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Computer versus Paper-Based Reading: A Case Study in English Language Teaching Context

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This research aims to determine the preference of prospective English teachers in performing computer and paper-based reading tasks and to what extent computer and paper-based reading influence their reading speed, accuracy and comprehension. The research was conducted at a State run University, English Language Teaching Department in Turkey. The participants were 96 prospective English teachers, 74 females and 22 males. Two types of data were collected in this research. First, the Questionnaire for Online Reading Comprehension was used to collect data about the participants' views on their computer and paper-based reading activities. Second, one experiment was conducted with 14 volunteering subjects to understand their reading speed, accuracy and comprehension in both computer and paper-based reading activity. The results of the research suggested that prospective English teachers preferred paper-based reading to computer version and their performance was higher in paper-based reading than computer. The study also revealed that reading speed on a computer screen was nearly 12% faster than paper-based reading for prospective English teachers.

Introduction

Reading is composed of various activities with several purposes (Lorch et al, 1993. In a reading process, text may be read by skimming rapidly, be scanned for a specific piece of information, and be read for comprehension. In addition to how a text is read, the reason why a text is read also contributes greatly to these reading processes (O'Hara, 1996). The use of computer in comparison to paper in a reading process continues to attract research interest. Bolter (1991) considers the computer as the fourth great document medium, next to the papyrus, the medieval codex, and the printed book.

Some predict that technological advances in computer technologies, wireless, mobile computing technology, new input techniques, the Web, new hypertext applications, digital libraries, and digital document reading devices will make books out of date. These advances can also alter the relationship between authors and readers. Moreover, they can change our concept of traditional libraries in the form of physical volumes (Selen& Harper, 1996). In spite of these improvements, recent studies prove that paper still continues to be the preferred means for reading activities.

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This research aims to determine the preference of prospective English teachers in performing computer and paper-based reading tasks and to what extent computer and paper-based reading influence their reading speed, accuracy and comprehension. In this study, online reading refers to reading text from a computer screen including tablets and e-book readers whether the source is internet or the computer itself. The result of the study is important for prospective English teachers because their choice of reading format highly influences their academic success. What makes this study significant is that computer and paper-based reading are compared in English language teaching context among prospective English teachers in Turkey.

Review of Literature

Online versus paper-based reading

Experimental comparisons of computer- and paper-based tasks date back to the emerge of computers. The majority of early studies comparing the reading of paper versus computer documents focus on outcome measures of reading, such as speed, reading accuracy and comprehension. The results of earlier studies presented below on computer and paper-based reading tasks suggested that paper-based tasks were superior to computer- based tasks in terms of speed, accuracy and comprehension.

Dillon (1994) revealed that reading was nearly 20 to 30% slower with regard to performance from a computer screen than a paper. While some studies found minimal differences (Creed et al., 1987; Cushman, 1986; Keenan, 1984), Oborne & Holton (1988), Muter & Maurutto (1991) reported no significant difference between two formats. However, it is noteworthy that computer technology at that time was undeveloped when it is compared with today's contemporary technology.

When considering reading accuracy, findings proved that paper prevailed computer. Muter et al. (1982) and Creed et al. (1987) found the degree of accuracy in reading tasks to be lower for computer-based text. However, Askwall (1985), Gould et al. (1987) and Oborne & Holton (1988) reported no significant difference between the two formats for accuracy. Ziefle (1998) also found that paper was superior to computer because of the screen qualities which caused tiredness in the eye more quickly.

Recent literature especially after 2000s comparing computer and paper-based reading has supported the findings of early studies and favored paper-based reading. Mayes et al. (2001) found computer-based reading significantly slower. In their study, Wa¨ stlund et al. (2005) provided a psychological and physical explanation that computer-based reading caused a greater level of tiredness and stress. These effects required an increase in cognitive demands, that is, the activation of more perceptual, executive and cognitive resources. Although Noyes et al. (2004) found no significant difference in the comprehension scores for the two means, participants reported more workload from the computer-based tasks (Noyes & Garland, 2008).

Yen & Wang (2002) conducted an experiment which tested the university students' experience regarding electronic- or paper-based reading. The results showed that most people did not deal with e-based reading well. The main obstacles were the lower level of man-machine interactions and self-control during e-reading process.

Destefano & Lefevre (2007) studied the role of cognitive load in hypertext reading and results

revealed that readers with low memory and background knowledge were generally disadvantaged in screen-based reading. However, low background knowledge could be advantages, if the hypertext structure were in line with the knowledge domain.

Shepperd et al. (2008) examined the perceptions and performance of 392 psychology students who used an electronic versus a traditional paper textbook. The results suggested that two formats did not differ in academic achievement. However, students reported that they spent less time in screen-based reading, but generally they did not like reading electronic text.

Ackerman et al. (2011) examined subjective and objective differences between on-screen and on-paper reading in terms of a set of cognitive and metacognitive components. The results suggested that the main differences between the two study media were not cognitive but rather metacognitive.

Dundar & Akcayır (2012) compared primary school 5th-class students' performance with regard to reading speed and comprehension with tablet PCs and printed books in Turkey. They found no significant difference between the groups in reading speed or the level of reading comprehension

Kim (2013) examined differences between a LCD monitor and a traditional paper format in reading performances of teenagers. The results showed that teenagers scored significantly higher on the paper reading comprehension tests than on the electronic ones. Furthermore, it was reported that it took longer time to read passages and answer questions on the screen.

Mangen et al. (2013) explored the effects of the technological interface on reading comprehension among 72 tenth graders from two different primary schools in Norway. Main findings showed that the participants' academic achievement was higher in paper-based reading than screen-based reading. The common characteristic of early and recent literature reveals that readers' performance is higher in paper-based reading and they prefer paper to computer screen.

The debate over the choice of computer and paper-based tasks will probably go on and there will always be some tasks which are better performed in one form than in the other. However, the situation is changing through the technological advancements and the findings can differ from one study to another.

Method

Quantitative research design was used in this study; in addition, this research design was supported by empirical data. It is hypothesized that prospective English teachers perform better in paper-based reading tasks, so they prefer paper-based reading tasks and tests to online versions. Therefore, this study will answer the following research questions:

1. What are the views of prospective English teachers about computer and paper-based reading?
2. What are the advantages and disadvantages of computer-based reading for the subjects?
3. To what extent does computer-based reading influence participants' reading performance like reading speed, accuracy and comprehension?

Participants

The research was conducted at a State-run University, English Language Teaching Department in Turkey. The participants were 96 prospective third grade English teachers majoring English Language Teaching and taking up the lecture of teaching language skills during 2012-2013 academic year. The group whose native tongue was Turkish had similar characteristics with respect to age and educational background. In other words, they finished Anatolian Teacher Training High Schools and took the same University Entrance Exam. Gender distribution was 74 (77%) females and 22 (22,9%) males. The participants are believed to be an ideal group for the research, because they are exposed to reading tasks in most of their academic studies.

Instruments and Procedure

Two types of data were collected in this research. First, The Questionnaire for Online Reading Comprehension (Tseng, 2010) was used to collect data about the participants' views on their online and paper-based reading activities. Both qualitative and quantitative data was collected through the research. Quantitative data was collected from the questionnaire and qualitative data collected from open discussion questions.

The questionnaire was administered to 96 subjects and composed of two parts. The first part consisted of 10 questions which aimed to understand participants' ideas on online and paper-based reading activities. The first group was designed in a five point Likert scale from "I strongly disagree (1) to I strongly agree (5). The second part covered two open-ended questions. These questions were designed to explore students' views about the advantages and disadvantages of reading from computer screens.

Second, following the completion of the questionnaire, one experiment was conducted to 14 volunteering subjects out of 96 to understand their reading speed, accuracy and comprehension in both computer and paper-based reading activity. In the experiment, an advanced level reading text which consisted of 968 words in English language followed by eight wh- comprehension questions was assigned to two groups, seven subjects as online readers and seven subjects as paper-based readers, to determine subjects' reading speed, accuracy and comprehension. In the experiment, one computer was assigned for each online reader and time was set to measure their reading speed. After completing text reading, they answered the comprehension questions by keyboard. As of paper-based readers, they were in a classroom and the reading assignment was given as a three-page paper. They answered the questions by pencil on the paper.

In the questionnaire, relevant data extracted were analyzed using an SPSS (Statistical Package for the Social Sciences). Open-ended questions and results of the experiment were presented in tables in excel program.

Findings and Results

In this section, the findings of the study were presented in three tables as the views of the participants about online and paper-based reading, disadvantages and advantages of online reading and the performance of paper-based and online readers. Table 1 illustrates the views of the participants about online and paper-based reading.

Table 1: The Views of the Participants about Online and Paper-based Reading

Items	N	Mean	Std. Deviation
Item 1 It is easier to do the reading Comprehension questions on paper.	96	4,44	,90
Item 2 It is easier to do the reading Comprehension questions on compute screens.	96	1,79	,97
Item 3 If I have the choice, I would Prefer to read articles on computer screens.	96	1,72	,96
Item 4 If I have the choice, I would Prefer to read articles printed on paper	96	4,44	,85
Item 5 To me, there is no difference Between reading on computer screens And reading on paper.	96	1,87	1,10
Item 6 I think hyperlinks are helpful when I read on computer screens.	96	3,41	,99
Item 7 I think the scroll bar is helpful when I read on computer screens.	96	3,57	1,06
Item 8 I think the cursors are helpful when I read on computer screens.	96	3,30	,85
Item 9 I like to read articles on computer screens.	96	1,93	,93
Item 10 I like to read articles on paper.	96	4,25	1,04
Valid N (listwise)	96		

In Table 1, most of the items were cross-checked by another item to verify the data. Items 1-2, 3-4, 6-7-8, 9-10 were cross-checked by each other. In this group, participants cited in Item 1 with a mean of 4.4 that it was easier to the reading comprehension questions on paper. Next, item 4 saying 'if I have the choice, I would prefer to read articles printed on paper' got a mean of 4.4. Following this, in Item 10, participants maintained with a mean of 4.2 that they liked to read articles on paper. In Item 7 with a mean of 3.5, they thought scroll bar was helpful when they read on computer screens. Finally, as stated in item 5 which got the lowest mean 1.8, there were differences between reading on computer screens and reading on paper for the participants.

Table 2 shows the views of the participants about the advantages and disadvantages of online reading.

Table 2: Disadvantages and Advantages of Online Reading

Disadvantages		Advantages	
irritating eyes	40 (42%)	easy access to many resources	36 (38%)
tiring	22 (23%)	free of charge	10 (10%)
cannot use reading strategies	20 (21%)	more effective	5 (5%)
hard to follow on the screen	17 (18 %)	save time	5 (5%)

cannot concentrate\negative motivation	14 (15%)	access to update resources	2 (2%)
don't like on-line reading	10 (10%)		
forget the text easily	6 (6%)		
cannot carry the computer with me	5 (5%)		
more abstract	3 (3%)		
external factors (power failure etc.)	3 (3%)		

Table 2 was formed on the basis of answers given by the subjects to open-ended questions. As for disadvantages, 42% of the subjects stated online reading irritated their eyes. Next highest percentage 23% belonged to the item that online reading was tiring since they sat before a computer during the activity; 21% cited that "they cannot use reading strategies effectively like taking notes, circling and underlining during online reading"; 18% maintained that it was harder to follow on the computer screen; 15% stated that 'they cannot concentrate or motivate while reading online'; 10% explained they did not like or prefer to read online; 6 % cited they forgot the text during the process and 5% maintained they couldn't carry the computer with them. Finally, 3% considered online reading more abstract and external factors like power failure and setting influenced their online reading negatively.

As to advantages of online reading, 38% of the participants stated that they had easy access to many resources online; 10% found online resources free of charge. While 5 % considered online reading more effective than paper-based reading, 5% believed that they saved time and energy. Finally, 2% stated they could access to update resources. All in all, participants expressed more disadvantages of online reading than advantages.

Table 3 displays the performance of online and paper-based readers in terms of reading speed, accuracy and comprehension.

Table 3: The Performance of Paper-based and Online Readers

Online readers			Paper-based readers		
subjects	Duration (minute)	number of correct answers	subjects	Duration (minute)	number of correct answers
1	22	5 out of 8	1	17	5 out of 8
2	25	5 out of 8	2	20	7 out of 8
3	25	6 out of 8	3	26	7 out of 8
4	26	5 out of 8	4	26	7 out of 8
5	29	6 out of 8	5	26	7 out of 8
6	31	6 out of 8	6	27	7 out of 8
7	34	8 out of 8	7	28	8 out of 8
Average	27,4	5,8	Average	24,28	6,8

In Table 3, there were totally 14 volunteering subjects, seven as online readers and seven as paper-based readers and they read the same text but in a different format. As for online readers, the average duration of completing the tasks, including answering the questions, was 27.4 minutes and the average of correct answers was 5.8. As for paper-based readers, the average duration of completing reading tasks including answering the questions, is 24.2 minutes and the average of correct answers is 6.8. Comparing the two groups, paper-based readers completed reading tasks nearly 3.2 minutes earlier and answered one more question

correctly than online readers.

Moreover, during the experiment, it was observed that paper-based readers used reading strategies like underlining, circling, going back and forth quickly, and taking notes more often than online readers.

Discussion and Conclusion

Reading is an important skill especially for academic purposes and by means of technological advancement, readers' choice over paper-based or online reading in reaching reading objectives has been under discussion for decades. Glancing at some research done in this field, readers favor paper-based reading to online reading especially in early literature, yet the innovations in computer and internet technology sometimes have contradicted these findings and reported no significant differences.

According to the data collected in this study, the result of the present study is consistent with the findings of the early and recent literature. Participants highly preferred paper-based reading to the computer version; therefore, they reported more disadvantages than advantages while performing online reading. The reasons for the disadvantages were mainly physical, in other words, computer screens irritated their eyes and reading from a screen was tiring for them. In addition, in terms of cognitive load, participants expressed that they could not use reading strategies effectively and could not concentrate on the screen. On the other hand, participants reported some advantages to online reading such as easy access to many resources and they considered online reading more effective in terms of practicality and free of charge. The findings of Yen & Wang (2002), Wa¨ stlund et al. (2005) and Destefano &Lefevre (2007) supported the results of this research. Yen & Wang (2002) showed that most people did not deal with e-based reading well. The main obstacles were the lower level of man-machine interactions and self-control during e-reading process. In their study, Wa¨ stlund et al. (2005) provided that computer-based reading caused a greater level of tiredness and stress. These effects required an increase in cognitive demands. Destefano &Lefevre (2007) also revealed that readers with low working memory and low prior knowledge were usually disadvantaged in hypertext.

Analyzing the performance of the participants, it was observed that reading speed, accuracy and comprehension in paper-based reading and testing were better than the computer version. In paper-based reading, reading speed was nearly 12% faster than reading on computer screen. Moreover, the rate of comprehension based on the correct answers given in the test was approximately 15 % more accurate than online reading. In other words, participants performed better in paper-based reading and there was a difference for them between paper-based and online reading. This finding is in consistent with Dillon's study. Dillon (1994) found that reading was some 20 to 30% slower in terms of reading performance from a computer screen than a paper. Moreover, Kim (2013) and Mangen et al. (2013) also revealed that students who read texts in print scored significantly better on the reading comprehension test than students who read the texts digitally. On the other hand, Noyes et al. (2004) found no significant difference in the comprehension scores for the two means andShepperd et al. (2008) suggested that two formats did not differ in course grades for psychology students. As for Turkish context, Dundar&Akcayır(2012) also found no significant difference reading fromtablet PCs and printed books for Turkish elementary school students in Turkey.

In conclusion, in the light of data collected, prospective English teachers preferred paper-based reading to online version and their performance was higher in paper-based reading than

online. Although paper-based reading has become a habit throughout their educational background, their approach to online reading can shift with time by means of technological advancements in computer, e-book and internet technology. It can be the focus of other studies.

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APPENDIX Questionnaire for Online Reading Comprehension (Adapted from Tseng, 2010)

PART 1 Perceptions toward Hypertext

1 It is easier to do the reading comprehension questions on paper. 1 2 3 4 5

2 It is easier to do the reading comprehension questions on computer screens. 1 2 3 4 5

3 If I have the choice, I would prefer to read articles on computer screens. 1 2 3 4 5

4 If I have the choice, I would prefer to read articles printed on paper. 1 2 3 4 5

5 To me, there is no difference between reading on computer screens and reading on paper. 1 2 3 4 5

6 I think hyperlinks are helpful when I read on computer screens. 1 2 3 4 5

7 I think the scroll bar is helpful when I read on computer screens.1 2 3 4 5

8 I think the cursors are helpful when I read on computer screens.1 2 3 4 5

9 I like to read articles on computer screens. 1 2 3 4 5

10 I like to read articles on paper. 1 2 3 4 5

PART 2 Open-discussion Questions

1 What are the advantages of online reading in comparison to paper-based reading?

2 What are the disadvantages of online reading in comparison to paper-based reading?