THE INVESTIGATION OF INTERFACE USAGE ON TABLETS FOR READING
COMPREHENSION: A MIXED METHOD STUDY

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

THE INVESTIGATION OF INTERFACE USAGE ON TABLETS FOR READING COMPREHENSION: A MIXED METHOD STUDY

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The aim of this study is to investigate the effect of website design on interface usage interactions on tablets and the connection between interface usage interactions on tablets with reading comprehension. For this purpose, mixed method study was performed. Responsive and non-responsive website designs were used for the first of the study. In total, 58 students participated in the experiment where students read texts on tablets. The application took about 15 minutes. Responsive and non-responsive website designs were independent variables and interface usage interactions were dependent variables for the first part of the study. The interface usage interactions data were kept in the background of the software. MANOVA was used to evaluate the data obtained. Then, with the participation of 48 students voluntarily, the interview was held to understand the connection between interface usage interaction on tablets and reading comprehension of participants. The results showed that website design has no significant effect on the interface usage. However, when the detailed tables were examined, the reading comprehension data obtained from the interviews showed consistent results with the table results.

Keywords: Responsive Website Design, Interface Usage, Reading Comprehension

ÖZ

TABLETLERDE ARAYÜZ KULLANIMININ OKUDUĞUNU ANLAMA İÇİN ARAŞTIRILMASI: BİR KARMA YÖNTEM ÇALIŞMASI

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Bu çalışmanın amacı, web sitesi tasarımının tabletlerde arayüz kullanım etkileşimleri üzerindeki etkisini ve tabletlerde arayüz kullanım etkileşimleri ile okuduğunu anlama arasındaki bağlantıyı araştırmaktır. Bu amaçla karma yöntem çalışması yapılmıştır. Çalışmanın ilk bölümünde uyarlanabilir ve uyarlanabilir olmayan web sitesi tasarımları kullanılmıştır. Toplamda 58 öğrenci tablette metin okuduğu deneye katılmıştır. Uygulama yaklaşık 15 dakika sürmüştür. Çalışmanın ilk bölümü için, uyarlanabilir ve uyarlanabilir olmayan web sitesi tasarımları bağımsız değişkenlerdir ve arayüz kullanım etkileşimleri bağımlı değişkenlerdir. Arayüz kullanım etkileşimleri verileri yazılımın arka planda tutulmuştur. Elde edilen verileri değerlendirmek için MANOVA kullanılmıştır. Daha sonra, 48 öğrencinin gönüllü olarak katılımıyla, tabletlerde arayüz kullanımı etkileşimi ile katılımcıların okuduğunu anlama arasındaki bağlantıyı anlamak için görüşme yapılmıştır. Sonuçlar, web sitesi tasarımının arayüz kullanımı üzerinde önemli bir etkisi olmadığını göstermiştir. Ancak, ayrıntılı tablolar incelendiğinde, görüşmelerden elde edilen okuduğunu anlama verileri, tablo sonuçlarıyla tutarlılık göstermiştir.

Anahtar Kelimeler: Duyarlı Websitesi Tasarımı, Arayüz Kullanımı, Okuduğunu Anlama

To my family and my twin sister Merve..

ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS

ABBREVIATIONS

IU: Interface Usage

MANOVA: Multivariate Analysis of Variance

RWD: Responsive Website Design

RST: Reading Span Test

SPSS: Statistical Package for the Social Sciences

WM: Working Memory

CHAPTER 1

INTRODUCTION

1.1. Introduction

In this chapter, literature was reviewed to understand the background of the study, then a statement of the problem was clearly given according to the gap in the literature, and the significance of the study was explained by identifying reasons why this research is necessary, then, the purpose of the study was stated briefly.

1.2. Background of the Problem

Learning processes have long been researched on, and results reveal that successful and effective learning is always associated to the implication degree of a learner in the learning process. (Scott & Tomadaki, 2006) That is to say, learning is the outcome of interaction, and to be specific, the outcome of engagement with the subject and discussions with others about that matter. (Mattingly, Rice, & Berge, n.d.) Viewed in this way, computer-based multimedia learning areas comprised of pictures (like animation) and words (like narration) suggest a potentially powerful resource to develop student comprehension.

There were some studies about learning, comprehension and their integration with technology. Recollect as a learning environment is a lecture capture solution developed at the University of Saskatchewan in part by authors to collect low-level learner behavior data. During the duration of a lecture, Recollect reports a set of user behaviors such as mouse clicking in the interface, searching about content of the course or in the video that use the video scrubber, guiding within the video that use section widgets, mousing over, or scrolling during the listing. Each of these behaviors

are tied up to observed time, initiated behavior of the student, and particular video they have watched. The results show that using collected data from learning fields to alter the field during instruction has a value. (Larusson & White, 2014). This study was an example from students' behavior at an online environment. Also, in our research, we want to observe and collect information about interface usage of participant on tablets and understand whether there is a connection between interface usage interactions and reading comprehension of students.

Moreover, recent works have stressed the working memory role, text integration and "text representation with rich information" as significant contributors to comprehension talents. (Oakhill, Cain & Bryant 2003). Poor comprehension talents are shown to be directly associated with poor performance on working memory tasks (these duties that need a change between storage and processing operations) (Oakhill et al, 2003). It should be taken into consideration the borders of Working Memory, therefore, knowledge can be stored efficiently in the Long Term Memory (Chandler & Sweller, 1991). In our study, working memory is taken into consideration because of this literature information.

Additionally, studies about multimedia learning centralize the effects of different representation styles, such as text and picture (in fixed or moving style) on learning and understanding. (Mayer & Moreno, 2002; Schnotz & Bannert, 2003). Lots of research studies demonstrated that using the modality principle in multimedia learning surroundings provide better learning outcomes. (Jeung, Chandler & Sweller, 1997; Mayer & Moreno, 1998; Moreno & Mayer, 1999). However, what Tabbers et al (2004), consistent with Burkes (2007), found is that as a result of lengthy audio narrative trace, students require to hold more of the information in their working memory, which as a result, concludes to modality having even a negative impact on online learning environments. In our study, multimedia learning principles were taken into consideration to support learning and comprehension.

Furthermore, there are two example study to show the relation of digital environments on students' comprehension level and attitudes. Greenlee-Moore and Smith's (1996) US study (for their sample of 31 9–10-year-olds) showed that when the story is long and difficult, comprehension grades are higher in the electronic status. Davis and Lyman-Hager (1997) inquired on performance and attitude regarding computerized second language reading of students. Forty-two French students who were in the intermediate level read a glossed quote from Une Vie de Boy on a computer screen. After reading it, the students were interviewed. The interview exposed that students had an extremely positive attitude towards the software.

These studies provided a point view to us for in our study. According to these studies, comprehension grades of students were increasing when they read long and difficult texts in the electronic environment, and attitude of students towards reading from a computer screen was positive. In our study, we used a software where students read 3 texts (from easy to hard) to understand the level of students' reading comprehension. However, this software was used on the tablet screen not on the computer screen. This similar study was expected to give similar outcomes with others.

1.3. Statement of the Problem

Many researches were conducted about website design effect on user experience on different devices (Marcotte, 2011; Liu, 2005). One of them is that investigation the effect of responsive web design on the user experience with laptop and smartphone devices (Hussain & Mkpojiogu, 2015). However, the effects of website design on interface usage interactions were not researched before. Also, comprehension on different media platforms was researched many times (Wästlund, Reinikka, Norlander, & Archer, 2005; Ackerman & Lauterman, 2012). However, there is no research whether there is a connection between interface usage interactions with reading comprehension on tablets specifically. It is necessary to find out whether

website design has an effect on interface usage interactions or not. Moreover, it is necessary to understand whether interface usage interactions having connection with reading comprehension or not. Thereby, learning environments that are prepared by using multimedia principles can be developed by taking into consideration design type, usage interface interactions and their relationships with comprehension.

1.4. Significance of the Study

When the literature is examined, many studies conclude that learning in multimedia is more effective and permanent. In particular, the reasons for the success of technology-based multimedia learning includes the following factors: closeness to real life, persistency, attractiveness, and flexible learning environments. (Raupers, 2000; Tsoua, Wang ve Tzeng, 2004). According to researchers, technology based multimedia should be close to real life, be persistent, be attractive and be flexible in terms of learning environments to provide an effective and permanent multimedia environment.

Without understanding totally the processes of the individual when the reading, we should not expect to be able to create a system where capabilities of person will have maximum effectiveness. Therefore, it is required that examining of an individual's ability for reading processes, in general, and from a virtual screen, specifically (Mayes, Sims, & Koonce, 2001). In this study, reading process of participants from a tablet was examined for this purpose.

1.5. Purpose of the Study

According to the literature, interface usage is an often-researched topic and it is believed that these data may be related to different learning outcomes, so multimedia learning can be more effective and permanent. In this research, the aim is to investigate

the effect of website design on interface usage interactions on tablets and to investigate the connection these interactions with participants' reading comprehension.

1.6. Research Questions

1) Is there a significant difference between the text reading on a responsive website design (RWD) and the text reading on a non-responsive website design (non-RWD) in terms of the interface usage interactions?
2) What is the connection between interface usage interactions with participants' reading comprehension?

1.7. Assumptions

For this research, the following assumptions were made:
1) The participants answered all questions in the interview questions accurately and honestly.
2) The questionnaires and scales are reliable and valid indicators for the study conducted.
3) The data were collected, recorded and analyzed accurately.
4) The applied processes and tools have equal chances to be applied and generalized to schools in similar circumstances.

1.8. Limitations

- This research is limited to students who are participate the implementation from the Informatics Systems Engineering, Computer Engineering and Software Engineering Departments at Atılım University.
- This study is limited to the academic year of 2018-2019.
- This study is limited to subjects who are studying at the same school but in different classes.

- Also, subject characteristics can be different even if participants are selected from same school, similar culture and similar socioeconomic status, so sometimes it cannot be enough exactly to remove the threat.

- Additionally, the validity of this study is limited by the reliability of the instrument which is used for reading span test.

- Moreover, testing is a threat and it can be controlled by determining some issues before applying the test. In this study, implementation time was decided to be around 15-20 minutes.

- Another limitation is the honesty of the subjects' answers to the instruments.

- Also, the results of the research may not be the same with different school settings.

- Moreover, environmental factors (school size, the location of the school etc.) and the socioeconomic status of the students may influence the results.

- Another limitation is that this can only be generalized to students that are studying in Ankara, it cannot be generalized to all schools.

- Other limitations are mortality and regression. Students can give up and regress from the study before completing all tasks or be obliged to quit the study. This is a voluntary study, so, to keep students participating in the study, the tasks should be rendered not be boring.

1.9. Delimitations

The study is confined to students from a private university in Ankara. The study focuses on the effects of website design on interface usage interactions when students read a text from a tablet and also focused on the connection between interface usage interactions with participants' reading comprehension. Information Systems Engineering, Software Engineering and Computer Engineering students from Atılım University were included in this study.

1.10. Definitions of Terms

<u>Responsive Website Design</u> is the adjustment of web pages respective to the screen size and type of any device (Hussain & Mkpojiogu, 2015).

<u>Working memory</u> is a brain system that supports temporary storage and handling of information required for such composite cognitive task as language understanding, learning and reasoning. (Baddeley, 1992, p. 256).

<u>Reading span test</u> is a test to understand the effects of the working memory's capacity or span on text comprehension. (Daneman and Carpenter,1980).

<u>Reading Comprehension</u> is a reading process in which a message is transferred graphically between persons for communication (Kingston, 1967, p.72).

1.11. Summary

In Chapter One, the introduction, background of the problem, the statement of the problem, the purpose of the study, the hypothesis, the significance of the study, the research question with hypothesis, the assumptions, limitations, delimitations, the definitions of terms, and the summary of the study were presented.

Chapter Two is a review of recent literature.

Chapter Three presents the methodology used in this study, including a description and rationale of a sample, the data collection procedures, a description of instrument development, and the methods of analysis of the data.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

According to De La Harpe, Kulski, and Radloff (1999), having open learning goals, using accessible resources effectively, knowing about own strengths and weaknesses, understanding the process of learning, dealing with feelings properly, taking responsibility for one's own learning, planning, observing, assessing and adapting to the learning process are the characteristics of effective learners. Basic analytics about students' actions such as activities that are performed by students, allocation of time for the activities and the accessibility of content by students can be created (Brown, 2011).

The purpose of this chapter is to review the research literature to identify what kind of studies were done before about interface usage interactions in the education field. The other purpose of this chapter is to gather ideas of students about what type of interface usage interactions used by them and what are the reasons of them and what is the relation of them with reading comprehension of students. Also, working memory, multimedia learning and instructional principles, and e-reading fields were researched to combine this information to create better learning environments.

2.2. Synthesis of the Literature

2.2.1. Interface Usage Interactions

Fundamentally, learning is an outcome of interaction, to be more precise, it is the outcome of engagement with a subject, and discussions with others about it (Mattingly, Rice, & Berge, 2012). Viewed in this way, interaction with the subject

matter enables learning. Learning processes have been a matter of research for a long time, and results reveal that successful and effective learning is always associated to the implication degree of the learner in the learning process (Scott & Tomadaki, 2006). To experience meaningful learning, the learner must choose related terms and visuals, coordinate them into consistent oral and visual depictions, and combine corresponding oral and visual depictions in their cognitive process (Mayer & Moreno, 2002). Computer-based multimedia learning areas which are comprised of pictures (like animation) and terms (like narrative), suggest a potentially strong resource for the development of student comprehension. It is not utilized enough in traditional learning areas that are book-based (Mayer & Moreno, 2002).

Before the origination of online education, or widespread data to be more descriptive, instructional organizations included institutional search and assessment. Department of Survey Research of the UK Open University demonstrated the ten years progress course of their many of remoteness education students at various levels in a semester in 1979 (McIntosh, 1979). The study was not bounded with personal establishments. At the time Tinto (1997) broadcasted his studies about student persistence affecting factors, he was able to pull a varied database of works that was collected over the span of 20 years, which included institutional stages and students' characters. His synthesis of persistence works, and his stress on the importance of academic & social consolidation, confirmed that institutions should take into consideration analytics for solving the problems of dropping student rates (Ferguson, 2012).

According to De La Harpe et al. (1999), having clear learning goals, using accessible resources effectively, knowing about your own strengths and weaknesses, understanding the process of learning, dealing with feelings properly, taking responsibility for your own learning, and planning, observing, assessing and adapting learning process are the characteristics of effective learners. In order to develop a learning design and assess the efficiency of a course, teachers should know the real process of learning activities that students have pursued during the course (Fernández-

Gallego, Lama, Vidal, & Mucientes, 2013). For this reason, they can collect an amount of data about the actual process, learning activities, learner behaviors. At that point, some data and information were exposed about learning usage, trends, and patterns. However, most of the course evaluations about these usages, trends and patters are made at the end of the course semester. It becomes a challenge when the data and information are obtained later on. However, on the other hand, if usage interface interactions were to be collected before the end of the course, it could help to identify students' struggles during the course, and it may give feedback about the level of participation and how participants are using the course content (Mattingly et al., 2012).

After 2008, pedagogical theory began to appear more powerfully in literature with the aim of focusing on comprehension and optimization of learning, thus, it started to crystallize as an approach to analytics (Ferguson, 2012). Analytic instruments were generally shown as neutral pedagogy. For instance, GISMO, which is a student-monitoring tool, allowed the observing of specific learning aspects which are social, cognitive and behavioral. Graphical demonstrations of it allowed exploring these factors by teachers, however, they were not created to support any specific instruction and learning approach (Mazza and Milani, 2004). Additionally, CourseVis was a neutral pedagogical tool which utilized LMS data to assist teachers in order to find out what occurred during online lectures, and to specify people who needed additional promotions (Mazza and Dimitrova, 2007). The GRAPPLE Visualisation Infrastructure Service (GVIS) tool does not only cope with one VLE, but it can also draw out different portions of data of a learner's Personal Learning Environment (PLE), and use the collected information to promote meta-cognitive talents like self-reflection (Mazzola and Mazza, 2011).

Basic analytics about students' actions and the allocation of time for the activities and accessibility of content by students can be created for servicing to the instructors (Brown, 2011). In order to evaluate the academic process, to foresee prospective performance, and to recognize potential issues, commenting is done on a variety of

data which are produced by and collected on behalf of students. (Johnson, Smith, Willis, Levine, & Haywood, 2011).

Recollect as a learning environment is a lecture capture solution developed at the University of Saskatchewan in part by authors to collect low-level learner behavior data. During the lecture, "Recollect" reports a set of user behaviors such as mouse clicking in the interface, searches about content of the course or in the video that use the video scrubber, guiding within the video that uses section widgets, making mouse over, or scrolling during the listing. Each of these behaviors are tied up to the observed time, initiated behavior of student, and the particularly watched video. The results show that using collected data from learning fields to alter the instructional field has a value (Larusson & White, 2014).

Based on the literature, a research specified three classifications of interactions that were system-independent (agent type, frequency of use of activities and participation mode) and assessed the relationship of their factors with academic performance during two different learning modes: virtual learning environment (VLE), which is supported with face-to-face (F2F), and online learning. For this purpose, an empirical study was performed with data from six online and two VLE (with F2F) classes. The results showed that, for each categorization, there is a relationship between some types of interactions and academic performance in online courses, however, this relationship is not significant in the case of VLE (with F2F) classes (Agudo-Peregrina et al., 2014).

Purdue University created the Signals system in 2007, which was a direct branch of Campbell's (2007) thesis inquiring on to what extent data extracted from the LMS could be used to foresee student performance. The difficulty was to recognize poor performances of risky students in a class using only data that was eagerly accessible; that is, current course scores (e.g., test/assignment scores), academic history info (e.g., standardized test grades and high school or current CGPA), demographic forms, and data pointing out to what extent a student was interacting with the LMS (Larusson &

White, 2014). LMSs can follow click-level data on a variety of user-actions such as accessing a course discussion, uploading an assignment, or downloading a course resource (Larusson & White, 2014). Signals work like traffic lights, green conditions show that students are doing well, and in contrast, red conditions show that they have been in high risk, and moreover, amber conditions show that they have been in moderate risk. Reported findings seem promising; experimental group students wanted help earlier than control group students, and the pilot group got 12% more B/C grades and 14% less D/F grades than the control group (Arnold, 2010).

A main thought of the data-aided approach is whether learner interactivities are related to pedagogical aims, and measures of learning results within learning environments. These interactions can be filling out a survey that is particularly made by learners, or it can be navigating through content that is implicitly made by output of the learning action itself. Called "clickstream data or traces" interactions are hard to comprehend on their own partly because of the large number of collected data and the weak level meaning that the info corresponds (e.g. the clicking of a link or clicking a key on the keyboard). Firstly, obtained data should be summarized, after that, it should be linked with aims of learners to be made actionable (Larusson & White, 2014).

2.2.2. Responsive Website Design

Cyr (2015) identified the responsive design that is being able to adapt an interface with its content to across all the devices. Also, this content is adapting the layout and margins across the many of different screen sizes. Therefore, the content consistency is protected.

According to Buidu (2016), the responsive design provides conformity for many different types of devices that have different screen sizes, however; it cannot work properly when there are complex tasks and contents. As opposite to the Buidu, Sheil (2015) stated that using responsive design at a LMS environment has lots of

advantages. For example, it supports the users by visualizing the content that requires minimal resizing and scrolling.

To make the design work properly on mobile devices is necessary to make easy interaction of users with component. For this purpose, compatibility procedures of touchscreen should be taken into consideration in the design step (Turan & Şahin, 2017).

Nergiz compared the website and mobile interface of a Learning Management System (LMS) in terms of perceived aesthetics in her study. The Learning Management System she used was ODTUClass which was approved by Middle East Technical University as official LMS of the university. She claimed that the ODTUClass has a responsive design for website and mobile interfaces. Compared to the website design, same content and approximately the same amount of objects are displayed in the mobile interface but with smaller dimensions. This property of ODTUClass makes it perfect for a study that compares different interfaces in terms of visual features. According to the results Nergiz has obtained, most of the students prefered using website version of LMS due to perceived aesthetics. Although same content and colors were used in both interface by the help of responsive design, the smaller screen size of mobile devices made users to perceive aesthetic dimensions differently and saw mobile interface as unprofessional. Designer should take this into consideration when designing a mobile app and create a different design for it (Kılınç, 2016).

The effect of responsive website design on user experiences based on laptops and smartphones when participants use the e-Ebola Awareness System was researched. The findings showed that there is no significant effect of the experiences of participants with these two devices being at 95% level of confidence. That is to say, the responsive website design affected the experience and attitudes of participants similarly to those metrics (Hussain & Mkpojiogu, 2015). According to a study, if the level of interactivity on a website raises, it provides positive effects on satisfaction, effectiveness, value, and attitude of users (Teo, Oh, Liu, & Wei, 2003).

2.2.3. Reading Comprehension

Occurring the learning in person is required the understanding of reading (Ocak, 2004). Understanding is a process of detecting the meaning in the reading text, thinking about the meaning, examining the causes, reaching the conclusions and evaluating (Güneş, 2000).

Demirel (2000) expressed the relationship between reading and understanding as follows: reading and comprehension are considered as different occupation, however there is a causal relation between them. The purpose of the person to read is to understand. Tazebay (1995) stated that if reading activity results in meaning, it will be valuable only in this situation.

Literat's (2014) questionnaire, which is about new media literacy, demonstrates the capacity for alternative procedures to describe potential guide pointers of literacy improvement and comprehension. Most of the skills are not easily evaluated with standardized testing. According to the results, the efficiency of the evaluation needs a more nuanced and varied procedure than what is present through fundamental knowledge testing (Shane & George, 2014).

Chen and his friends conducted a study to understand the effects of reading comprehension on paper, tablets, and computers. Also, they were taken into consider the familiarity issue that affects reading. Results showed that students who read from a paper had significantly better performance than students who read from computer-based in terms of shallow comprehension. Navigation style was the main point to impact reading process. Also, the other result was that students who had higher familiarity to tablets had significantly better performance than the students who had lower familiarity to tablets in terms of deep comprehension. This means that if students have higher familiarity to tablets, they obtain better reading comprehension on tablets (Chen et al., 2014).

2.2.4. Working Memory Capacity

The main features of the human memory are strengthness/durability, potential (number of pieces of knowledge accumulated in storage), and access acceleration (Kalyuga, 2009). The assumptions of the CL theory and cognitive multimedia learning theory are based on the assumptions on limited working memory capacity of learners and unlimited long term memory of learners. (Sweller et al., 1998).

Mayer (2001) argues that human short-term memory can only process a limited amount of data at a time. He supports his assumption with Baddeley's (1992) concept of short-term memory. According to the model of working memory offered by Baddeley and Hitch (1974), working memory is a mind system that supports temporal storing and handling of the knowledge required for composite cognitive duty such as language understanding, learning and thinking. (Baddeley, 1992, p. 256). The functioning of this system is related to high cognitive talents such as reading and comprehension; when knowledge is stored in the short interval, the working memory variety of personal should be related to the functioning of cognitive duties (Unsworth & Engle, 2007).

The working memory system allows several items of knowledge to be kept in memory at the same time and be interconnected (Pickering, Phye, & Corporation, 2006). Slavin (1991) identified that Working Memory is the place where the mind functions on knowledge, adjusts itself for keeping or discarding it, and links it to other knowledge. Some factors impact the working memory capacity. Systematic distinctions between individuals in their working memory capacity for specific duties are obvious, and these distinctions affect performance when someone functions at the borders of his/her working memory capacity (Kalyuga, 2009).

There are two predictions about the working memory model:

1. If the same component is used by two tasks (of working memory), they together cannot be fulfilled successfully.

2. If different components are used by two tasks, it should be workable to fulfill them both together and independently (Hitch & Baddeley, 1976).

Real-life tasks are applied by the working memory:

- reading as phonologic circle

- solving the problem as center administrator

- navigatig processing as optic and spacial (McLeod, 2012).

Created reading span test was used to try to understand the effects of the working memory capacity or the span of it on text comprehension. Results showed that high working spans were better to comprehend in misleading text and better to make inferences from the text. (Daneman and Carpenter,1980). The writers deduced that students who have high working memory capacity were able to prevent irrelevant ideas when making decisions (Goldinger, Kleider, Azuma & Beike, 2003).

The writers assumed that high ability students can assign more resources for learning from concurrent conditions (animation and narration) than to assign other two conditions (animation followed by narration condition and narration followed by animation condition). However, the low ability students assigned more energy to advance visual representation of concurrent conditions, therefore, they have fewer cognitive resources for mental conception (Mayer & Sims, 1994).

2.2.5. Multimedia Learning and Instructional Principles

Providing technology for teaching and learning is very common in today's educational foundations. However, solely making technology available or providing the usage of it to students does not mean that success is guaranteed. (Larusson & White, 2014)

Active learning is generated by passing the obtained information from the learner's cognitive process. The output of active cognitive processes is shown as meaningful mental presentations and active learning is observed as a model creation process (Mayer, 2001).

Mayer identifies five different ways of creating coherent mental structures. These ways are process, comparison, generalization, enumeration and classification. Learners structure the information by using these ways, and so they participate in the process actively. (Akkoyunlu & Yılmaz, 2005) In the learning environments, contained information and communication technologies, producing, researching, experimenting and understanding by students are tried actively (Jonassen, 1996).

Texts, graphics, art, sounds, animations and videos, which are combined and linked to each other, somehow enable users the skill to browse, guide and analyze the materials through diverse searching and listing characteristics. Multimedia has the capacity to distribute lots of materials in multiple forms and, present them in a blended environment (Natarajan, 2006). Learning environments which involve multimedia, enable to introduce many new and innovative forms of knowledge (Stern, Aprea & Ebner, 2003). Kozma (1991) collected results of researches on learning with books, television, computers and multimedia. As a result, Kozma describes learning with multimedia as a "complementary process".

Multimedia learning can be considered as reply strengthening, information acquiring, and knowing structure. There are three possible learning results that are no learning, learn by rote, and meaningful learning. (Mayer, 2017) According to Mayer (2017), multimedia teaching is the exhibiting of materials that include both words and images to with the intent of encouraging learners. Actually, it is a dual mode, dual code, or dual channel learning.

Multimedia learning theory combines approaches that deal with the elimination of a distinction between channels within the frame of sensory and representation style and classified them as auditory / verbal and visual / pictorial channels. (Akkoyunlu & Yılmaz, 2005) If the information that is perceived through the senses are processed together on both channels, the first channel that processes verbal information, such as texts and spoken words (expression) and the second channel that processes the non-verbal information, such as visual presentations or voice; it is easier to recollect knowledge when compared to information processed in a single channel (Najjar, 1996).

Semiotic and sensory levels of multimedia focus on the multimedia learning researches (Pekdağ, 2010). The semiotic level makes reference to the presentation styles of information (text, image and sound). On the other hand, the sensory level is associated with the acceptance of information in a visual or auditory style (Schnotz & Lowe, 2003). Rather than the traditional form of communication with words, multimedia tools designed to include words and images provide deeper learning for students. This was revealed by researches conducted on multimedia learning. However, multimedia tools should not contain information that could cause the students' visual and / or auditory memory to overload (Mayer & Moreno, 2002; Mayer, 2003).

Since multimedia enables the integration of different media types such as texts, images, sounds, animations, and videos; it brings forward a new way of individual learning. This situation presents new learning styles in education (Chera & Wood, 2003). Through the capacity of multimedia, which enables the creation of suitable and interactive learning environments, it is supportive and acts as an actualiser for cognitive changes in students (Depover, Giardina & Marton, 1998). Multimedia provides students to be in an active learning environment (Byers, 1997). Researchers expressed that multimedia has a huge capability to develop learning in the classroom (Moore & Miller, 1996).

The advantages of using multimedia in educational environments for students are: that it provides motivation for the students in learning and research (Jonassen, 1996), encourages the students to attend the lessons, enables them to retain information in their memory and develop their learning (Moore & Miller, 1996), helps the students to learn complex topics (Schnotz & Lowe, 2003), and facilitates the understanding of the complex subject for students (Mayer & Moreno, 2002). Studies about multimedia learning clearly indicate the effects of different representation styles, such as text and picture (in fixed or moving style) on learning and understanding. (Mayer & Moreno, 2002; Schnotz & Bannert, 2003). Most of the research are established on the dual coding theory (Clark & Paivio, 1991) and cognitive load theory (Sweller, 1988; Chandler & Sweller, 1991).

One of the distinctions of multimedia learning is that it contributes to instructional practice, and the other one is that it contributes to learning theory. The cognitive theory of multimedia learning covers the opinions of dual channels, restricted capacity, and operative processing. The theory can assist the comprehension of how design principles which will be tested is created and when the principles apply or not is explained (Mayer, 2017).

Generative Multimedia Learning Theory of Mayer relies upon three cognitive theories which are dual coding, limited capacity and active processing. These theories offer learners to join in the teaching and learning process actively throughout choice, coordinating and blending actions. Selection is defined as choosing words and images presented in the material that are related with the topic carefully and solidifying them in the short term memory. Organizing can be described as the arrangements of selected words or images by using the ways of configuring the above mentioned information. Integration is associating selected materials with existing information. (Mayer, 2001). Generative Theory of Multimedia Learning comprehends seven principles (principle of multimedia, principle of spatial contiguity, principle of temporal contiguity, principle of coherence, principle of modality, principle of redundancy, principle of

individual differences) to draw up efficient multimedia learning (Akkoyunlu & Yılmaz, 2005).

According to the Binary Coding theory, it is seen that definitions of multimedia learning focus on words and pictures to be used in the learning process. (Mayer, 2001) According to the Binary Coding Theory, after information in a learning environment is perceived by a learner, it is encoded by symbolizing it and storing it in the memory. Information is symbolized in two ways:

• Transformation of information into mental symbols (images)

• Transformation of information into verbal symbols (Senemoğlu, 1997, p.232).

When the literature is examined, many studies conclude that learning in multimedia is more effective and permanent. In particular, the reasons for the success of technology-based multimedia learning include the following factors: closeness to real life, persistency, attractiveness, and flexible learning environments. (Raupers, 2000; Tsoua, Wang ve Tzeng, 2004). Lots of research studies demonstrated that using the modality principle in multimedia learning surroundings provide better learning outcomes. (Jeung, Chandler & Sweller, 1997; Mayer & Moreno, 1998; Moreno & Mayer, 1999). However, as Tabbers et al (2004), consistent with Burkes (2007), found that as a result of lengthy audio narrative traces that students require to hold in working memory, the modality even has a negative impact in online learning surroundings.

2.2.6. E-Reading

As the technologies that provide reading on screen have become more widespread, the behavior patterns known in the process of acquiring, sharing and using information have changed. Digital reading is an action to read data, informatics and information through digital tools. Change forces the reader to develop new mental strategies and explicit aims in purposeful reading. Achievement on digital reading becomes dependent on identification and application of analysis, synthesis, integration and

interpretation of texts with its components and rich objects. Usual reading-understanding strategies are not adequate for digital reading areas. For this reason, every reader should be provided with the reading ability enriched with the talents appropriate to the nature of digital reading areas (Odabaş, Odabaş, & Sevmez, 2018).

The nature of reading has changed by multimedia and has become a dynamic facilitator of words which is an important new dimension. Words are triggers for multimedia readers to extend the text to learn more about a topic (Natarajan, 2006). The introduction of technology alongside educational environments enrich the learning environments by enabling the design of instructional materials appropriate for different student characteristics, which facilitates accessibility to the learning environments, and, therefore, creates efficient learning environments. Using instructional technology for learning environments makes the learning and teaching environments with a variety of sources more appealing to the senses, thus, increasing student motivation and success (Akkoyunlu & Yılmaz, 2005).

Greenlee-Moore and Smith's (1996) US investigation (31 9–10-year-olds for their sample) showed that when the story is hard and long, comprehension grades are higher in the electronic status. In order to accomplish a broader comprehension of the text, multimedia attachments like images, sounds, cultural, historical and geographical references, and directed questions can improve understanding (Lomicka, 1998).

Digital reading tools provide more possibilities for a variety of features such as audio, video, graphics, address bridges, which add richness and diversity to a subject (Tveit & Mangen, 2014). These richnesses and diversities contribute to a reader's perception and internalization of the topic during the reading (Odabaş, Odabaş, & Sevmez, 2018).

Clark and Mayer (2003) presumed that learners could learn more deeply when a presentation is created by excluding redundant on-screen text rather than including it. Better ergonomics and wording design can affect subscriber's eyes, comfort,

effectiveness of reading, satisfaction; and the learning skill for reading can change reading behavior. (Wang, Bao, Ou, Thorn & Lu, 2013). The approaches to reading of engaged readers are enthusiastic and confident (Meyer & Rose, 1999).

The results of Shirley Grimshaw, Naomi Dungworth, Cliff McKnight and Anne Morris' Study demonstrated that the reading time of children was generally longer when done from computers in comparison to published books (2007). Davis and Lyman-Hager (1997) conducted a study on performance and attitude regarding computerized second language reading of students. Forty-two French students who were in intermediate level read a glossed quote from Une Vie de Boy on a computer screen. After the reading process, an interview was conducted with the students. This interview exposed that students have an extremely positive attitude toward the software.

In this research, taking into consideration the Mayer Multimedia principles and e-reading behaviors of people, a responsive and nonresponsive learning environment was created. The aim of this that investigation of the effects of RWD on interface usage interactions and the investigation of connection between interface usage interactions and reading comprehension during reading on tablets.

2.2.7. Summary

The important thing is to explore how interface usage interactions are affected by website design during a learning process. In this research, a text reading on the different design of website was taken as a focus. One of the aims is to explore the differences in the learning experiences generated from the interface usage interactions between text reading on a RWD and the text reading on a non-RWD. The other aim is to understand the connection between reading comprehension of students and interface usage interactions on tablets. For these purposes, literature was reviewed to understand what the ideas of the experts are about interface usage interactions, reading

comprehension and so on, and what kind of studies were done in this field. These ideas and studies were guiding sources for this study.

CHAPTER 3

METHODOLOGY

3.1. Introduction

The purpose of this research is to investigate the effects of website design on interface usage interactions when students read a text from a tablet, and to investigate the connection between interface usage interactions on tablets with the reading comprehension. This study compares two groups of students who use RWD and non-RWD where interface usage interactions were collected in the background of the software. This chapter presents the research questions and includes the description of the research methodology.

3.2. Participants

Population of this study was Engineering departments related to information and computers students. For this purpose, convenience sampling was used for the selection of participants. Information systems engineering, Software engineering and Computer engineering students from Atılım University were selected as participants for this research. These students were selected because they were easily reachable. They have similar background courses, same school culture, and similar socioeconomic status. Students participated in the research on a voluntary basis and they signed a consent form. In total, 58 students participated in the research. The gender distribution of the students was as 35 male and 23 females. Students were assigned as pairs according to their working memory scores and gender. For example, while two female students with high scores in the working memory test were assigned as pairs, two male students with low scores in the working memory test were assigned as a different couple. There were 29 pairs and each of the pairs were assigned to different groups

(experiment/control). After selecting the group types with the excel program for each group, names of the two people in each group were written down on two pieces of paper, and then they were put in a bag and one of them was selected randomly. The selected name was assigned to a group which included another randomly assigned member, and the other participant would be assigned to a different random group. After all the grouping, in total there were 29 students included in the experiment group and 29 students added to the control group according to the random assignment results of the excel program. After the experiment study was over, 48 students were volunteered to participate an interview.

3.3. Research Design

A mixed method research design is a scientifically attentive research design consisted of a core component (qualitative or quantitative) with supplementary component (qualitative or quantitative) (Morse & Niehaus, 2016). This research design is preferred for the presented study because the researcher want to explore different aspects (understanding mechanisms and determining associations) of 'the effects of interface usage of tablets on reading comprehension' phenomenon. Actually, researcher intended to investigate the question (Is there a significant difference in terms of reading comprehension between participants using interface usage interactions at different website designs?) at the group (macro) level as well as at the individual (micro) level.

Instead of using a single method, mixed method was used for enriching our understanding through the supplemental component which is qualitative side of the study. According to Tashakkori and Creswell (2007), it can be said that mixed method was used for the presented study because there were two types of preplanned research questions (qualitative and quantitative), two types of data collection procedures (true experimental and interview), two types of data (numerical and verbal), two types of

data analysis (statistical and content), and two types of conclusions (objective and subjective).

In this research, mixed method was applied. First part of the study contained matched between participants after only true experimental design. The between participants design provided an advantage in terms of reducing learning effects and having shorter session features of it. When taken into consideration of the between subjects design, different participants were distributed to 2 groups that were determined before randomly. For the purpose of true random assignment, more than 30 people were reached for the implementation. In total, 58 students joined the implementation. This provided an equality and balance. Also, ensured the accuracy of the experiment, keeping other variables under control. Allocating participants randomly to groups, ensured that participant assignment would not affect the study results.

Working memory and gender were identified as input variables. Before the actual implementation of the study, the reading span test was applied to measure the working memory of students. According to working memory results and gender of them, students were matched in pairs. Then, for every pair, random assignment was applied to allocate them to groups. Thereby, 29 randomly selected students were assigned to the experimental group and the other 29 randomly selected students were assigned to the control group.

For the implementation, a specific software was prepared to facilitate reading on tablets and collect the interface usage interactions. With the help of this software, the experimental and control groups read 3 texts about technology. It took about 15-20 minutes. During this process, the experimental group used the RWD and the control group used the non-RWD. Website design was the independent variable for this research. During this implementation, interface usage interactions were collected in the background of the software. These interface usage interactions were "zoom movement, vertical movement, horizontal movement and time" information. The

effect of website design on interface usage interactions when students read a text from the tablet was investigated. Interface usage interactions were dependent variable for the first part of the aim.

Following diagram shows step of experimental design:

O1 R X O2

O1 R   O2

Working memory test was applied to students and two groups were formed by making the matching accordingly before random assignment. Input variables were working memory and gender. This diagram can be explained with the following table:

Table 3.1. *Treatment Diagram*

1st observation (measurement) of the dependent variable O_1=Measuring input variables for matching	Scientific Random Assignment of Subjects to:	Exposure to the Treatment (X) (independent variable)	2nd observation (measurement) of the dependent variable O_2=Post-test
Participants' average score on the input variables	Experimental Group	X	Experimental Group's average score on the dependent variables
	Control Group		Control Group's average score on the dependent variables

Dependent variables= Interface usage interactions
Independent variable= Responsive website design
Input variables= Working memory and Gender

The secondary aim was to investigate the connection between interface usage interactions with reading comprehension of students during they are reading on tablet. The second part of the study contained content analysis. 48 students joined an interview voluntarily. According to their answers, content analysis was conducted for understanding reading comprehension level of students and connection the results with interface usage interactions on tablets.

Table 3.2. *Quantitative and Qualitative Parts of the Study*

Quantitative Part (True Experimental Design)	Qualitative Part (Interview)
Independent Variable: Website Design (Responsive or non-Responsive) Dependent Variable: Interface Usage Interactions (zoom, time, horizontal move, vertical move)	Interview: to understand the students' reading comprehension level when they read from the tablets and when they interact with interface of tablets during the implementation
RQ-1: Is there a significant difference between the text reading on a responsive website design (RWD) and the text reading on a non-responsive website design (non-RWD) in terms of the interface usage interactions?	**RQ-2:** What is the connection between interface usage interactions with participants' reading comprehension?

3.4. Data Collection Instruments

3.4.1. Reading Span Test

Reading Span Test is used to measure the working memory of participants. According to Gathercole and others (2004), RST is used to examine the Central Executive in adults. Whitney et al. (2001) explained that participants read given sentences aloud and give their opinions on the truthfulness of sentences during the RST. At the end of each set of sentences, they are asked to keep in mind the red and underlined words and repeat them respectively. The set size is 2 to 6. When the set size rises, the recollection

of participants decreases because they need to remember more words after judging more sentences for their truthfulness.

The results can be measured in two ways. One of the ways is detecting participants' largest set size completed correctly. The other is taking the score of the total number of remembered red and underlined words (Daneman and Carpenter, 1980 as cited in Whitney et al., 2001). In this research, the first way of measurement was selected and applied.

The test starts with binary sets that cover 2 sentences. There are in total 6 binary groups. After each sentence, participants judge the truthfulness of the sentences and after each set, participants try to remember target words. If the participant makes two or more mistakes in a set, the activity is stopped. Moreover, a voice recorder is used to capture the answers of the participants.

Gülten Ünal created The Turkish Reading Span Test for adults. The test is similar to that of the English version. Sentences that includes widely known facts are chosen from school books for medium age children. For example, an English sentence that is "One of the salon sports is bowling" adapted to Turkish as "Salon sporlarından biri de bowlingdir." (see Appendix A).

3.4.2. Software Used for the Research

The software was created to collect and analyze responsive and non-responsive screen information and interface usage interactions of students on tablets. These software records each movement of the students such as turning the direction of the tablet, sliding the page in vertical or horizontal direction, and enlarging the page. Also, it records the time data for each student. Before starting the application, it collected the students' school id or name to adjust the data according to them. At the end of the experiment, it gave a report about all movements of each student. This software

worked in the background of the tablets. Also, the software included two option for the tablets, one of them was RWD and the other one was non-RWD. Therefore, it collected two types of interface usage interactions for each design. These are the examples:

Figure 3.1. Example of responsive website design
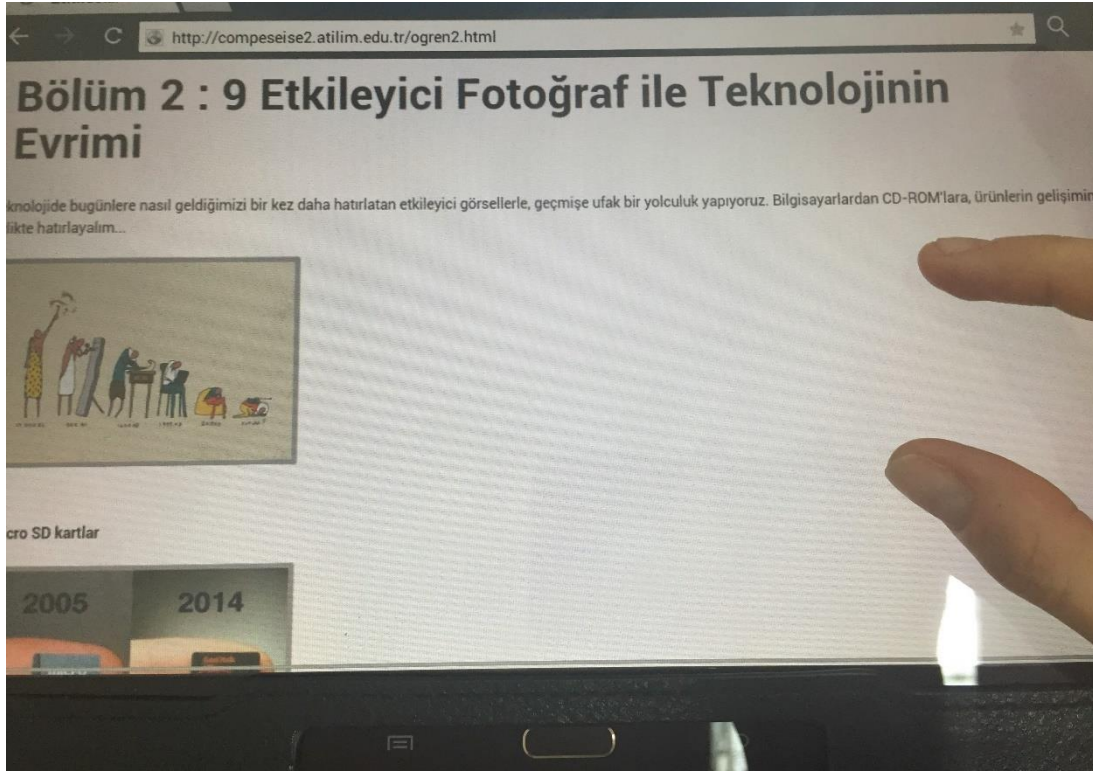
Figure 3.2. Example of non-responsive website design

3.4.3. Semi-structured Interview

Two types of interviews were prepared, one was for the experiment group students and other one was for the control group students. The interviews were conducted after the tablet application was completed. The Experiment and control group questions were very similar. (see Appendix E). The purpose of preparing these interview questions were to gain more insight about the relationship between student ideas and movements on tablets, determine whether there was a connection between interface usage interactions with reading comprehension of students or not.

3.5. Implementation Process
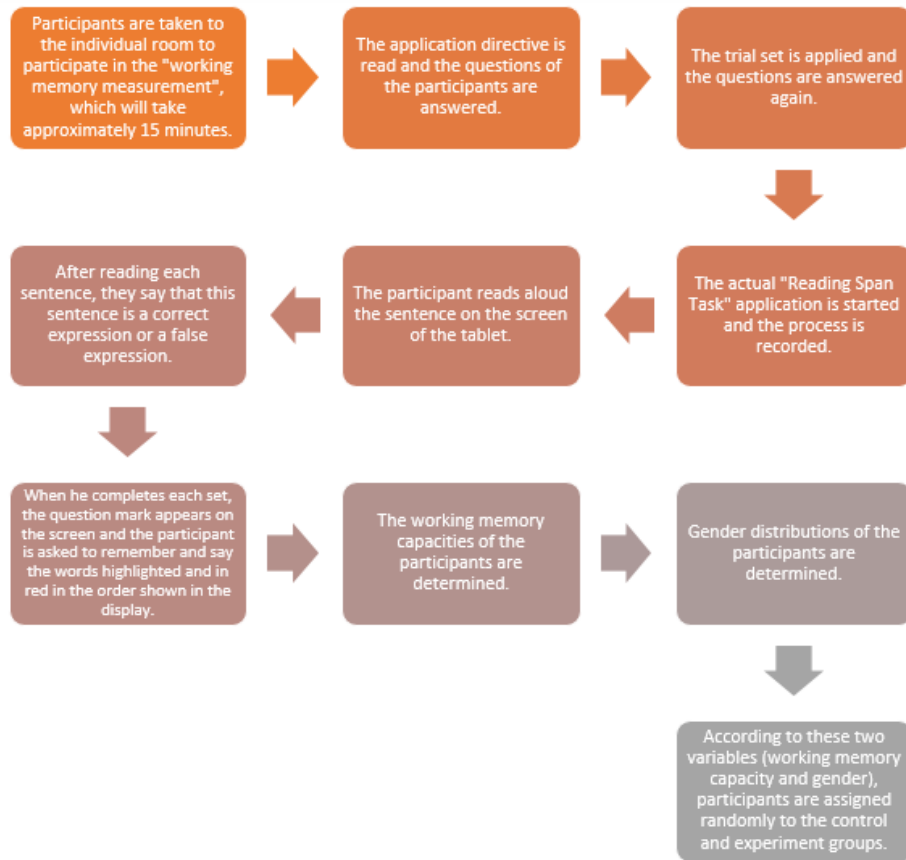
Figure 3.3. Pre-test Process Diagram

Starting the implementation of a study requires preliminary preparations such as deciding what is wanted to obtained after the implementation, determining which data are collected and what kind of collection method is used for it, selecting suitable scales to measure what you want measure, reaching the participants, and adjusting the implementation environment. While we preparing for the implementation, related factors which affected the measurement were taken into consideration. Studies show that the working memory affects comprehension. (Daneman and Carpenter,1980). To design a reliable implementation and distribute the participants in a balanced way, working memory was identified as input independent variable.

Reading span test is a type of scale to measure the working memory and it is used to get verbal memory level of participants. In this research, the reading span test was used in order to measure the participants' verbal subject evaluation of the study. This measurement was the pre-implementation process of the research. In the reading span test, there were different sets of group types into which students were included. At the first part of the task, the requirements and expectations were clearly explained to the students. Then, an example was demonstrated to make the process completely coherent. After the trial set, any questions that were present asked by the students about the process were answered. After that, real reading span test was started. During this task, students firstly read a common sentence aloud. Then, they stated whether this sentence is true or wrong. For example, "Çorum İç Anadolu Bölgesinde yer almaktadır." is a sentence. Students gave their answers as "true" or "false". Also, this sentence contained a word or phrase that was underlined and written in red. Students tried to keep this word or phrase in their mind. Then, the second sentence appeared. Students again read this sentence, and decided on its truthfulness, then they kept the underlined, red word in their mind. After that, they encountered a question mark. This meant that they had to the say words that had kept in their mind so far. Students said the underlined red words respectively. Following that, the researcher took notes of the amount of words recollected correctly. This was the binary set. The same process was applied for 3, 4, 5, and 6 sets. Then, the working memory level of the participants was calculated by utilizing the reading span test measurement rules. If students had two or more wrong answers (not remembered correctly) in a set, the test was terminated. According to the results and genders, students were grouped in pairs.

After applying the pre-implementation stage to obtain the working memory results of the students, they were distributed to control or experiment group in pairs for the actual implementation. This distribution was done with random assignment. Excel was used to assign the students randomly to the dual groups 1 (for experiment group) or 0 (for control group). After that, names in the first dual group were added in a bag and a name was selected randomly. This selected name was assigned to a predetermined

group. For instance, the first dual group number was assigned randomly as 1 by excel and Ali was selected from the bag so he was assigned to group number 1 (experiment) and the other partner of the dual group was assigned to group number 0 (control).
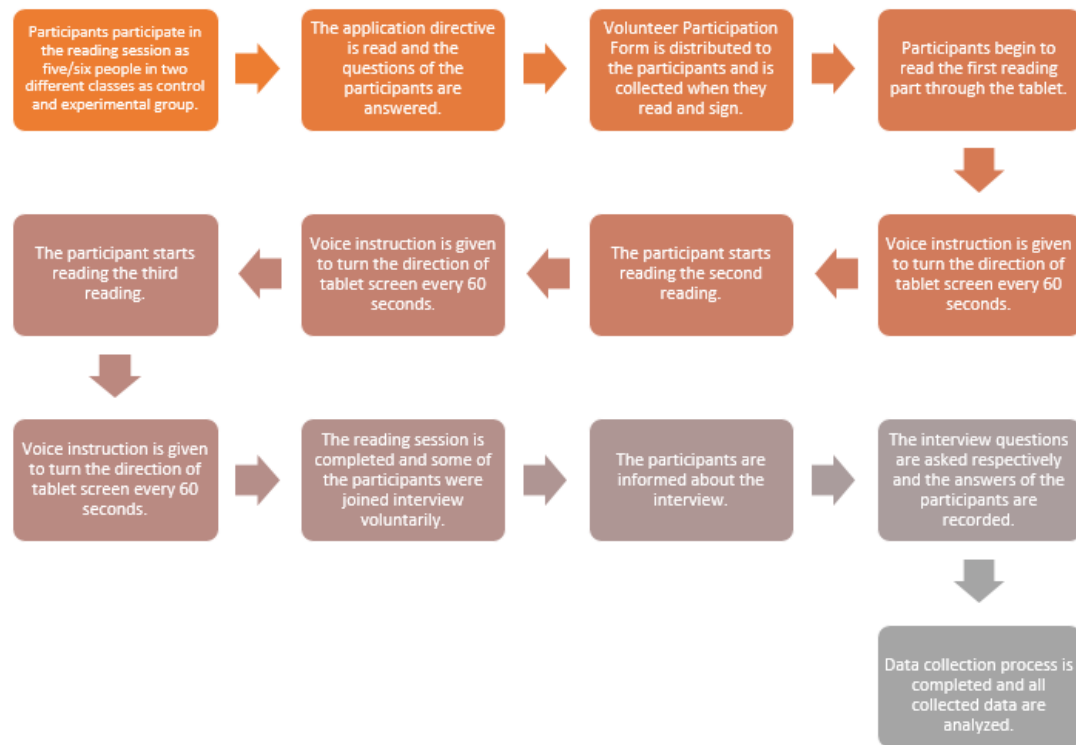
Figure 3.4. Implementation Process Diagram

A web-based application was created for the texts on the tablet. This application included two types of design; one of them was responsive and other one was nonresponsive. The students who used the RWD integrated tablet was the experiment group students. The other students who were in the control group of this research used the non-RWD tablets. The number of students who used responsive and nonresponsive type website designs were planned to be balanced. Before using the application, pilot tests were applied to some people. They did not attend the actual study. According to the ideas of the people and examination of researchers, the application was developed to a suitable version for the research. Additionally, to determine the validity of the

reading comprehension texts, an expert who is a Turkish language and literature teacher examined the texts and deduced that they were valid and in accordance with the research objectives.

In the actual implementation process, participants were asked to fill and sign a voluntary participation form that included information about the main points of the research. Tablets were distributed to the experimental and control groups. In the implementation process, there were 3 different texts which were related to technology on the tablets. While the students were reading the texts, they rotated the tablets when the researcher gave voice instructions (for every 60 seconds). The experiment group was dealing with a-RWD supportive device, while the control group did not have RWD implemented in their device. At the end of the reading part, students waited silently until all students completed the implementation. After that, an interview was conducted with most of the students about their ideas on the implementation, reading comprehension level, having difficulty level when they interact with interface, and movement types during their reading process on the tablets, to compare the results with the implementation.

3.6. Data Analysis

For the first part of this study, website design (responsive or nonresponsive) was the independent variable, and interface usage interactions were the dependent variables. To analyze the data, MANOVA (Multivariate Analysis of variance) was used. This analysis was selected because Field (2013) stated that several dependent variables requires multivariate analysis rather than the applying several analysis of variance (ANOVA) and also indicated that MANOVA decreases the chance of Type I error. Independent variables interactions can be investigated by using MANOVA and the effects of dimension combination on groups by using dependent variables in the same analysis can be understood with MANOVA. (Field, 2013). In this study, whether there is an effect of website design of tablets on interface usage interactions, and whether

there is a connection between interface usage interactions on tablets with reading comprehension of students were examined using MANOVA and content analysis.

CHAPTER 4

FINDINGS

4.1. Descriptive analysis of variables

Table 4.1 shows that there are in total 58 undergraduate students who joined this study as samples. Students were distributed to an experimental group and a control group by random assignment. (1: experimental group, 2: control group) The experimental group used RWD tablets (n=29) and the control group used non-RWD tablets (n=29). These variables are given in the descriptive Table 4.1 and 4.2.

Table 4.1. *Between Subjects Factors*

		Value Label	N
GroupNo	1	Responsive	29
	2	Non-responsive	29

Table 4.2. *Descriptive Statistics*

	Website Design	Mean	Std. Deviation	N
Total Time	Responsive	865,79	205,563	29
	Non-responsive	832,79	146,562	29
	Total	849,29	177,725	58
Zoom Move	Responsive	4,4483	3,43913	29
	Non-responsive	9,1034	12,07520	29
	Total	6,7759	9,10763	58
Vertical Interactions	Responsive	15,0172	10,05741	29
	Non-responsive	15,2759	16,37484	29
	Total	15,1466	13,46927	58
Horizontal Interactions	Responsive	22,2069	15,31894	29
	Non-responsive	24,2414	23,87416	29
	Total	23,2241	19,90772	58

4.2. Inferential Analysis of Variables

Before multivariate analysis, equality of covariance matrices should be provided as the assumption. Therefore, according to the results of the test of equality of covariance matrices [Box's M=48.78, $F_{(10, 14992.83)}$ =4.50, p=.00] variances are not equal. However, if there is a significant effect of dependent variables on independent variables, it should be checked again whether this result is meaningful.

Box's Test of Equality of Covariance Matrices[a]

Box's M	48,78
F	4,50
df1	10
df2	14992,83
Sig.	,00

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
a. Design: Intercept + Website Design

Multivariate analysis was applied to investigate the effects of a nominal variable (website design) on dependent variables (interface usage interactions). The multivariate test results of these variables are shown in Table 4.3.

Table 4.3. *Multivariate Tests*

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Intercept	Pillai's Trace	,96	322,47[b]	4,00	53,00	,00	,96	1289,88	1,00
	Wilks' Lambda	,04	322,47[b]	4,00	53,00	,00	,96	1289,88	1,00
	Hotelling's Trace	24,34	322,47[b]	4,00	53,00	,00	,96	1289,88	1,00
	Roy's Largest Root	24,34	322,47[b]	4,00	53,00	,00	,96	1289,88	1,00
Website Design	Pillai's Trace	,10	1,44[b]	4,00	53,00	,23	,10	5,76	,42
	Wilks' Lambda	,90	1,44[b]	4,00	53,00	,23	,10	5,76	,42
	Hotelling's Trace	,11	1,44[b]	4,00	53,00	,23	,10	5,76	,42
	Roy's Largest Root	,11	1,44[b]	4,00	53,00	,23	,10	5,76	,42

a. Design: Intercept + Website Design

b. Exact statistic

c. Computed using alpha = ,05

	F	df1	df2	Sig.
Total Time	,79	1	56	,38
Zoom Move	12,44	1	56	,00
Vertical Interactions	1,41	1	56	,24
Horizontal Interactions	1,55	1	56	,22

Tests the null hypothesis that the error variance of the dependent
variable is equal across groups.

a. Design: Intercept + Website Design

According to the multivariate test results, the independent variable did not give any significant results. Based on the results of responsive vs. non-responsive website design, Wilk's λ=.90, F (4,53) =1.44, p=.23, partial η^2=.10 indicating %10 of variance.

In order to examine each independent variable effect on each dependent variable in detail, between subject analysis was carried out. Levene's test was carried out to provide equality of error variances that is one of the assumptions of this analysis. Levene's test results are F (1,56) =.79, p=.38 for total time, F (1,56) =12.44, p=.00 for zoom move, F (1,56) =1.41, p=.24 for vertical move, F (1,56) =1.55, p=.22 for horizontal move. Variance in between groups is not equal (exclude only for one independent variable (zoom move)) for independent variables, however, if there is an effect of dependent variables on independent variables, it should be checked again whether this result is meaningful.

4.2.1. Website Design Effect

Results show that website design (responsive vs. non-responsive) has a marginal effect only on zoom move F (1,56) =3.99, p=.05, partial η^2=.07. However, website design has no significant effect on total time F (1,56) =.50, p=.48, partial η^2=.01, on vertical interactions F (1,56) =.01, p=.94, partial η^2=.00, and on horizontal interactions F

$(1,56) = .15$, $p=.70$, partial $\eta^2=.00$. This means that using different website design affects partially people's zoom move on tablets by indicating % 7 of variance.

Table 4.4. *Tests of Between-Subjects Effects*

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[e]
Corrected Model	Total Time	15790,50[a]	1	15790,50	,50	,48	,01	,50	,11
	Zoom Move	314,22[b]	1	314,22	3,99	,05	,07	3,99	,50
	Vertical Interactions	,97[c]	1	,97	,01	,94	,00	,01	,05
	Horizontal Interactions	60,02[d]	1	60,02	,15	,70	,00	,15	,07
Intercept	Total Time	41835328,98	1	41835328,98	1312,76	,000	,96	1312,76	1,00
	Zoom Move	2662,91	1	2662,91	33,79	,000	,38	33,79	1,00
	Vertical Interactions	13306,25	1	13306,25	72,07	,000	,56	72,07	1,00
	Horizontal Interactions	31282,91	1	31282,91	77,76	,000	,58	77,76	1,00
Website Design	Total Time	15790,50	1	15790,50	,50	,48	,01	,50	,17
	Zoom Move	314,22	1	314,22	3,99	,05	,07	3,99	,50
	Vertical Interactions	,97	1	,97	,01	,94	,00	,01	,05
	Horizontal Interactions	60,02	1	60,02	,15	,70	,00	,15	,07
Error	Total Time	1784623,52	56	31868,28					
	Zoom Move	4413,86	56	78,82					
	Vertical Interactions	10340,03	56	184,64					

	Horizontal Interactions	22530,07	56	402,32
Total	Total Time	43635743,0 0	58	
	Zoom Move	7391,00	58	
	Vertical Interactions	23647,25	58	
	Horizontal Interactions	53873,00	58	
Corre cted Total	Total Time	1800414,02	57	
	Zoom Move	4728,09	57	
	Vertical Interactions	10341,00	57	
	Horizontal Interactions	22590,09	57	

a. R Squared = .009 (Adjusted R Squared = -.009)

b. R Squared = .066 (Adjusted R Squared = .050)

c. R Squared = .000 (Adjusted R Squared = -.018)

d. R Squared = .003 (Adjusted R Squared = -.015)

e. Computed using alpha = ,05

4.2.2. Zoom Move in Terms of Website Design
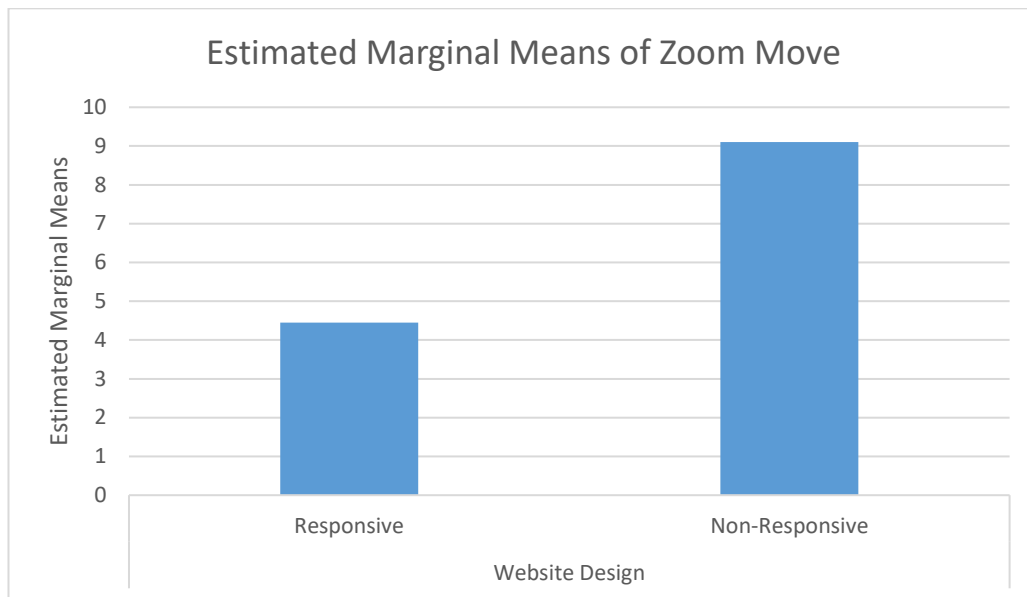
Figure 4.1. The effect of website design on zoom move

Figure 4.1. shows that students who used non-responsive website design had higher mean scores than the students who used responsive website design on tablets in terms of zoom move. This is a meaningful result when is thought that non-responsive design has small letters and pictures rather than responsive design. However, the important thing is that learning the results of using more zoom move on nonresponsive website design. That is, it is important to learn that whether it caused distraction or it caused easy reading comprehension.

Interview results support distraction idea. Some qualitative results like following:

Student-12 (used non-RWD): "During the implementation, I used zoom in and zoom out moves often. I would like to use responsive website design because nonresponsive website design distracted my attention. Using zoom move caused mental load resulting in less understanding from the text. However, in the normal condition (she

mention on responsive website design), tablet has an advantage in terms of being able to zoom rather than books."

Student-16 (used non-RWD): "I used to zoom in to see photos and articles. Constantly zooming in and out was exhausting and hindering my recall from the text. In my opinion, the article had to be fully adapted to the screen."

Student-30 (used non-RWD): "The zoom process made the text easier to read. Actually, zooming can be advantageous, but it is an exhausting action when it is used very."

On the other hand, RWD users stated that they use zoom move when they need however, because they did not zoom move very much, it did not distract them, on the contrary, it helped for comprehending the reading. Some students' ideas about this situation are in the following:

Student-5 (used RWD): "Since the tablet provides flexibility in scaling, enlarging the font size on the tablet and zooming into content on the tablet, I prefer the tablet rather than book when I was reading. Because, it makes the comprehending easier for me."

Student-13 (used RWD): "I used zoom move as if I have been underlining a book and so zooming helped me for understanding."

Student-18 (used RWD): "Responsive website design helped me by making easy to read, so I didn't use zoom move."

This means that zoom move was used more on nonresponsive website design because of disadvantages of the design. Using zoom move very much, distracted the students' attention. However, responsive website design has an advantage to make easy the reading comprehension. Students used zoom move in normal level and so their reading comprehension ideas about themselves was high.

4.2.3. Horizontal Interactions in Terms of Website Design

Figure 4.2. The effect of website design on horizontal interactions

Figure 4.2 shows that students who used non-RWD had higher mean scores than the students who used RWD on tablets in terms of horizontal interactions. If we are thinking on the previous graphic, it can be made inference that students used zoom move on non-RWD more than RWD, so it affected the frequency of using horizontal interactions. Results of interviews with students also supported this inference and they stated that they had difficulty when they used horizontal move very much like following:

Student-16 (used non-RWD): "There were problems in sizing and scaling. The site could have been responsive. The font could arrange itself while I was reading the text in the horizontal or vertical direction rather than arranging the text by scrolling left or right. It caused difficulty when I was reading and I'm distracted."

Student-19 (used non-RWD): "When the implementation started, because the letters of the text came small to see, I zoomed in. When I zoomed in, I couldn't see the whole sentence. I used horizontal move very much. After the end of the sentence, it was

difficult to go back from left to right. Therefore, I didn't zoom in again. I chose to read small instead of zooming and moving to left or right."

Student-22 (used non-RWD): "Doing the right-left move at the same time with the zoom move forced me during the implementation."

Student-30 (used non-RWD): "It was very difficult to do horizontal movement, I had difficulty in following it, and so I couldn't focus. This situation caused difficulty to understand what I reading."

Student-33 (used non-RWD): "Scrolling left and right forced me during my reading. It was exhausting and distracting. I couldn't control whether I should use my finger on tablet or should follow the text."

On the other hand, RWD users stated that they did not need to horizontal movement very much. Most of them did not used horizontal movement because of the advantage of responsive design. And students stated that using horizontal interactions less or never, helped students' focusing and understanding the text. (Some of the students' ideas like following:

Student-9 (used RWD): "I didn't need to shift the screen left or right because it was responsive. This was an advantage to support easy comprehension."

Student-20 (used RWD): "It was pretty comfortable being its responsive so I didn't do horizontal movement. This situation helped me to provide focusing."

Student-35: (used RWD): "Being its responsive of course helped me in terms of the readability. I've just followed the reading texts, I did not used left or right or zoom move. Therefore, I was not distracted and it made easy to understand of reading."

This means that horizontal interactions are not useful for tablets and especially they used when website design was non-responsive. In terms of horizontal interactions, non-responsive design has a disadvantage and responsive design has an advantage for reading comprehension.

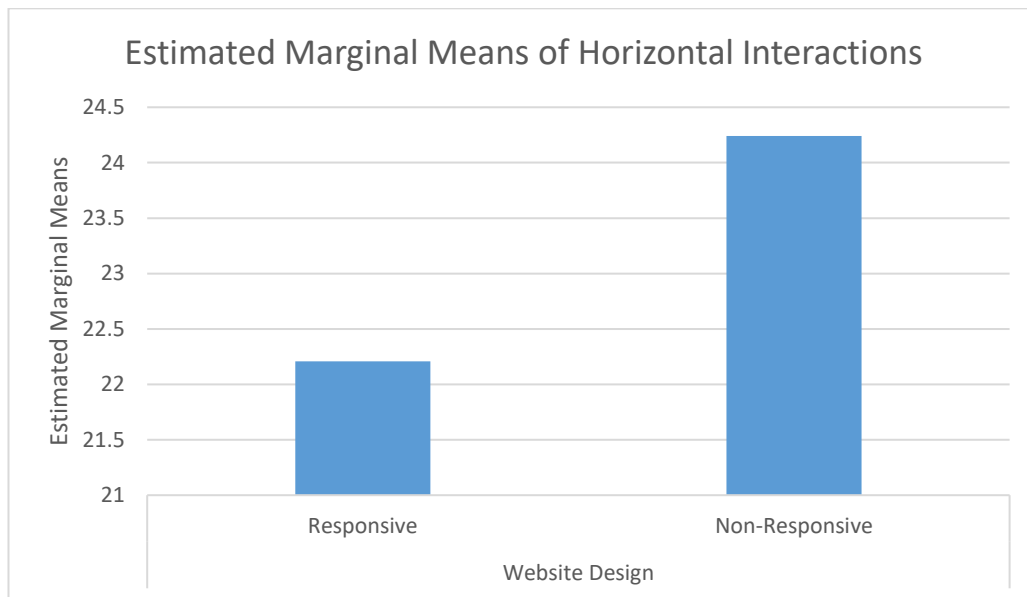### 4.2.4. Vertical Interactions in Terms of Website Design
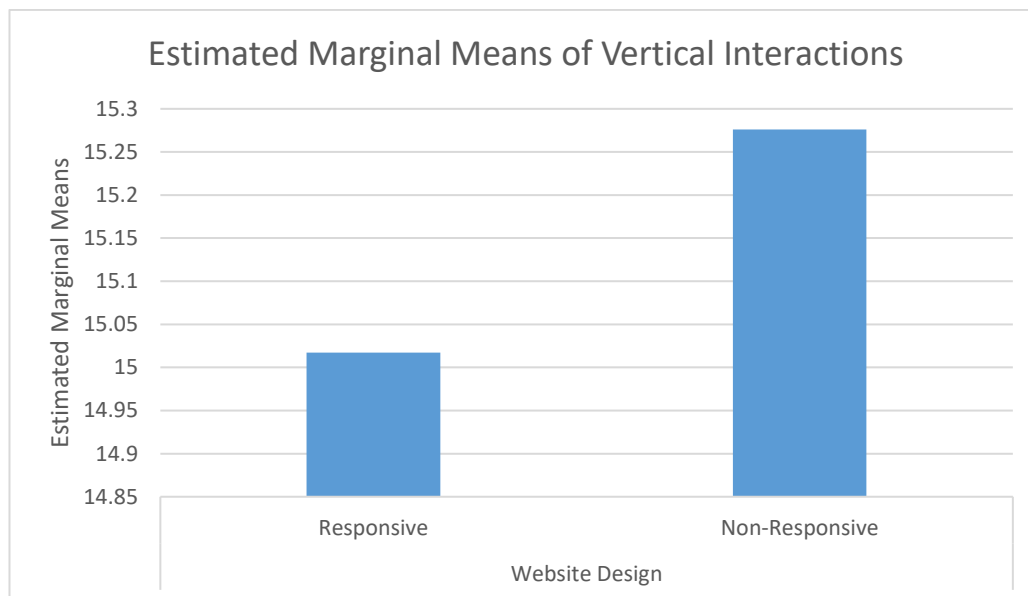
Figure 4.3. The effect of website design on vertical interactions

Figure 4.3 shows that students who used non-RWD had higher mean scores than the students who used RWD on tablets in terms of vertical interactions. Zoom move and horizontal interactions could be affected the vertical interactions. For example, when participants used zoom move, seen area on the tablet became less than before, and so they could be used vertical interactions more. The other possible situation was responsive website design provide better environment to read so students only used to slide down to follow the text. Students' ideas about this situation was like that:

Student-1 (used RWD): "I didn't use horizontal or zoom move because font size was enough to see and I am familiar to use tablet. That is, I used only down move to follow the text. So, I did not have any difficulty to understand the texts."

Student-26 (used RWD): "I didn't zoom in and left or right move. I just used to slide the page down to see more, because the articles were the suitable size to see. This movement has been useful for me because I continued as a single page. Turning the

page did not required, it was easier. Therefore, I focused to the texts easily and it helped me to comprehend my reading."

Students' ideas about non-RWD was like that:
Student-39 (used non-RWD): "I had to change the scaling of the screen because the size of the article grew up when I every changed the direction to horizontal. I zoomed in on the vertical, zoomed out in the horizontal. Therefore, I used more horizontal and vertical interactions. This caused distraction and I had difficulty to understand reading texts while I was trying to arrange the screen."

As seen in the qualitative results, when vertical interactions were used in a normal level, it helped the students to comprehend the reading. On the other hand, if they were used very much, it caused distraction and difficulty for reading comprehension.

4.2.5. Comparison of Horizontal and Vertical Direction

In this part, comparison of horizontal and vertical direction should be taken into consider. Students explained their ideas about why they used horizontal and vertical interactions mostly. However, they also explained advantages and disadvantages of horizontal and vertical directions. To make it clear, horizontal interactions means that sliding right to left or left to right, and vertical interactions means that sliding up to down or down to up. On the other hand, horizontal and vertical direction means that angle of the tablets when they are used. Students identified that they used tablets in vertical direction effectively, however, they had difficulty when they changed the direction of tablet from vertical to horizontal. Their ideas were like that:

Student-4 (used RWD): "It was hard to follow on the tablet in the horizontal direction. It was easier to follow in the vertical, like a book."

Student-7 (used RWD): "When the tablet was vertical direction, the whole text was fit and was good for reading. But I had trouble reading horizontally, seeing a less part of the piece on a wider field, making it difficult for me to follow and understand."

Student-20 (used RWD): "While the screen was vertical, being responsive was quite comfortable. I didn't like to use the screen horizontally, because I had difficulty when following the text."

Student-39 (used non-RWD): "I had to change the scaling of the screen because the size of the article grew up when I every changed the direction to horizontal. I zoomed in on the vertical, zoomed out in the horizontal."

Student-41 (used non-RWD): "Font size was small. It would be more comfortable if it was responsive. Fatigue was in the horizontal direction, but in the vertical direction it seemed like a regular book. Zooming during horizontal direction was required cognitive effort."

These ideas showed that students had difficulty when they read a text from a horizontal direction tablet and students accepted vertical direction of tablet for easy reading. Because vertical direction was close to the experience that reading from a book. Additionally, zoom move affected horizontal and vertical interaction numbers and because the zoom move was used more on non-responsive website design, also horizontal and vertical interactions were used on non-responsive website design more. This caused distraction and hard reading comprehension. However, responsive website design and using the zoom move, and horizontal and vertical interactions in normal level, provide more suitable environment for easy reading comprehension.

4.2.6. Total Time in Terms of Website Design
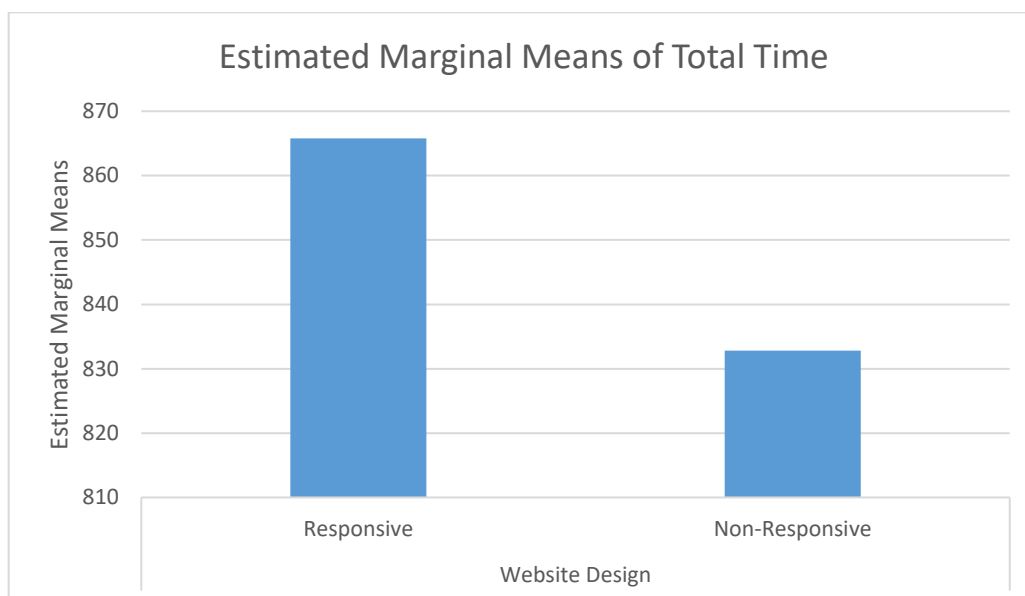
Figure 4.4. The effect of website design on total time

Figure 4.4. shows that students who used RWD had higher mean scores than the students who used non-RWD on tablets in terms of total time. This means that students who used responsive website design tablets spent more time during implementation. There could be many reasons for spending more time on responsive website design and spending less time on nonresponsive website design. However, there could be two meaningful reasons in the first look. First reason could be that students lost their attention and had difficulty when they were reading on non-responsive website, so they passed the text quickly. The second reason could be that non-responsive website design made easy students' following the text so they completed reading in less time.

Interview results pointed that first reasons can be accepted by students. Some of the students' ideas supported this quantitative result like following:

Student-19 (used non-RWD): "When the implementation started, because the letters of the text came small to see, I zoomed in. When I zoomed in, I couldn't see the whole

sentence. I used horizontal move very much. After the end of the sentence, it was difficult to go back from left to right. Therefore, I didn't zoom in again. I chose to read small instead of zooming and moving to left or right."

Student-40 (used non-RWD): "When we changed the direction of the tablet, we could had difficulty to find the line we stayed."

Results demonstrated that because the responsive website design has an advantage to make easy reading comprehension that was mention before, students read texts carefully and spent more time. On the other hand, non-responsive website design has a disadvantage that requires using zoom move, horizontal and vertical interactions more and they caused losing the attention of students. Therefore, students read the text in less time without giving their attention to the topic and without trying understanding the texts.

In brief, according to multivariate test results, independent variable (website design) did not give significant results on dependent variables (interface usage interactions). Since the results were not found as significant, it was thought that there is no need to check Box' test for MANOVA Multivariate Results and Levene's test results for MANOVA Between Subject Analysis again. According to detailed Tables and interview results, RWD has an advantage in terms of most of interface usage interactions and it provides better usage to make easy reading comprehension when compared with non-RWD.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1. Interface Usage Interactions

In this study, the problem was understanding the effect of website design on interface usage interactions in the first part. In the literature, there are so many researches about interface usage interactions in education. However, they have different variables when compared to this study. Some of the research mentioned in the literature focused on students' dropout rates, and some of them created a system to compare students' success. In the literature, there is no similar research with this study.

One of the studies in the literature was conducted by Mazza and Dimitrova. CourseVis, which is a neutral pedagogical tool, utilizes LMS data to assist teachers in order to find out what occurres in online lectures and to specify people who need additional support (Mazza and Dimitrova, 2007).

The other study was conducted by Larusson and White (2014). Recollect as a learning environment is a lecture capture solution developed at the University of Saskatchewan authors to collect low-level learner behavior data. During a lecture, "Recollect" reports a set of user behaviors such as mouse clickings in the interface, searching about content of the course or in the video that use the video scrubber, guiding within the video that use section widgets, mousing over, or scrolling during the listing. Each of these behaviors are tied up to the observed time, initiated behavior of student, and the watched particular video. The results show that using collected data from learning fields to alter the field during instruction has a value. (Larusson & White, 2014).

In this study, results show similarity and differences with Larusson and White study. While Larusson and White study showed that using collected data from learning fields to alter the field during instruction has a value, this study showed that website design (responsive vs. non-responsive) has no significant effect on interface usage interactions (zoom move, horizontal interactions, vertical interactions and total time). Even though there is no significant effect, students who used non-responsive web design had higher mean scores than the students who used responsive web design on tablets in terms of zoom move, horizontal interactions and vertical interactions. And they explained that non-responsive website design required unnecessary interactions and this caused distraction and less reading comprehension. This shows that responsive web design has an advantage on tablets in terms of zoom move, horizontal and vertical interactions because it provides better learning environment for reading comprehension rather than non-responsive website design. Moreover, students who used responsive website design had higher mean scores than the students who used non-responsive website design on tablets in terms of total time. Qualitative results showed that spending more time on responsive website design was the conclusion of reading carefully of students and their trying the comprehension of reading texts.

5.2. Reading Comprehension

The other problem was understanding the whether there is a connection between interface usage interactions and reading comprehension of students. For this purpose, reading comprehension of students were assessed with an interview in this study. Therefore, this study provided the knowledge of what type of interface usage interactions they used according to website design on tablets. Furthermore, it showed what interactions were used more on responsive website design and what interactions were used more on non-responsive website design. Also, students explained their reasons and relation with the reading comprehension.

Chen and his friends study results showed that students who read from a paper had significantly better performance than students who read from computer-based in terms of shallow comprehension. Also, the other result was that students who had higher familiarity to tablets had significantly better performance than the students who had lower familiarity to tablets in terms of deep comprehension. (Chen et al., 2014). In our study, familiarity issue was not taken into consideration and website design was compared rather than paper or computer. Although there is no significance difference between website design and interface usage interactions, students stated that they comprehend the reading better when they read from responsive website design. In the future, familiarity issue should be taken into consideration.

According to Sheil (2015), responsive design has lots of advantages. One of them is supporting the users by visualizing the content that requires minimal resizing and scrolling. This idea was supported also in this research results.

Results demonstrated that students used zoom move, horizontal interactions and vertical interactions on non-responsive website design, however, they spent more time on responsive website design. Results were become meaningful reasons with students' explanations. Responsive website design has an advantage in terms of reading comprehension rather than non-responsive website design. The reason was that students used zoom move, horizontal and vertical interactions in the medium level and as necessary on RWD. Therefore, their focusing and reading comprehension was increased. On the other hand, students spent more time on RWD because they tried to understand the reading rather than having difficulty because of the website design, losing their attention and completing the reading text as soon as possible without comprehension.

5.3. Implications

It is thought that this study will contribute to the electronic book sector in terms of providing meaningful data. Thus, it is thought that these results can contribute to the improvement, renewal and use of electronic reading tools. It is also thought that the study will support the efficient electronic reading by determining the usage habits of the electronic reading tools and by changing the design of the electronic reading screens according to the interface usage interactions data. The researcher can prefer the RWD and interface usage interactions to develop usefulness of reading on tablets. Thus, effective learning environments especially for e-reading can be provided to the students by using interface usage interactions data.

5.4. Conclusion

Interface usage interactions data produced by reading from the tablet may vary according to age and familiarity to technology. That is, older age people may have difficulty while reading on tablets and may have more interactions with the screen during this process. In this study, experiment was applied to university students and it is assumed that students close relation with technology. If participants change, results can be change. In addition, alterations in learning environments can also change interface usage interactions data. For example, the situations, in mobile learning environments with RWD or non-RWD can cause different interface usage interaction results.

Moreover, different interface usage interactions can generate different results for the reading comprehension. In this study, zoom move, horizontal interactions (left, right), vertical interactions (up, down) and total time data were researched. The effect of interface usage interactions data should be examined in more detail by adding different interactions and repeating the experiment.

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A. READING SPAN TEST (RST)

Deneme seti

1. Kışın en soğuk zamanına zemheri denir.

2. Çorum İç Anadolu Bölgesi'nde yer almaktadır.

3. Almanya'da on iki milyon türk yaşamaktadır.

2'LİK SETLER

1

1. Senin kardeşinin çocuğu yiğenindir.

2. Trabzon mısırı ile ün salmıştır.

2

1. Haritada Türkiye Fransa'dan daha fazla yer kaplar.

2. 30 Eylül'de doğanlar akrep burcu olurlar.

3

1. Zorunlu eğitim ülkemizde 8 yıldır.

2. Uzağı iyi göremeyen hipermetrop gözlerdir.

4

1. Bir yumurta 80 kalori barındırır.

2. İnsan susuzluğa haftalarca dayanabilir.

5

1. Bir insanda 46 çift kromozom bulunur.

2. Türk Hukuk Kurumu THK ile kısaltılır.

6

1. Osmanlı İmparatorluğu 1299 yılında kurulmuştur.

2. Yapraklar ilkbaharda sararır.

3'LÜK SETLER

1

1. Salon sporlarından biri de <u>bowlingdir</u>.

2. Sebzeler bol miktarda B vitamini <u>ihtiva eder</u>.

3. Osmanlı Devleti <u>dünyadaki</u> en uzun süren imparatorluktur.

2

1. Boza içeceği <u>Arap kökenlidir</u>.

2. Bir bardak şekersiz çay sıfır <u>kaloridir</u>.

3. Sol ele <u>söz yüzüğü</u> takılır.

3

1. Lodos <u>güneybatıdan</u> esen rüzgara denir.

2. İskambil kağıdı ile <u>briç oyunu</u> oynanabilir.

3. Haritada Bulgaristan Yunanistan'dan daha fazla <u>yer kaplar</u>.

4

1. 1920 yılında <u>cumhuriyet</u> ilan edilmiştir.

2. Trampet <u>nefesli</u> bir çalgı türüdür.

3. Kıvırcık saçlı olmak <u>kalıtımsaldır</u>.

5

1. Uranüs <u>güneşten</u> en uzak olan gezegendir.

2. Rüştiye <u>lise dereceli</u> eğitim kurumuna denir.

3. Mozart Viyana'da <u>doğmuştur</u>.

6

1. Bir yıl <u>üç yüz altmış</u> beş gündür.

2. Çarparken çıkarmayı, <u>bölerken</u> toplamayı kullanırız.

3. Seksen tane şehir <u>ülkemizde</u> bulunmaktadır.

4'LÜK SETLER

1

1. 30 adet taşla <u>tavla oyunu</u> oynanabilir.

2. Etkisiz elemanı sıfır olan işlem <u>toplamadır</u>.

3. Türkiye'nin <u>üçüncü</u> cumhurbaşkanı Cemal Gürsel'dir.

4. İyot tiroit bezinin çalışması için <u>gereklidir</u>.

2

1. Baklagil türlerinden biri de <u>mercimektir</u>.

2. Dama ve satranç aynı sayıda taşla <u>oynanmaktadır</u>.

3. İzmir Muğla'dan <u>yüzölçüm</u> bakımından daha küçüktür.

4. Bir araba için hız sınırı <u>otoyolda</u> 90 km'dir.

3

1. Salep bir <u>Türk içeceğidir</u>.

2. Epik şiir <u>kahramanlıklardan</u> bahseder.

3. İç Anadolu Bölgesi Türkiye'nin <u>en geniş</u> bölgesidir.

4. 30 Mart'ta <u>doğanlar</u> kova burcu olurlar.

4

1. Tavşanlar ot <u>yiyerek</u> yaşar.

2. Sarı ve kırmızı birlikte <u>karışırsa</u> yeşil olur.

3. Yılan ve timsah <u>sürüngendir</u>.

4. % 74 oranında su <u>çiğ yumurtada</u> bulunur.

5

1. Kuş türlerinden biri de <u>devekuşudur</u>.

2. Teyzenin çocuğu senin <u>yiğenindir</u>.

3. 35 kalorilik enerji <u>havuçta</u> vardır.

4. Telli çalgılara örnek olarak <u>akordiyon</u> verilebilir.

6

1. Dünyanın <u>yüzölçümü</u> en büyük olan ülkesi Amerika'dır.

2. Ev telefonları <u>elektrikle</u> çalışır.

3. Azerbaycan Türkiye'ye <u>komşudur</u>.

4. Ay dünyanın <u>üçte biri</u> büyüklüğündedir.

5'LİK SETLER

1

1. Tuzlu su daha kısa sürede <u>kaynamaktadır</u>.

2. Bolu'nun yüzölçümü Sivas'ın yüzölçümünden <u>büyüktür</u>.

3. Oyun kartları 52 adet karttan <u>oluşmaktadır</u>.

4. Bir gözleri açık uyuyan hayvan <u>yunuslardır</u>.

5. Yirmi dört tane diş <u>çocuklarda</u> bulunmaktadır.

2

1. İstanbul 1453'de <u>fethedildi</u>.

2. İskambil kağıtlarındaki kupa ve sinek <u>kırmızıdır</u>.

3. C vitamini <u>domateste</u> bulunur.

4. Bir ünlem cümlesine örnek olarak <u>aman tanrım</u> verilebilir.

5. Jupiter güneşe en yakın <u>gezegendir</u>.

3

1. Rafting <u>akarsuda</u> yapılan bir spordur.

2. 15'şer adet siyah ve beyaz taş <u>satrançta</u> bulunur.

3. Dünya'nın en uzun insanı iki metre doksan cm <u>boyundadır</u>.

4. Fıstık fındıktan daha yağlı bir <u>kuruyemiştir</u>.

5. Roma rakamında C harfi ile <u>100 sayısı</u> gösterilir.

4

1. Bir <u>kilometre</u> bir milden daha uzundur.

2. Tatlı su balıklarından biri de <u>alabalıktır</u>.

3. Bir yıl elli dört hafta <u>sürmektedir</u>.

4. Altı kişilik iki takımla <u>voleybol</u> oynanabilir.

5. Haritada Rusya Çin'e göre <u>daha fazla</u> yer kaplar.

5

1. İsim tamlamasına örnek olarak <u>balın peteği</u> verilebilir.

2. Futbol on iki kişilik iki takımla <u>oynanır</u>.

3. Sigara sağlığa <u>yararlıdır</u>.

4. Doğu Anadolu Bölgesi Malatya'yı da <u>içermektedir</u>.

5. Miyop gözler yakını iyi <u>göremez</u>.

6

1. Kemençe telli bir çalgı <u>türüdür</u>.

2. Mor doğada nadir bulunan <u>renklerdendir</u>.

3. Suriye'nin yönetim şekli <u>cumhuriyettir</u>.

4. Bir karınca kendi ağırlığının 20 katını <u>taşıyabilir</u>.

5. Çorum <u>leblebi</u> ile ünlüdür.

6'LIK SETLER

1

1. Gökkuşağının ortasında bulunan renk yeşildir.

2. 30 gün çeken aylardan biri de Mayıs ayıdır.

3. Bir şişe maden suyu bir kaloridir.

4. Osmanlı Devleti'nin para birimi akçedir.

5. Türkiye'nin en uzun akarsuyu Kızılırmak'tır.

6. Güneş dünyamızdan daha küçüktür.

2

1. Kediler sadece siyah beyaz görebilirler.

2. Elektrik akımı ölçüm birimi volttur.

3. Otizmde zekada gerilik yoktur.

4. Patates asit oranı yüksek bir sebzedir.

5. Bu yıl cumhuriyetin 84. yılını kutluyoruz.

6. Dünya'nın en yoğun nüfuslu ülkesi Hindistan'dır.

3

1. Poyraz sıcak bir rüzgar türüdür.

2. Antalya'nın nüfusu İstanbul'unkinden daha fazladır.

3. A vitamini göz sağlığı için gereklidir.

4. Türkiye Avrupa Konseyi'ne üye olmuştur.

5. Yeşil ve siyah renkler karışırsa kahverengi olur.

6. Toplam 184 ülke dünyada bulunmaktadır.

4

1. Elma asit oranı yüksek olan meyvelerdendir.

2. Kanın pıhtılaşması için kalsiyum gereklidir.

3. 8 kalorilik enerji salatalıkta vardır.

4. Mustafa Kemal Selanik'te doğmuştur.

5. Zebraların siyah üstüne beyaz çizgili derileri vardır.

6. Bursa'nın nüfusu Sivas'ın nüfusundan eksiktir.

5

1. Ankara'nın yüzölçümü Konya'nınkinden büyüktür.

2. Sıfat tamlamasına örnek olarak kapının kolu verilebilir.

3. Kılıçla yapılan sporlardan biri de eskrimdir.

4. Çiçekler kış mevsiminde açar.

5. Pirinç bir tahıl türüdür.

6. 26 tane harf İngilizlerde bulunmaktadır.

6

1. Mimar Sinan Türk soyundan gelmektedir.

2. Peynirde D vitamini bulunur.

3. Beş kişilik iki takımla basketbol oynanabilir.

4. Güneş sisteminde dokuz tane gezegen bulunmaktadır.

5. Malatya kayısı ile ünlüdür.

6. Ege Bölgesi Balıkesir'i de bulundurur.

B. INTERVIEWS

Deney Grubu Görüşme Soruları:

- Ekrandan okuma yapmayı tercih eder misiniz? Neden?
  - Ekrandan okuma yapmak anlamanızı kolaylaştıracak olsa ekrandan okuma yapmayı tercih eder misiniz? Neden?
  - Ekrandan okuma yaptığınızda anlama düzeyinizdeki başarınız artacak olsa yine de kitabı tercih eder misiniz? Neden?
- Tabletler aracılığıyla okuma yaparken web sayfasının tasarımına dikkat ettiniz mi?
  - Siz okuma yaparken ekranı çevirdiğinizde web sayfasının düzeni değişiyordu, bu konuda ne düşünüyorsunuz? Nasıl bir değişim gözlemlediniz?
  - Bu düzen sizin daha rahat okumanıza yardımcı oldu mu? (Nasıl rahat okumanızı sağladı? / Neden rahat okumanızı sağlamadı?)
  - Herhangi bir yorgunluk hissettiniz mi? Neden?
- Okuma sırasında:
  - Ekran ile nasıl etkileşime girdiniz? (Yakınlaşma, aşağı-yukarı hareket etme vb.)
  - Hangi hareketleri yapmak sizi zorladı?
  - Hangi hareketleri yaparken yorulduğunuzu hissettiniz?
  - Hangi hareketler sizin işinize yaradı?

Kontrol Grubu Görüşme Soruları:

- Ekrandan okuma yapmayı tercih eder misiniz?
  - Ekrandan okuma yapmak anlamanızı kolaylaştıracak olsa ekrandan okuma yapmayı tercih eder misiniz? Neden?
  - Ekrandan okuma yaptığınızda anlama düzeyindeki başarınız artacak olsa yine de kitabı tercih eder misiniz? Neden?
- Tabletler aracılığıyla okuma yaparken web sayfasının düzenine dikkat ettiniz mi?
  - Siz okuma yaparken ekranı çevirdiğinizde web sayfasının düzeni değişmiyordu, bu konuda ne düşünüyorsunuz?
  - Bu düzen sizi okuma açısından zorladı mı? (Nasıl rahat okumanızı sağladı? / Neden rahat okumanızı sağlamadı?)
  - Dikkatinizi dağıttı mı?
  - Yorulduğunuzu hissettiniz mi?
- Okuma sırasında:
  - Ekran ile nasıl etkileşime girdiniz? (Yakınlaşma, aşağı-yukarı hareket etme vb.)
  - Hangi hareketleri yapmak sizi zorladı?
  - Hangi hareketleri yaparken yorulduğunuzu hissettiniz?
  - Hangi hareketler sizin işinize yaradı?

C. CONSENT FORM

<div align="center">ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU</div>

Bu araştırma, ODTÜ Yüksek Lisans öğrencilerinden Özge Aytekin tarafından ODTÜ öğretim üyelerinden Prof. Dr. Soner Yıldırım danışmanlığında yürütülmektedir. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Araştırmanın amacı, web sitesi tasarımının tabletlerde arayüz kullanım etkileşimleri üzerindeki etkisini araştırmak ve tabletlerde arayüz kullanım etkileşimleri ile okuduğunu anlama arasındaki bağlantıyı araştırmaktır.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Araştırmaya katılmayı kabul ederseniz, sizden ilk olarak kısa bir çalışmaya katılmanız beklenecektir. Bu çalışmada çalışan bellek kapasitenizi ölçmeye yönelik bir uygulama yapılacak ve ses kaydı alınacaktır. Daha sonra, 5 kişiden oluşan gruplarla bir web sayfası üzerinden metin okuma oturumuna katılmanız beklenmektedir. Yaklaşık olarak 15-20 dakika sürmesi beklenen bu oturumda sizlere bir web sayfası üzerinden tabletler aracılığıyla okuma parçalarının tamamı okutularak gözlem yapılacaktır. Ayrıca, okuma sırasında verilen sesli yönerge ile ekranı çevirmeniz istenecektir. Gözlem sırasında araştırmacılar tarafından süre tutulacak ve not alınacaktır. Ayrıca elektronik ortamda tablet üzerinde yaptığınız etkileşimler arka planda otomatik kayıt edilecektir. Oturum sonunda ise elektronik ortamdaki okuma deneyiminize ve ekran etkileşiminize yönelik sorular yöneltilecektir. Sorulara verilen yanıtlar araştırmacılar tarafından ses kaydına alınacaktır.

Sizden Topladığımız Bilgileri Nasıl Kullanacağız?

Araştırmaya katılımınız tamamen gönüllülük temelinde olmalıdır. Elektronik okuma oturumunda sizden kimlik veya çalıştığınız kurum/bölüm/birim belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak, sadece araştırmacılar tarafından değerlendirilecektir. Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır. Sağladığınız veriler gönüllü katılım formlarında toplanan kimlik bilgileri ile eşleştirilmeyecektir.

Katılımınızla ilgili bilmeniz gerekenler:

Çalışma, genel olarak kişisel rahatsızlık verecek sorular içermemektedir. Ancak, katılım sırasında sorulardan ya da herhangi başka bir nedenden ötürü kendinizi rahatsız hissederseniz cevaplama işini yarıda bırakıp çıkmakta serbestsiniz. Böyle bir durumda çalışmayı uygulayan kişiye, çalışmadan çıkmak istediğinizi söylemeniz yeterli olacaktır.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için ODTÜ öğretim üyelerinden Prof. Dr. Soner Yıldırım (E-posta: soner@metu.edu.tr) ya da yüksek lisans öğrencisi Özge Aytekin (E-posta: 180693@metu.edu.tr) ile iletişim kurabilirsiniz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.
(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad   Tarih   İmza
                              ---/----/-----

D. ETHICS COMMITTEE APPROVAL

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11 ARALIK 2018

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu

(İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof.Dr. Soner YILDIRIM

Danışmanlığını yaptığınız Özge AYTEKİN'in "**Duyarlı ekran tasarımının, öğrenme analitiği verilerinin ve düzeylerinin üzerine etkisinin incelenmesi ve tabletler üzerinde okuma sırasında öğrenme analitiği verilerinin ve düzeylerinin okuduğunu anlama ve bilişsel yük üzerine etkisinin araştırılması**" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2018-EGT-167** protokol numarası ile araştırma yapması onaylanmıştır.

Saygılarımla bilgilerinize sunarım.
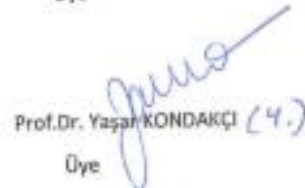
Prof. Dr. Tülin GENÇÖZ

Başkan

Prof. Dr. Ayhan SOL

Üye

Prof.Dr. Yaşar KONDAKÇI (4.)

Üye

Doç. Dr. Emre SELÇUK

Üye

Prof. Dr. Ayhan Gürbüz DEMİR

Üye

Ali Emre TURGUT

Üye

Doç.Dr. Üyesi Pınar KAYGAN

Üye