

# Tablet vs. Paper: The Effect on Learners' Reading Performance

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## Abstract

The purpose of this study is to compare primary school 5<sup>th</sup>-class students' electronic text reading performance, reading speed and reading comprehension with tablet PCs and printed books. This study examined a sample of 20 students. The students were randomly divided into two groups, a control group and a treatment group. The control group students read ordinary printed books, and the students in the treatment group read the same text on an electronic tablet PC display. Both qualitative and quantitative data collection tools were used for the study. Qualitative data were collected on the reading speed and reading comprehension skills for both groups of students. Statistically, there was no significant difference between the groups in reading speed or the level of reading comprehension. Students' opinions on tablet PCs and recommendations for future studies are also discussed.

**Keywords:** Tablet PC, Elementary Education, Human-Computer Interface, Media in Education

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## Introduction

The continuous development of computer technology and software provides an opportunity for the efficient transfer of data, course notes and images from paper to an electronic environment. As a result of this development, people often prefer to access information on computers because of the accessibility of the information, the ability to change text to the desired size, ease of archiving and organization, the avoidance of paper costs and reduction of paper use, and environmental benefits (Dyson & Haselgrove, 2001; Garland & Noyes, 2004; Rose, 2011; Spencer, 2006). In addition to the widespread use of the internet for obtaining information, university libraries are moving to the use of e-books and e-magazines. Increased e-mail traffic, the availability of computer-supported training and the power of multimedia

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are factors that contribute to the wide use of computers for accessing information and reading texts (Hanson, 2008; Hezroni, 2004; Levine-Clark, 2006; Littman, 2002; Reinking, 1997; Slater, 2009; Snyder, 2002; Turbill, 2001; Woody, Daniel & Baker, 2010). There has been a significant increase in e-book production and sales (Peek, 2005). Computers play an active role in distance education, further increasing the rate of use of electronic texts (Dyson & Haselgrove, 2000). As a result of this situation, electronic texts have superseded traditional printed paper (Rose, 2011), raising the question of the environment in which electronic texts are most efficient.

#### *Literature review*

Many previous studies have examined the shift from printed text to electronic texts due to the widespread use of personal computers in the 1980s (Mills & Weldon, 1987; Dillon, 1992). The findings of these studies suggest that it is 20-30% slower to read a paper printout compared with an electronic text (Muter et al., 1982; Gould & Grischkowsky, 1984; Gould et al., 1986; Mayes, Sims, Koonce, 2001). A study conducted by Wagner and Sternberg (1987) determined that students reading electronic texts were capable of understanding the main theme of the text, but they were not capable of remembering the details of the text. Computer use is tiresome compared to reading a book, and computer displays cause eye fatigue. Therefore, the use of electronic texts remains low in comparison with printed texts (Kropman, Schoch & Yeoh, 2004; Young, 2000). In recent years, this situation has continued despite developments in technology and software. Readers continue to experience physical problems and decreased performance when reading electronic texts, and they prefer printed texts (Woody, Daniel & Baker, 2010).

Studies have also examined why e-books are ineffective when compared to printed texts. Paper has been found to be more effective because readers are able to browse electronic texts more easily, reducing their ability to remember the details of a text (Muter & Maurutto, 1991; Nielson, 1997; Rho & Gedeon, 2000). According to Garland and Noyes (2004), the vibrations that occur when CRT monitors refresh negatively affect reading performance. According to Blanco and Leirøs (2000), because CRT monitors are brighter than paper, readers prefer printed paper to reduce eye fatigue. Another reason for this preference is that the brightness of a monitor negatively affects brain activities, thereby reducing efficiency (Kammer, Lehr & Kirschfeld, 1999). Belmore (1985) concluded that people who used computer monitors more often read faster and more effectively than people reading printed texts. Dyson and Haselgrove (2000) similarly concluded that people with experience reading on computer monitors have increased reading speed and comprehension levels. According to Carlson (2002), it is very tiresome for e-book users to navigate pages, and it is difficult for readers to advance to a desired section.

In the 2000s, LCD monitors began to be used rather than the larger CRT monitors that were not suitable for reading. LCD monitors were expected to solve these technical problems as the use of laptops became widespread. However, studies found that computer monitors were technically difficult to use and placed a physical strain on users (Dockrell, Earle & Galvin, 2010; Woody, Daniel & Baker, 2010). Furthermore, readers found it boring to interact with the mouse and to be unable to touch the text. The physical contact and the scent of the paper is important for readers. For this reason, rather than spending extended amounts of time looking at a monitor, readers prefer to read books that they can hold in their hands (Spencer, 2006). The results of a study by Woo (2005) on 2654 students found that 71.8% of the students preferred paper texts. The findings of a study by Shepperd, Grace, and Koch (2008) showed that 90% of students preferred textbooks, despite the greater accessibility and lower cost of e-books.

### *Purpose*

Comparisons of reading on e-books and on printed paper suggest that reading performance and readers' choices are always to the detriment of e-books (Garland & Noyes, 2004; Kropman, Schoch & Yeoh, 2004; Young, 2000). Readers prefer printed texts due to ergonomic challenges in computer use (eg., Dockrell, Earle & Galvin, 2010; Levine-Clark, 2006; McGrail, 2007; Woody, Daniel & Baker, 2010) and eyestrain caused by CRT or LCD displays (eg., Blanco & Leirøs, 2000; Garland & Noyes, 2004; Kropman, Schoch & Yeoh, 2004; Nishiyama, 1990; Rose, 2011; Wu, Lee, Lin, 2007; Young, 2000). Therefore, developments in technology must attempt to overcome the disadvantages of e-books. This situation has been noted in the literature in studies investigating readers' interactions with e-books and ways of reducing the physical challenges imposed by e books (eye fatigue, navigation, lumbar pain etc.) (Woody, Daniel & Baker, 2010). A solution to these problems with e-books may be provided by tablet computers, such as the iPad 2 and CRT and LCD displays. The iPad 2 is quite thin, small (9.7 inches) and light (603 gr) when compared to other laptop and desktop computers. It is easier to handling and use than other computers. The touchscreen of the iPad 2 allows users to perform their work more easily. The iPad 2's touchscreen, ergonomic design, ability to open electronic documents in many formats (for example, doc, docx, and pdf) and interactive use make it powerful (Apple, 2012). Users can read a text as easily as reading a book by holding the tablet.

Projects have been developed by the Ministry of National Education in the Republic of Turkey to provide tablet computers to students. Various educational products will be distributed to schools in Turkey for the project called F@TİH (Initiative to Increase Opportunities and to Develop Technology), which commenced in 2010. The project was expected to be completed in four years with a budget of approximately \$1 billion. This project will distribute products such as smart boards, projectors, and tablet PCs to all state schools (Ministry of National Education [MEB], 2010). The pilot scheme began with 51 schools of 5<sup>th</sup>- and 9<sup>th</sup>-class students in the spring period of the 2011- 2012 educational year.

The reading performance of 5<sup>th</sup>-class students on tablet computers and printed texts was assessed in detail, and students' opinions on the tablet PCs were collected.

### **Method**

This study used an experimental design described by Campbell and Stanley (1963). Students were randomly assigned to the treatment and control groups. Three texts available in the 5<sup>th</sup>-class Turkish course were read by both groups. Normal printed texts were used by the control group, and tablet PCs were used by the treatment group.

Both qualitative and quantitative data collection tools were used for this research. Quantitative data allows us to investigate the effects of tablet PCs for reading. Qualitative scales allow us to investigate students' behaviors with tablet PCs and the effects of tablet PCs on the reading process. The purpose of this research was to determine whether the tablet PC produced a statistically significant increase or change in students' academic performance and behavior.

### *Participants*

This research was conducted at Toki primary school, located in Kırıkkale city center in Turkey, during the 2011-2012 academic year. Twenty fifth-grade primary school students aged 11-12 years participated in the study. Ten students were randomly assigned to the treatment group, and 10 students were randomly assigned to the control group.

### Instruments

Data were collected through quantitative and qualitative instruments, including interviews and reading performance tests. Three reading texts were conducted to determine students' oral reading speed and their reading comprehension levels. These reading tests included texts that were not previously encountered by the treatment and control groups. The texts were Turkish course books for 5<sup>th</sup>-grade students approved by the Head of the Council of Education and Morality in 2007 by the MEB (Gören, Yener, İldeniz, Aksal & Sariöz, 2007). Digital printouts were taken from the MEB Publication Department to allow the treatment group to read these texts on tablet PCs. Eleven questions were posed about the texts *Sound of Our Heart*, *You Can be an Inventor* and *Miniaturk*. The questions were prepared based on the opinions of two academicians, one in primary school teaching and the other in Turkish teaching, and two class teachers. Four of the questions intended to measure comprehension were related to perceiving, and 7 were simple comprehension questions. A summary question covered the main theme and the entire text for the in-depth perception questions. Questions were included about the title and content of the text for the simple perception questions. A reading period (min.) section was added to each test. An interview was performed after the implementation of the reading test to obtain opinions from all of the students in the treatment group about the experience of reading on the tablet PC. Three interview questions were prepared about the students' use of tablet PCs:

- Do you prefer a tablet computer or a book to read texts? Why?
- Would you like to have all of your other books on the tablet PC?
- Did you have problems with the use of the tablet PC?

### Data analysis

Reading speed was calculated by the number of words read correctly in 1 minute (Erden, Kurdoğlu and Uslu, 2002). The level of reading comprehension was calculated using Akyol's (2003) chart for understanding. The grading system is indicated in the following table 1.

Table 1. *Grading Table for Percieving Questions*

Answer	Grade
No answer	0
Half – answered	1
Fully answered	2

To examine the effects of tablet PCs on learners' reading performance, an independent *t*-test was used. Reading speed and comprehension were used as dependent variables, and the reading environment (tablet PC or hard copy) was used as an independent variable. The significance level for all tests was set at the  $p < .05$  level. An analytical seven-stage process, as recommended by Deikermann (1989), was utilized by one researcher to analyze the data from the interviews (see Table 2).

Table 2. *Deikermann (1989) Seven Stages of Analysis*

1. Reading the interviews, reflective journal, literature and SD results to obtain an overall understanding.
2. Writing interpretive summaries and coding for possible themes.
3. Analyzing selected transcripts as a group in order to identify themes.
4. Returning to the text or to the participants for clarification of disagreements in interpreting and writing a composite analysis of each text.
5. Comparing and contrasting texts to identify and describe shared practices and common

meanings.

6. Identifying constitutive patterns that link the themes.

7. Eliciting responses and suggestions on a final draft from a colleague familiar with the content and or methods of the study.

### Procedure

In this quasi-experimental study, 10-person student groups were determined randomly. Both groups were tested in the students' classrooms. All students performed their reading independently (see Figure 1). During the reading process, the researchers noted the number of words read incorrectly by the students for the entire period. After the reading process was completed, questions relevant to the text were asked of the students. Interviews were organized with the students in the treatment group after the students read all of the text. The students in the treatment group used tablet PCs on normal desks. The students in the control group read the same texts in their books.



Figure 1: Treatment group

Tablet PCs were introduced to all students in the treatment group by the researchers prior to the experiment, and brief information was given about their use (see Figure 2). None of the students had any problems with the use of the tablet PCs during the application of the test.



Figure 2: Introducing tablet PC

The grades of both groups of students in their 4th-grade Turkish courses were compared with their reading speeds for a text called "Fault Lines' Movements" (Gören et al, 2007) based on the averages of their grades in reading comprehension.

Table 3. Comparisons Made for the Balance of Two Groups before Implementation

Group	Reading speed				Reading Comprehension				Academic success			
	X	ss	t	p	X	ss	t	p	X	ss	t	p
Control	105.0	23.89			3.70	1.41			80.40	13.09		
Treatment	108.6	14.90	.404	.69	3.60	1.26	.16	.87	80.50	10.28	.019	.98

It was determined that there was no significant difference in reading comprehension between the two groups as a result of the previous tests. Thus, the treatment and control groups were assigned randomly.

**Results**

*Reading speed and comprehension*

According to the independent *t*-test results, no significant difference was found for reading speed or reading comprehension of the treatment group and the control group (see Table 4). The students' reading speeds were identified by the number of words they read per minute.

Table 4. *Independent t-Test of students' Reading Speed*

Group	N	X	ss	Sd	t	p
Control	10	107.43	19.14	18	0.811	.428
Treatment	10	101.83	10.50			

Table 4 shows that the number of words read by the treatment group per minute was 107.43, and the number of words read per minute by the control group students was 101.83. Although the average number of words read by the control group students per minute was higher than the treatment group, this result is not statistically significant ( $t= 0.811, p >.05$ ). There is no difference between the reading speeds of the students with the tablet PC or the printed text.

No significant difference was found for reading comprehension in the treatment and control groups (see Table 5). The success levels of the students were assessed over 20 points.

Table 5. *Independent t-Test Of Students' Reading Comprehension*

Group	N	X	ss	Sd	t	P
Control	10	4.93	0.87	18	0.67	.507
Treatment	10	5.16	0.65			

Although the average success level of the treatment group is higher than the control group in Table 5 (5.16 and 4.93), this result is not statistically significant ( $t= 0.67, p >.05$ ). In other words, there is no difference in reading comprehension between the groups using the tablet PC and the printed text.

*Qualitative results*

The interviews lasted approximately 10 minutes. The one-on-one interviews produced two themes relating to reading from tablet PCs.

*Theme one – ergonomics and ease of use of the tablet PC*

The students commented that the tablet PCs were very ergonomic. They found it easy to change the size of the characters on the display and to turn the pages and found the tablet PCs to be lightweight. Students S1 and S4 expressed these opinions, as follows:

[S1]: *I liked tablet PCs very much. I can magnify letters by turning the tablet or manually. Letters are legible. Letters are small in books and books are heavier.*

[S4]: *It was very easy to use the tablet PC. I think it is better than books. I can easily open pages. I don't even need to carry a bag. It is hard to carry bags.*

*Theme two – enjoyable to read from tablet PC*

All of the treatment group students mentioned that reading texts on the tablet PC was entertaining when compared to reading from books. Some of the students (30%) wanted to read all of their books on the tablet PC. Tablet PCs are very light when compared to books, making tablet PCs a pleasant reading tool. Students S5 and S2 offered the following statements:

*[S5]: It is very enjoyable, amusing and easy to read on the tablet. Lighter when compared to books. I would like to read all of my books on this.*

*[S2]: Tablet PCs are much more fun. I can magnify letters. I think it is easier and enjoyable to read on this.*

## **Discussion**

This study compared the text reading performance, comprehension and number of words read per minute of 5<sup>th</sup>-grade students with students who read from printed text. Many studies have examined the widespread use of e-books in literature and their increasing use. Studies have suggested that people do not prefer electronic books and have suggested that they are ineffective (Shamir & Shlafer, 2011). In this study, electronic books were considered to remove physical and ergonomic difficulties. According to the findings of this study, tablet PCs are effective tools for reading electronic texts. The availability, display quality and ergonomics of tablet PCs have positive effects on students. Students can easily read the text by holding the PC like a book. Tablet PCs can be used in both horizontal and vertical positions, which positively affects reading because rotating a tablet PC to a horizontal position provides a wider reading area. Moreover, students are able to adjust the size of the text, allowing them to read more comfortably.

In similar studies, electronic texts were compared to normal printed texts. However, this method has consistently been detrimental to electronic texts (Garland & Noyes, 2004; Kropman, Schoch & Yeoh, 2004; Young, 2000). In this study, there was no significant difference in either reading speed or reading comprehension between the two groups. In other words, there was no difference between reading the same text in printed form or on a tablet PC. These findings suggest that tablet PCs can be an effective solution for the ergonomic and physical problems of reading electronic texts. Tablet PCs are more user friendly than other types of displays (CRT and LCD). Ergonomics is one of the most significant factors in making electronic texts less effective than printed texts (Levine-Clark, 2006; McGrail, 2007; Woody, Daniel & Baker, 2010). Students can easily read a text by placing a tablet PC on their desktop, whereas looking at a monitor for an extended period is both boring and tiresome. The ergonomic qualities of tablets are also important to allow them to be used for other purposes. For example, tablet PCs would be more effective than other types of displays for students watching educational videos or playing educational games. Ergonomics is one of the major factors affecting education in schools (McGrail, 2007). When students find computers ergonomically difficult, their learning process becomes more difficult, and their attitudes toward technology may be negatively affected (Dockrell, Earle & Galvin, 2010).

All of the students in the treatment group exhibited positive attitudes toward tablet PCs. Students preferred tablet PCs to reading printed books because books are heavier and difficult to carry. It is much easier for students to carry a tablet PC than to carry many books. This is an important factor in the students' preference for tablet PCs. Moreover, the students note that it is entertaining to read books on the tablet PC. The researchers observed that the students immediately adapted to the use of tablet PCs.

### Conclusion and recommendations

In today's world, computer technology continuously develops and increases its field of application in every sector. In the field of education, computer technology continues to expand its sphere of influence through various applications and projects. Interactive applications in education, such as the utilization of enriched texts in courses, suggests that the effectiveness of computer technologies will increase in educational environments. The F@TİH project plans to distribute tablet PCs to all students. There has been a significant increase in the preference for e-books for both personal and professional development. This study examined the reading speed and reading comprehension of primary school 5<sup>th</sup>-grade students by comparing tablet PCs and printed texts. There was no significant difference between the two groups in either reading speed or reading comprehension. However, this study found that students' opinions about the use of tablet PCs was significantly positive. In addition to the benefits of being ergonomic and easy to carry, students found the use of tablet PCs enjoyable. Further studies could examine students' silent reading performance and comprehension to determine reading difficulties and students' motivation for reading through comparisons of printed materials and tablet PCs. Additional studies can be planned to measure not only reading and comprehension but also academic success and students' attitudes about the courses available in primary and secondary education. Another phase of this study could be performed to examine teachers' attitudes toward tablet PCs and their level of utilization and application. Applications of tablet PCs for students can also be examined based on the opinions of teachers.

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