). Females and males may be employing different strategies when participating in the same task which may be due to education background, sex hormones, cultural differences or other factors that influence neurodevelopment (Speck et al., 2000). In the reading task, different strategies may be employed by females and males in comprehending the tasks. It would be interesting to know how would females and males differ in their reading comprehension tasks especially when the use of technology, in particular, digital reading is used as one of the mediums.

The above discussion raises the following research questions:

1. Are there any differences in reading comprehension between female and male participants?
2. Are there any differences in reading comprehension between the two groups (printed text versus digital text)?

The goal of the present study was to find out the effect of gender and different types of reading mediums on reading comprehension. In particular, the present study aimed to find out whether digital reading can benefit the students in their reading comprehension, given the fact that the students in these modern days are digital natives. In addition, the present study aimed to find out whether there were any differences in reading comprehension between females and males, and how the gender factor can influence the performance in digital and print reading. The findings obtained from the present study will be able to shed light on the effects of digital and print reading and ensure that readers, particularly students, are well aware of which reading mediums can promote better learning experiences for them.

METHOD

Participants

The target population for this study was the undergraduate students in Universiti Malaysia Sarawak (UNIMAS). The sample for this study was selected through simple random sampling to ensure an unbiased representation of the population. A total of 40 undergraduate students were recruited with an equal number of participants representing both male and female genders. To ensure that

the experiment was equitable, a pre-screening test was conducted on the participants based on their results in the Malaysia University English Test (MUET), as well as their knowledge on the chosen topic for the texts used which was on psychopathology. In terms of MUET results, participants with MUET Band 3 and above were selected. MUET Band 3 was set to be the minimum requirement to ensure that the participants had at least a moderate level of English proficiency to reduce the chances of language proficiency affecting their performance. As for the topic knowledge, only participants who had no pre-existing knowledge on psychopathology were selected.

The main reason to pre-screen the participants was to examine their pre-existing knowledge about the topic of the texts. A recent study by Singer and Alexander (2017), focused on students from the human development and educational psychology course and the text chosen for their study was on childhood ailments, which appealed to the participants' interest. However, this method was likely to introduce bias as a few of the participants may have pre-existing knowledge of the text used, and therefore, their performance could be argued to be solely due to the experimental manipulation. In addition, Singer and Alexander's (2017) research participants were those aged 19 to 26 years, which they concluded satisfied the description of digital natives (Prensky, 2001).

Research Design

The present study used a 2 (Gender: female and male) X 2 (Reading Medium: digital vs print text) mixed-subjects experimental design. Gender was varied between-subjects, whereas the reading medium was varied within-subjects. Each participant (either in female or male group) was exposed to all the conditions of the reading mediums where, in this case, the participant would read both printed and digital texts. Within-subject design was chosen for the reading medium variable to reduce the possibility of any experimental errors due to individual differences between participants. The materials used in the experiment were presented in a counterbalanced order. In each gender group, half of the participants read the four reading texts in the following order : print, digital, print, digital, whereas the other half of the participants read the articles in the following order : digital, print, digital, print. The print reading involved participants reading from printed text, while the digital reading involved participants reading digital texts presented on the computer screen.

Instruments

Reading comprehension texts (Study Phase). Four reading texts about psychopathology were used in this study. Two of the texts were for print reading, whereas the other two texts were for digital reading. Printed texts were presented on paper while digital texts were read from computer screens. The digital texts were presented as Portable Document Format (PDF) files, which were read using Adobe Reader for Windows. The texts were similar in terms of their length. The texts were grammatically and lexically moderate in terms of their difficulty in order to facilitate reading comprehension in participants. Even though several psychopathology terms were included in the texts, the terms were uncommon to the participants regardless of

their MUET levels. As mentioned earlier, for the topic knowledge, only participants who had no pre-existing knowledge on psychopathology and who had no explicit knowledge of psychopathology were selected

Reading comprehension questions (Test Phase). The participants were given a total of 32 questions (28 multiple choice questions and 4 subjective questions) in the test phase. Each text passage had eight questions which carried 10 marks for them to answer, comprising seven multiple-choice questions and one subjective question.

Data Collection Procedure

First, the participants were given a consent form for them to indicate their agreement to participate in the present study, and later the participants were briefed on what they were expected to do in the experiment.

During the experimental manipulation, the participants were given their first reading text passage either in print or digital form (study phase). After they had completed the first reading task, they were given a reading comprehension test for the first text passage, where they had to answer eight questions (test phase). The steps for study phase and test phase were repeated for the next three reading passages. Since the order of the texts was counterbalanced, half of the participant read in the following order: printed text, digital text, printed text and digital text, while the other half of the participants read in the order of: digital text, printed text, digital text and lastly printed text. After completing the four reading tasks and test phases, the participants were debriefed before they left the experimental room

RESULTS

A two-way mixed ANOVA statistical test was used to analyze the collected data, in particular, to find out the differences in reading comprehension between female and male participants, differences in reading comprehension between the two groups (printed text vs. digital text) as well as the interaction between gender and reading medium. Regarding the first research question, the results showed that there was no significant difference in reading comprehension between gender, $F(1, 38) = 0.381$, $p = .541$. This indicated that regardless of reading medium, the reading comprehension performance between females and males did not differ. Although the difference in reading comprehension between gender was not observed, it can be seen in Table 1 that the females' mean scores in reading comprehension were slightly higher ($M = 13.13$) than males ($M = 12.78$).

With respect to the second research question, the result was not statistically significant, $F(1, 38) = 3.692$, $p = .062$, indicating that there was no significant difference in reading comprehension between the two groups (print text vs. digital text). This suggested that the students' comprehension performance in digital reading was equivalent to their comprehension performance in print reading. Although the main effect of reading medium was not significant, the reading comprehension means in Table 2 showed that participants' performance in print reading ($M = 13.40$, $SD = 2.06$) was slightly higher than in digital reading ($M = 12.50$, $SD = 2.63$). The students seemed to have benefited slightly from the print reading compared to digital reading.

Table 1: Means of reading comprehension performance between gender

Gender	M
Female	13.13
Male	12.78

Table 2: Means and standard deviations of reading comprehension scores for each reading mediums

Reading Mediums	M	SD
Digital	12.50	2.63
Print	13.40	2.06

Table 3: Means and standard deviations of the interaction between gender and reading mediums

Reading Mediums	Gender	M	SD
Digital	Female	12.15	2.74
	Male	12.85	2.54
	Total	12.50	2.63
Print	Female	14.10	2.02
	Male	12.70	1.90
	Total	13.40	2.06

With regard to the interaction effect between gender and reading mediums, the results showed that the interaction was significant, $F(1, 38) = 5.025$, $p = .031$. In terms of the mean values shown in Table 3, it can be seen that the reading comprehension scores of the male participants' were slightly higher ($M = 12.85$, $SD = 2.54$) compared to female participants' scores ($M = 12.15$, $SD = 2.74$) for the digital reading. As for print reading, it was clear that female participants scored higher ($M = 14.10$, $SD = 2.02$) than male participants ($M = 12.70$, $SD = 1.90$), indicating that the reading comprehension of the female participants was better.

DISCUSSION AND CONCLUSION

With respect to the effect of gender on reading comprehension, the analysis showed that there was no significant difference between genders, indicating that the performance in reading comprehension between males and females was similar. Previous studies found that females were significantly better than males in performing verbal tasks such as reading (Boyle, Furedy, Neumann & Westbury, 2010; Kimura, 2002); however, such a pattern was not observed in the present study. One plausible explanation for this finding was perhaps due to the topic tested which was on psychopathology, an area in which participants were unfamiliar. The participants' unfamiliarity with the psychopathology texts seemed not to facilitate a better reading comprehension in the female participants in the present study. Although differences in reading comprehension between genders were not observed, the mean scores for reading comprehension showed that female participants' performance in reading comprehension ($M = 13.13$) was slightly better than male participants ($M = 12.78$).

With regard to the effect of reading mediums on reading comprehension, the present study found no significant difference in participants performance between the two reading mediums (printed text versus digital text), which implies that the participants' performance in reading comprehension was equivalent in both digital reading and print reading. The present finding was not consistent with the findings from past studies which have shown the effectiveness of print reading in facilitating better reading comprehension in participants compared to digital reading. A

possible reason for the absence of differences in reading comprehension between the two reading mediums used may also be due to the participants' unfamiliarity with the topic knowledge of the texts used. Participants had to read the texts on psychopathology, a topic, in which they had no pre-existing knowledge. It seems that when the participants are unacquainted with the reading content, print reading did not help much in enhancing their reading comprehension. Although the main effect of reading medium was not significant and regardless of the gender factor, the reading comprehension mean scores showed that participants' performance in print reading (M = 13.40) was slightly better than in digital reading (M = 12.50), which seems to indicate that participants may have benefited slightly more from print reading than from digital reading. Research has shown that the differences in processing the learning materials, in particular, digital text and print text are related to the sequential versus continuous reading involved. The participants who engaged in digital reading need to scroll regularly between portions of each text, and it has been argued that this frequent scrolling during digital reading could be a factor that adds to the reader's cognitive demand which may result in the lower performance in the reading task (Wastlund, 2007). Garland and Noyes (2004) further supported the benefits of print reading and argued that transfer of knowledge from the episodic memory to the semantic memory was more efficient when using printed material. Garland and Noyes (2004) agreed that the features in the LCD screen, such as refresh rate, contrast levels and shifting lights contributed to the negative effects of digital reading which include the interference during the retrieval process, thus throwing further light on why people tend to perform better in print reading than digital reading.

Importantly, the present study found a significant interaction effect between gender and reading medium. The mean scores for reading comprehension showed that female participants (M = 14.10) performed better than male participants (M = 12.70) in print reading whereas male participants (M = 12.85) performed better than female participants (M = 12.15) in digital reading. The present finding is consistent with the previous findings by Sun, Shieh and Huang (2013) which found that males outperformed females in screen reading, whereas females did better than males in print reading. The females' preference towards print-based text was likely to contribute to their better performance in print reading compared to digital reading (Sun, Shieh and Huang, 2013). According to Liu and Huang (2008), females showed greater preference for paper based-reading and a stronger reliance on printed material as the reading medium compared to males. Liu and Huang (2008) reasoned that females prefer print reading because they are more thorough readers and tend to annotate more often than males. Since digital text or document is not as convenient as paper document in terms of the reader's ability to annotate freely, this may explain why females prefer to engage with print reading instead of digital reading, thus supporting the findings of the present study. According to Stoop, Kreutzer and Kircz's (2013) study, annotation is an essential part of academic reading and doing it digitally is not as effective as highlighting and writing notes on paper. While annotation functions are slowly improving on e-reading devices and in PDF format, it is argued that they are still incapable

of matching the functionality that their print counterparts offer (Stoop, Kreutzer & Kircz, 2013). As for males, it is possible that their performance in digital reading is slightly better than females, and this could be due to their positive attitudes towards technology in general (Schumacher & Morahan-Martin, 2001). Their accepting attitude towards technology may result in a higher engagement with technology, compared to females. Additionally, based on Bandura's (1993) self-efficacy theory, it is likely that males' greater confidence in screen reading environment (Vekiri & Chronaki, 2008) contributes to their better performance in digital reading.

Future research can extend the present study by excluding time of testing which means not setting a time limit for reading the texts. Previous studies had reported that speed of reading from a screen is slower than that of print reading (Gould & Grischkowsky, 1984; Muter, Latremoullie, Treurniet & Beam, 1982). Based on the findings of Kerr and Symons (2006), children read text slower on computers than on paper, however they remembered more information that they had read from the computer than from paper. When time limits for testing were set, the findings showed that the children were more competent at understanding the texts when reading from paper. Therefore, it would be interesting to find out if similar or different patterns of findings will emerge if time limits are not set for the testing.

REFERENCES

Ackerman, R., & Goldsmith, M. (2011). Metacognitive regulation of text learning: On screen versus on paper. *Journal of Experimental Psychology: Applied, 17*(1), 18-12.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*(2), 117–148.

Boyle, G. J., Furedy, J. J., Neumann, D. L., & Westbury, H. R. (2010). Sex differences in verbal and visual-spatial tasks under different hemispheric visual-field presentation conditions. *Perceptual and motor skills*, *110*(2), 396-410.

Farah, C. S., & Maybury, T. (2009). Implementing digital technology to enhance student learning of pathology. *European Journal of Dental Education, 13*(3), 172-178. doi: 10.1111/j.1600-0579.2009.00570.x

Garland, K. J., & Noyes, J. M. (2004). Computer experience: A poor predictor of computer attitudes. *Computers in Human Behavior, 20*(6), 823–840.

Gould, J. D., & Grischkowsky, N. (1984). Doing the same work with hard copy and cathode ray tube (CRT) computer terminals. *Human Factors, 26,* 323-337. doi:10.1177/001872088402600-308

Kerr, M. A., & Symons, S. E. (2006). Computerized presentation of text: Effects on children's reading of informational material. *Reading and Writing, 19*(1), 1–19.

Kimura, D. (2002). Sex differences in the brain. *Scientific American*, *287*, 32-37.

Lee, D. S., Ko, Y. H., Shen, I. H., & Chao, C. Y. (2011). Effect of light source, ambient illumination, character size and interline spacing on visual performance and visual fatigue with

electronic paper displays. *Displays, 32*(1), 1–7.

Liu, Z., & Huang, X. (2008). Gender differences in the online reading environment. *Journal of Documentation, 64*(4), 616-626.

Mangen, A., Walgermo, B. R., & Brønnick, K. (2013). Reading linear texts on paper versus computer screen: Effects on reading comprehension. *International Journal of Educational Research, 58*, 61–68.

McCrea-Andrews, H. J. (2014). *A comparison of adolescents' digital and print reading experiences: Does mode matter?* South Carolina, SC: Tiger Prints, Clemson University.

Muter, P., Latremoullie, S. A., Treurniet, W. C. & Beam, P. (1982). Extended reading of continuous text on television screens. *Human Factors, 24*(5), 501-508.

Oakhill, J. & Yuill, N. (1996). Higher order factors in comprehension disability: processes and remediation. In Cornoldi and Oakhill (eds.) *Reading comprehension difficulties. Processes and intervention*. Mahwah, NJ: Erlbaum.

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9*(5), 1–6.

Proaps, A. B., & Bliss, J. P. (2014). The effects of text presentation format on reading comprehension and video game performance. *Computers in Human Behavior, 36*, 41–47.

Schumacher, P. & Morahan-Martin, J. (2001). Gender, internet and computer attitudes and experiences. *Computers in Human Behavior, 17*(1), 95-110.

Seymour, P. H. K., & Evans, H. M. (1994). Levels of phonological awareness and learning to read. *Reading and Writing: An Interdisciplinary Journal, 6*, 221-250.

Singer, L. M., & Alexander, P. A. (2017). Reading across mediums: Effects of reading digital and print texts on comprehension and calibration. *The Journal of Experimental Education, 85*(1), 155-172.

Speck, O., Ernst, T., Braun, J., Koch, C., Miller, E., & Chang, L. (2000). Gender differences in the educational organization of the brain for working memory. *NeuroReport, 11*, 2581-2585.

Stoop, J., Kreutzer, P., & Kircz, J. (2013). Reading and learning from screen versus print: A study in changing habits; Part 1. *New Library World, 114*, 284–300. doi:10.1108/NLW-01-2013-0012

Sun, S. Y., Shieh, C, J., & Huang, K. P. (2013). A research on comprehension differences between print and screen reading. *South African Journal of Economic and Management Sciences Special Issue, 16*, 87-101.

Vekiri, I., & Chronaki, A. (2008). Gender issues in technology use: Perceived social support, computer self-efficacy and value beliefs, and computer use beyond school. *Computers & Education*, *51*(3), 1392–1404.

Wagner, R. K., Torgesen, J. K., & Rashotte, C. A. (1994). Development of reading-related phonological processing abilities: New evidence of bi-directional causality from a latent variable longitudinal study. *Developmental Psychology, 30*(1), 73-87.

Wallis, C. (2010). *The impacts of media multitasking on children's learning and development: Report from a research*

seminar. New York, NY: Joan Ganz Cooney Center at Sesame Workshop.

Wastlund, E. (2007). *Experimental studies of human-computer interaction: Working memory and mental workload in complex cognition*. Gotebord, Sweden: Department of Psychology, Gotenburg University.

Wu, J. Y. (2013). Gender differences in online reading engagement, metacognitive strategies, navigation skills and reading literacy. *Journal of Computer Assisted Learning, 30*, 252-271.

Zickuhr, K., Rainie, L., Purcell, K., Madden, M., & Brenner, J. (2012). *Younger American's reading and library habits*. Washington, DC: Pew Research Center