



Examination of Different Reading Strategies with Eye Tracking Measures in Paragraph Questions*

Paragraf Sorularında Farklı Okuma Stratejilerinin Göz İzleme Metrikleriyle İncelenmesi

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• Received: 10.04.2018 • Accepted: 21.03.2019 • Published: 27.03.2019

Kaynakça Bilgisi: Bayrak Karsli, M., Demirel, T., & Kurşun, E. (2019). Paragraf sorularında farklı okuma stratejilerinin göz izleme metrikleriyle incelenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*. Advance online publication. doi: 10.16986/HUJE.2019051160

Citation Information: Bayrak Karsli, M., Demirel, T., & Kurşun, E. (2019). Examination of different reading strategies with eye tracking measures in paragraph questions. *Hacettepe University Journal of Education*. Advance online publication. doi: 10.16986/HUJE.2019051160

ABSTRACT: This study aims at investigating the effects of two different test-taking strategies on reading achievement, dwell time, fixation counts and number of regressions on area of interests (AOIs) of the multiple choice reading comprehension questions with different type and difficulty levels. In this true experimental study, 28 subjects are randomly assigned into two groups. While subjects in stem first strategy (S-FS) group read the question stem first, subjects in paragraph first strategy group (P-FS) read paragraph first. Results of this study show that dwell time, fixation counts, and number of regressions on question stem AOIs in the S-FS group are significantly higher than the P-FS group. As a result, contrary to the common recommendations in practice, reading the question stem first provides no advantage in terms of reading achievement and dwell time as expected. Moreover, the S-FS significantly increases dwell time, fixation counts, and number of regressions on question stem AOIs.

Keywords: reading comprehension, eye tracking, reading strategies, stem first strategy, paragraph first strategy

ÖZ: Bu çalışmada farklı tür ve zorluklardaki çoktan seçmeli okuduğunu anlama sorularının çözümünde kullanılan iki farklı soru çözme stratejisinin başarı, soru çözme süresi, odaklanma sayısı ve okunulan alana tekrar geri dönme sayısı üzerindeki etkisinin araştırılması amaçlanmıştır. Tam deneysel olarak yürütülen bu çalışmada 28 katılımcı rastgele olarak iki gruba ayrılmıştır. Önce soru kökü stratejisini (Ö-SkS) kullanan grup, soruları önce soru kökünü okuyarak, önce paragraf stratejisini (Ö-PS) kullanan grup ise, soruları önce paragrafı okuyarak çözmüşlerdir. Çalışmadan elde edilen sonuçlara göre Ö-SkS grubunun soru kökü alanında harcadığı süre, odaklanma sayısı ve okunulan alana geri dönme sayısı Ö-PS grubuna göre anlamlı olarak daha fazladır. Sonuç olarak, uygulamada yaygın olarak tavsiye edilen aksine, paragraf sorusu çözerken önce soru kökünün okunmasının başarı ve soru çözme süresi açısından avantaj sağlamadığı gibi, Ö-SkS kullanımının soru kökü alanında harcanan süreyi, odaklanma sayısını ve okunulan alana geri dönme sayısını anlamlı derecede artırdığı ortaya çıkmıştır.

Anahtar Sözcükler: Okuduğunu anlama, göz izleme, okuma stratejileri, önce soru kökü stratejisi, önce paragraf stratejisi

* A part of this study was presented as an oral presentation at 11th International Computer and Instructional Technologies Symposium.

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1. INTRODUCTION

Ali took his place in the class for one of the most important moments of his life, which was university entrance exam. The upcoming questions that he was about to answer had a very important place in shaping his future life. In addition to giving right answers to the questions, he also had to solve them in a short time. Ali had to answer each question in one minute. He was especially afraid of multiple choice reading comprehension questions that were placed in the verbal section of the exam because these were the most time-consuming questions. For this reason, as soon as the exam began, he started to solve these questions. He read the questions according to the strategy which he was often told by his teachers, “first read the question stem”. However, he was not sure about whether this test-taking strategy would work. Would this strategy help him solve the questions more quickly? Or if he had not used this strategy, would he had a same achievement for the questions that he answered? In fact, all of these would be questioned about reading comprehension.

1.1. Reading Comprehension

Reading competency can be defined as understanding, using and reflecting of a written text, and linking to readers’ prior knowledge and let them achieve their reading goal (OECD, 2013). In this scope, reading comprehension is defined as an interpretation procedure in which reader combines his existing knowledge with information resides in a text (Basaran, 2013; Rupley & Blair, 1983; Snow, 2002). In this process, not only pre-existing knowledge of the reader and information in the text but also the social and cultural dynamics have an important role (MoNE, 2015). Reading comprehension is actually a widely used process throughout the life of human being. It plays a critical role in reading a newspaper, trying to understand a mathematics problem or even this article. Just and Carpenter (1980) describes mental and physical processes which take place during reading comprehension process by two assumptions which are immediacy assumption and eye-mind assumption. While the former proposes that mind follows eye, the latter asserts that eye follows mind. Immediacy assumption claims that in the first moment a person encounters a literary context, even having wrong inferences the person tries to interpret these words. During this interpretation process, firstly the words are coded and a meaning which fits the word according to its position in the sentence and the discourse is preferred. Eye-mind assumption, on the other hand, argues that while mental processing of a word is taking place, eye simultaneously fixates on that word. Therefore, the time elapsed for a newly fixated word is directly related to gaze duration. During this process, without doing any regressions (returning to the prior visited area of interests), information gathered from outstanding parts of the text can be also used. According to this assumption, there is no significant lag between fixation and processing.

1.2. Reading Comprehension in Test-Taking

Since test-taking requires students to completely understand what is requested in multiple choice reading comprehension questions, this process involves reading comprehension. These questions may have different goals such as to find the main idea of the paragraph, to make inference about literal content, to determine meaning of a word which is given in a specific context (Powers, n.d.), and to fill in the blank in the paragraph. Therefore, each type of question requires a different analysis on the paragraph. For this reason, multiple choice reading comprehension questions have a vital importance and are widely used in the assessment of reading comprehension of the students. For instance, in higher education entrance exam in Turkey more than half of questions in the section of Turkish language proficiency of the exam consists of multiple choice reading comprehension questions (Dogru Tercihler, 2016).

1.3. Strategy Use in Test-Taking

A number of factors can affect reading comprehension levels of the students and their answering speed. These factors can be attributed to either questions such as subject area and the difficulty level of the question or to students such as reading skills, prior knowledge, short-term memory, working memory and reading strategies (Hannon, 2012; Leeuw, Segers & Verhoeven, 2016; Solaz-Portolés & Sanjosé, 2007). In order to comprehend better, students can develop their own reading strategies or use recommended strategies by their peers and teachers (Basturk & Dogan, 2010; Cohen, 1998; Yesilyurt, 2008). Chou (2013) and Wu (2014) emphasized that students should develop their own strategies and make these strategies work in any reading attempt to achieve their goals. These strategies require learners to plan, monitor and coordinate the input from the text to search for the best way to answer the questions (Chou, 2013). Therefore, it is stated that good readers take the benefit of different reading strategies to be able to understand any text sufficiently (MoNE, 2015; Presley & McCormick, 1995; Pang, 2008).

While answering reading comprehension questions, various strategies are recommended as follows: (1) if the main idea of a paragraph is asked, look at the first or last sentence (Basaran, 2013); (2) to find the right answer, first examine the answer choices (Guler, 2013), (3) delaying answering difficult questions (Mousavi, 1999), (4) to solve the question quickly and correctly, first read the question stem and then read the paragraph (Basaran, 2013; Leone, n.d); and (5) to comprehend the question better, first read the paragraph and then read the question stem (Craven & Jones, n.d.; Killoran, 2016). However, the effectiveness of these strategies is a controversial issue. Thus, this study focuses on the last two strategies which are often recommended in practice. The third strategy will be called “stem first strategy - S-FS” and the fourth will be called “paragraph first strategy - P-FS”. In the literature, there was no terms used for these two strategies. Therefore these terms were coined in the context of this study to be used in literature.

Proponents of S-FS argue that this strategy provides an advantage to the students in terms of achievement and time (Basaran, 2013). One of the basic assumptions of this strategy suggests that students, after understanding the question stem, can consciously read the related paragraph in accordance with a purpose (Magoosh GRE Blog, n.d.). The students may need to read the paragraph again and this situation may cause both time loss and cognitive load (Kolay Turkce, n.d.; Turk Dili ve Edebiyati, 2007). Another claim is that if the question stem is read first, students may easily detect the type of the question. This makes easier for the students to be aware what they are really looking for in the answer choices and the paragraph (Magoosh GRE Blog, n.d.). Kaplan Publishing, a well-known publisher about test-taking strategies, also argues that the question stem should be read first in the multiple choice reading comprehension questions which require logical reasoning. In the examination application guide prepared by Turkish MoNE for the students with visually impaired, it is stated that proctors should read the question stem first in the multiple choice reading comprehension questions (MoNE, n.d.).

P-FS supporters, on the other hand, explain their argument with two justifications. Firstly, reading the paragraph first develops the logical reasoning ability of the students. Since the students focus on the whole paragraph, they can comprehend the paragraph and even guess the question stem before they read it (Craven & Jones, n.d.; Killoran, 2016). The second argument is that because the question stems generally have no extra information about the paragraph, reading the question stem first will provide no advantage. In fact, especially in the question sets that require two questions to be answered in the same paragraph (double-question stimulus) reading the question stem first may lead to confusion and it requires the paragraph to be read again for the second question after the first question is answered (Killoran, 2016).

1.4. Studies of Reading Comprehension and Eye Tracking

137 years ago, Louis Emile Javal discovered that our eyes have no continuous and linear movements along a line of a text, instead, they make rapid movements with short spans (saccades) and short stops (fixations). According to Radach (1998), human eyes do not move randomly over a page of a text but the eyes move in synchrony along with the ideas represented in the sentences to be read. Based on this basic idea, eye-tracking devices give information about where, how long and when users look. Working process of an eye-tracking device is that an infrared light source is directed toward eye and the built in camera records reflection of the light source with the help of a software. Different types of eye-tracking measures are used in research studies. These measures can be classified under three different types, temporal, spatial and count. While fixation duration and total reading time are temporal scale measures, number of regressions, and fixation counts were count scale measures and indices such as fixation sequence and saccade length are categorized under the spatial measure (Lai et al., 2013).

The eye movements which happen during reading may give clues about reading comprehension (Sung, Wu, Chen, & Chang, 2015, p.4). Because of the complex nature of the reading comprehension, precise measurements are needed about reading process (Raney, Campbell & Bovee, 2014, p.1). The traditional methods of reading studies such as recording the reading time (Hyönä & Lorch, 2004, p.135) or counting the mouse clicks (Sung et al., 2015, p.4) offer very limited data about reading comprehension. On the other hand, the measurements acquired by an eye tracking device offer precise and unique data that cannot be obtained via other methods. That is why eye tracking device is widely used in reading comprehension studies (Raney, Campbell & Bovee, 2014, p.1). In the reading comprehension studies, the focused point is generally temporal measures (Lai et al, 2013). Data obtained by these devices can include different levels such as general text, sentence or even word (Lai et al, 2013; Raney, Campbell & Bovee, 2014). In fact, first studies with eye tracking devices were conducted about reading (Huey, 1908, cited in Erdem, 2015) and the data obtained via these devices are valuable for these studies (Rayner, 1998).

Beyond offering precise and unique data, eye tracking devices have also the ability to record the reading process simultaneously and continuously. In eye-tracking studies, different types of data are recorded simultaneously while a reader performs the natural reading process on the screen. The reading process is not influenced since the readers do not deal with any other tasks in the meantime (Hyönä & Lorch, 2004). The data gathered during this process not only offers (interpretation opportunity of the information) such as word frequency, word length, familiar or unfamiliar words and sentence complexity of the text read, but also data may assist to associate the eye movements of the readers to cognitive process (Raney, Campbell & Bovee, 2014, p.1; Sung et al., 2015, p. 4).

Various interpretations about reading comprehension can be made from the measurements obtained from the eye movements during the reading period. Long fixation time may indicate a deep processing at the area of fixation (Rayner, 1998) because the fixation point can be thought as an indicator for which data is being processed at that time (Just & Carpenter, 1976). Also a long fixation time may also denote the difficulty experienced in processing of the information (Just & Carpenter, 1976). Besides, frequent fixations to a particular area may indicate that individuals place an importance on these areas (Poole et al., 2004, cited in Bayazit, 2013). Too many fixation counts that expanded to the screen can be interpreted as the confusion of an individual (Goldberg & Kotval, 1999).

Other measurements in reading comprehension are saccades and regressions. Regressions that may appear as a result of difficulties in processing at the semantic or syntactical level and word recognition or perception problems may be defined as interruption of the reading process (Radach, 1998, p.5). For example, long saccades to the previous sentences in the long texts may

be interpreted as having comprehension difficulties due to the difficulty level of the text (Roberts & Siyanova-Chanturia, 2013). An increase in saccades may indicate experiencing difficulties in comprehension of the text (Bayazit, 2013). Similarly, repetitive saccades and regressions may indicate the difficulty in recognizing an object (Rayner, 1998). Briefly, as a text becomes more difficult or critical, saccade length will decrease, fixation durations and regressions will increase (Rayner, 1998, p.376; Rayner & Castelhana, 2007; Sinatra & Broughton, 2011). Therefore, multiple fixations and regressions to a particular area may become an evidence for the existence of comprehension difficulties (Rayner & Pollatsek, 1989, cited in Erdem, 2015). The unskilled readers with comprehension difficulties make short saccades, long fixations, and increased regressions (Goltz, 1975; Griffin, Walton, & Ives, 1974; Heiman & Ross, 1974; Rubino & Minden, 1973, cited in Erdem, 2015). Shortly, eye tracking data may be interpreted in various ways. While interpreting the data it is important to consider the context in which the data are obtained and to empower this data with additional evidences.

1.5. Aim and Importance of the Study

Exams such as Graduate Record Examinations (GRE), Graduate Management Admission Test (GMAT) in USA, and Academic Personnel and Postgraduate Education Entrance Exam and Higher Education Entrance Exam in Turkey are very important examinations for the steps that the individuals will take in their careers. The achievement in examinations like Programme for International Student Assessment (PISA) that are in the content of international assessment studies of education, is important for both individual and national wide (MoNE, 2015; OECD, 2013). In these examinations, achievement and answering the questions in a short time is directly related to a good level of reading comprehension. Different strategies are used in order to be able to comprehend what is read better and in a shorter time. In this type of examinations, answering the questions in a short time is as important as answering them correctly. It is seen that there are various strategies for answering the multiple choice reading comprehension questions that sometimes may become very time-consuming. The S-FS is one of the most widely used and recommended strategies. However, the impact of this strategy on achievement and time devoted to test-taking is arguable (Craven & Jones, n.d.). The unique arguments of the supporters of both views are explained in detail under the title of strategy use in test-taking. Also most of the studies about reading strategies (Anderson, Bachman, Perkins & Cohen, 1991; Chou, 2013; Cohen, 2010; Kung, 2017; Parhoodeh, Rostamy & Mehry, 2015) in the literature were conducted on second language context, but this study was carried out within first language setting. However, little studies which use eye-tracking technology was situated in the text-based problem solving context. As seen from the following literature, studies which use eye-tracking technology in the context of problem-solving are mostly concentrated in the area of multimedia-based problem solving. Foreexample, Tsai, Hou, Lai, Liu and Yang (2012) examined novice-expert differences of students' visual attention while solving an imagebased multiple-choice science problem. Holsanova, Rahm and Holmqvist (2006) compared results from readers' actual interaction with newspapers. Netzel et al. (2017) investigated effects of visual scanning strategies people apply to perform a route finding task on metro maps. Hegarty, Hegarty, Mayer and Green (1992) et al. have conducted several eye-tracking studies to examine the comprehension process and the strategies for solving mathematics word problems (Hegarty, Mayer, & Green, 1992; Hegarty, Mayer, & Monk, 1995). Canham and Hegarty (2010) explored comprehension of complex graphics (such as weather maps). So, this study will fill a gap by examining the strategy use in text-based problem solving with eye-tracking technology.

Eye tracking method used in this study, on the contrary to the traditional methods, has the ability to gather online, unique, and precise data. In this way, it also enriches the study in a unique way (Djamasbi, 2014; Rayner, 1998). In addition, eye tracking method does not interfere with the natural reading process and it also provides rich information about the cognitive processes of the subjects. Another important contribution of use of eye tracking method to the

study is that; it makes possible to check whether the use of the test-taking strategy the core of the study, is fully and correctly implemented by the subjects. On the other hand, although the studies of eye tracking on reading exist in the literature, it is seen that the studies carried out in the context of the question (Erdem, 2015) are limited. In this context, the aim of this study is to investigate the effects of the use of different strategies (S-FS and P-FS) while answering multiple choice reading comprehension questions with different types and difficulty levels, on the reading achievement, the dwell time, the fixation counts and the number of regressions.

Research Questions

Does the test-taking strategy used while answering to different types of (main idea, supporting idea and paragraph completion) multiple choice reading comprehension questions at different difficulty levels (difficult or easy) have any effects on:

- a the reading achievement,
- b the total time spent (dwell time) on the AOIs (paragraph, question stem and answer choices)
- c fixation counts on the AOIs
- d the number of regressions to the AOIs

2. METHOD

In this study, a randomized posttest-only comparison group design as one of the true experimental designs, was used (McMillan & Schumacher, 2010, p. 276). Subjects were assigned randomly to the experimental (16 subjects) and comparison groups (15 subjects). In order to ensure the equality of the groups, the students' verbal scores in the Higher Education Entrance Exam, were compared by using independent samples t-test. Because, the multiple choice reading comprehension questions used in research context are mostly weighed in verbal score type in the Higher Education Entrance Exam. Independent samples t-test scores show no significant difference between the two groups in terms of verbal scores [$M_1=260.79$, $M_2=257.25$, $t_{(26)}=0.298$, $p>.05$].

2.1. Subjects

Subjects are 31 sophomore students (12 female and 19 male whose ages are between 20 and 24) at the department of Computer Education and Instructional Technologies at a state university in Turkey. All of the subjects' native language is Turkish. They have no problem in their normal or corrected vision. For their participation in the experiment, as a motivation, each of the subjects was given an extra score for a course.

The subjects in the experimental group answered the questions in the material by using the S-FS whereas the subjects in the comparison group answered the same questions by using the P-FS. 15 of the subjects in S-FS group stated that they use S-FS in their daily life whereas 1 subject use P-FS and 13 of the subjects in P-FS group stated that they use S-FS in their daily life whereas 2 subject use P-FS. However, the data of the 3 subjects in S-FS group could not be analyzed after the experiment, due to a recording problem arose in eye tracking device. As a result, S-FS group consisted of 13 subjects whereas P-FS group consisted of 15 subjects.

2.1. Materials

2.1.1. Achievement test

The achievement test involved 12 multiple choice reading comprehension questions which were previously asked in the Turkish Language part of the Higher Education Entrance Exam. The multiple choice reading comprehension questions consisted of 3 basic sections which include a paragraph, a question stem and the answer choices (see Fig. 2). While selecting the

questions to be used, the question types and difficulty levels were taken into consideration in accordance with the aim of the study. In this context, 3 different types of multiple choice reading comprehension questions were used. These were: (a) paragraph completion questions in which a section is left blank in the paragraph and required to be completed with a sentence, (b) main idea questions which require finding the main idea of the paragraph, and (c) supporting idea questions which require finding out the conclusions that can or cannot be reached from the paragraph. In this context, out of 146 multiple choice reading comprehension questions which were previously asked in Higher Education Entrance Exam from 2010 to 2016, 74 questions which were primarily in the types of paragraph completion, main idea and supporting idea questions were chosen by subject matter experts. Then, 10 questions (5 difficult and 5 easy) from each question types, in total 30 questions were randomly selected. Item difficulty index and item discrimination index for each question was defined in order to be able to do a more reliable selection of the questions in respect to their difficulty levels. Items whose item whose item discrimination index is under .19 were throw away. Moreover, the item difficulty index was ranging from 0.26 to 0.86 which was of moderate difficulty (Hopkins, 1988). Therefore, the selected 30 questions were administered to 100 students who took the 2016 Higher Education Entrance Exam and are now freshman students, and then the item difficulty index for each question was calculated. Item difficulty index for difficult questions were from 0 to 0.5 and for easy questions were from 0.5 to 1 (Ozcelik, 1997). After the grouping process, 4 questions (2 difficult and 2 easy) in three question types that have the highest and the lowest item difficulty index, a total of 12 questions were selected to be used in the achievement test. Also, the reliability of the achievement test was calculated using KR-20 formula and it was found .70. In addition to those questions, 1 more question was randomly selected and used as a pilot implementation before the experiment. In this way, the subjects were given the opportunity to gain experience by using the strategy that they are going to use in the experiment and thus to get used to the experiment setup and eye tracking device.

The selected questions were structured in a website as follows: each question was displayed on a different screen, and the next question appears on the screen if the subject gives an answer to the present question. The questions were organized in the reading achievement test according to their types and difficulty levels as it is seen in Figure 1. After this, two different arrangements were formed for the groups by adding an instruction screen at the beginning and a reminder on each of the question screens to indicate whether the subject read paragraph or question stem first (see Figure 2). Each group used the same strategy, assigned prior to experiment, throughout all questions. An example question screen of the reading achievement test is demonstrated in Figure 2.

Question Number	1	2	3	4	5	6	7	8	9	10	11	12
Question Type	Paragraph Completion				The Main Idea of the Paragraph				The Supported Idea of the Paragraph			
(D: Difficult, E: Easy)	E	D	E	D	E	D	E	D	E	D	E	D

Figure 1. Organization structure of the questions in the reading achievement test.

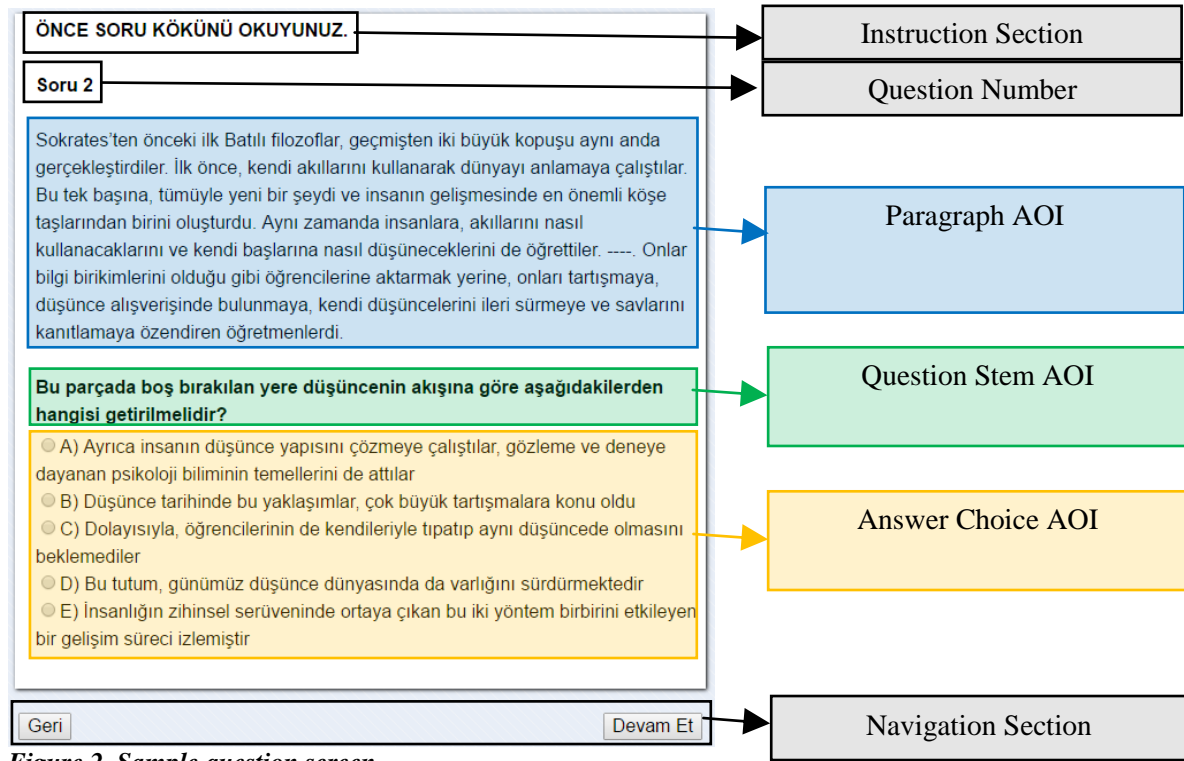


Figure 2. Sample question screen

2.1.2. Informed consent and demographic information form

Each subjects signed in an informed consent form at the beginning of the study. Demographic information form was used to gather data about the strategy that subjects use, the verbal score in Higher Education Entrance Exam, eye calibration values, and observation notes.

2.1.3. Apparatus

In the study, eye movements were recorded with SMI Red250Mobile eye tracking device. The device is a screen-based eye tracker designed for researchers who require both mobility and high sampling rate for studies inside as well as outside the lab. The tool has the ability to take samples about the eye position for once in every 4 milliseconds (250 Hz). Therefore the device is ideal for demanding applied studies like reading and linguistics studies. Subjects do not need to wear any devices when using this device.

2.2. Procedure

All experiments were done by a single researcher in order to remove the effects that may be resulted from different researchers. In addition, experiments were conducted in a soundproof laboratory so that subjects were not affected by the sound. The subjects were taken to the laboratory individually for the experiment. The experiment took approximately 40 minutes for each subject. The researcher read the subject guideline and informed them about the study. At that time, the subjects were allowed to ask any questions to the researcher. (To make the subjects feel relaxed during the experiment, it was emphasized that the aim of the research was not the evaluation of the subjects.) It was stated that there is no time limitation, but it was expected from students to complete answering the questions as soon as they could. It was also emphasized that after applying the strategy (S-FS or P-FS), they were free to read the question by starting from any point they wanted. They were not allowed to go back to a question they have already answered. After the calibration settings were made, the experiment was started with pilot implementation stage. To understand the experiment better, the subjects were allowed to talk to the researcher and asked their questions freely in the pilot implementation stage of the study.

The researcher made sure whether the strategy was correctly applied by simultaneously following the eye movements of the subject from another screen. Eye tracking data were recorded during the entire experiment process.

2.3. The Eye Metrics

During the data analysis, each question was divided into three AOIs (the paragraph, the question stem, and the answer choices) (see Figure 2) and eye metrics (dwell time, total fixation count, and the number of regressions) of these AOIs were included in the study. The frequency of the fixations on a particular AOI in each question was called as fixation counts. Total reading time (dwell time) was calculated as the total time spent on the fixations and saccades on a particular AOI in each question. Number of regression was defined as the number of movements of the eyes back to a previously read or looked AOI in each question (Erdem, 2015; Lai et al., 2013).

2.4. Data Analysis

The reading achievement of the subjects was measured according to their correct answers in achievement test. Data obtained by eye tracking device were analyzed in SMI BeGaze program and taken to IBM SPSS. All data were then analyzed in IBM SPSS. The extreme values were controlled before the analysis and the assumptions about the analyses were tested. As a result of tests of normality, it was found that the data fits a normal distribution and the values of skewness and kurtosis were between +2 and -2 (George & Mallery, 2010). Therefore, independent samples t-test was used for comparison of the groups. The effect size for independent sample t-test results was calculated with Cohen's d.

3. FINDINGS

The results obtained in this study which investigates the effects of different strategies on the reading achievement, dwell time, fixation counts and the number of regressions were organized in accordance with the research question.

3.1. Reading Achievement

Independent samples t-test was applied in order to determine the effects of using the S-FS or the P-FS on reading achievement while answering the multiple choice reading comprehension questions. Table 1 shows descriptive statistics for reading achievement scores for the comparison and the experimental groups.

The result of independent-samples t-test showed no significant difference between the S-FS and P-FS groups in achievement in terms of overall scores (scores for all questions), question difficulty (difficult, easy), and question types (paragraph completion, main idea, and supporting idea).

Table 1. Descriptive Statistics for the effects of using different strategies on reading achievement

Question	Strategy	N	Mean	SD
Overall	S-FS	13	6.08	2.14
	P-FS	15	6.20	1.78
Difficult	S-FS	11	2.09	0.70
	P-FS	15	2.33	1.54
Easy	S-FS	13	3.92	1.19
	P-FS	15	3.87	1.41
Paragraph Completion	S-FS	12	1.25	0.62
	P-FS	15	1.53	0.83
Main Idea	S-FS	13	2.46	0.52
	P-FS	15	2.80	1.01
Supporting Idea	S-FS	13	2.15	1.14
	P-FS	15	1.87	1.25

3.2. Dwell Time

Table 2 shows descriptive statistics for dwell time scores for the comparison and the experimental group. According to independent-samples t-tests, there was no significant difference between the S-FS and P-FS groups in dwell time for paragraph AOIs and answer choice AOIs in terms of overall scores, question difficulty, and question types. However, a statistically significant difference was found between the S-FS and P-FS groups in dwell time for question stem AOIs in terms of overall [$t(25)=3.762$, $p<.05$, $r=0.58$], difficult questions [$t(26)=3.822$, $p<.05$, $r=0.59$], easy questions [$t(26)=2.652$, $p<.05$, $r=0.44$], paragraph completion questions [$t(24)=3.689$, $p<.05$, $r=0.58$], main idea questions [$t(24)=2.729$, $p<.05$, $r=0.47$], and supporting idea questions [$t(26)=3.316$, $p<.05$, $r=0.53$] having higher dwell time in the S-FS group.

Table 2. Descriptive Statistics for the effects of using different strategies on dwell time

Question	AOI	Strategy	N	Mean	SD
Overall	Paragraph	S-FS	13	32491.33	9255.43
		P-FS	15	33629.12	7165.29
	Answer Choice	S-FS	12	15716.13	4572.82
		P-FS	15	17114.82	6254.90
	Question Stem*	S-FS	13	4717.40	1125.40
		P-FS	14	3201.66	966.81
Difficult	Paragraph	S-FS	13	37751.64	11701.25
		P-FS	15	38643.67	8640.36
	Answer Choice	S-FS	13	21512.28	8176.63
		P-FS	15	20762.31	7454.05
	Question Stem*	S-FS	13	4897.46	994.87
		P-FS	14	3297.48	1165.60
Easy	Paragraph	S-FS	13	27231.02	7459.09
		P-FS	15	28614.58	6173.95
	Answer Choice	S-FS	13	12440.82	5093.39
		P-FS	15	13467.34	5448.00
	Question Stem*	S-FS	13	4537.34	1474.74
		P-FS	15	3276.35	1029.65
Paragraph Completion	The Paragraph	S-FS	13	33982.59	8623.44
		P-FS	15	34433.66	8366.97
	The Answer Choice	S-FS	12	17036.05	6118.88
		P-FS	15	18513.22	6358.31
	Question Stem*	S-FS	13	4916.64	1460.68
		P-FS	13	3161.03	900.82
Main Idea	The Paragraph	S-FS	13	29170.12	9056.47
		P-FS	15	31259.01	6863.11
	The Answer Choice	S-FS	13	16293.61	6114.17
		P-FS	15	16284.85	6998.10
	Question Stem*	S-FS	12	4495.10	1036.08
		P-FS	14	3279.72	1207.30
Supporting Idea	The Paragraph	S-FS	13	34321.28	11343.98
		P-FS	15	35194.71	7786.73
	The Answer Choice	S-FS	12	14738.87	3963.88
		P-FS	15	16546.41	6351.54
	Question Stem*	S-FS	13	4442.65	965.80
		P-FS	15	3047.87	1219.97

3.3. Fixation Counts on the AOIs

Table 3 shows descriptive statistics for average fixation counts for the comparison and the experimental group. Independent-samples t-tests results illustrated that there was no significant difference between the S-FS and P-FS groups in fixation counts for paragraph AOIs and answer choice AOIs in terms of overall scores, question difficulty, and question types. However, a statistically significant difference was found between the S-FS and P-FS groups in fixation

counts for question stem AOIs in terms of overall [$t(25)=3.762$, $p<.05$, $r=0.57$], difficult questions [$t(26)= 3.615$, $p<.05$, $r=0.56$], easy questions [$t(26)= 3.615$, $p<.05$, $r=0.50$], paragraph completion questions [$t(26)= 2.275$, $p<.05$, $r=0.39$], main idea questions [$t(26)= 2.29$, $p<.05$, $r=0.39$], and supporting idea questions [$t(26)= 4.817$, $p<.05$, $r=0.67$] having higher fixation counts in the S-FS group.

Table 3. Descriptive Statistics for the effects of using different strategies on fixation counts

Question	AOI	Strategy	N	Mean	SD
Overall	Paragraph	S-FS	13	97.93	26.27
		P-FS	15	101.57	19.94
	Answer Choice	S-FS	13	54.36	15.64
		P-FS	15	56.39	20.77
	Question Stem*	S-FS	13	17.01	3.67
		P-FS	15	12.16	3.24
Difficult	Paragraph	S-FS	13	114.06	33.24
		P-FS	15	118.39	25.08
	Answer Choice	S-FS	13	68.85	21.84
		P-FS	15	68.17	25.16
	Question Stem*	S-FS	13	17.36	3.65
		P-FS	15	12.08	4.02
Easy	Paragraph	S-FS	13	81.79	21.61
		P-FS	15	84.75	16.42
	Answer Choice	S-FS	13	39.87	11.96
		P-FS	15	44.61	18.31
	Question Stem*	S-FS	13	16.67	4.43
		P-FS	15	12.24	2.90
Paragraph Completion	Paragraph	S-FS	12	97.73	20.32
		P-FS	15	106.93	24.38
	Answer Choice	S-FS	12	55.44	16.42
		P-FS	15	60.25	19.07
	Question Stem*	S-FS	13	17.21	5.15
		P-FS	15	13.08	4.46
Main Idea	Paragraph	S-FS	13	86.31	30.29
		P-FS	15	91.80	17.41
	Answer Choice	S-FS	13	52.98	16.64
		P-FS	15	55.07	22.63
	Question Stem*	S-FS	13	17.10	5.02
		P-FS	15	12.72	5.06
Supporting Idea	Paragraph	S-FS	13	103.29	29.08
		P-FS	15	105.98	23.32
	Answer Choice	S-FS	13	50.96	15.06
		P-FS	15	53.85	24.14
	Question Stem*	S-FS	13	16.73	3.09
		P-FS	15	10.68	3.49

3.4. Number of Regressions

Table 4 shows descriptive statistics for number of regressions for the comparison and the experimental group. Independent-samples t-tests showed no significant difference between the S-FS and P-FS groups in number of regressions for paragraph AOIs and answer choice AOIs in terms of overall scores, question difficulty, and question types. However, a statistically significant difference was found between the S-FS and P-FS groups in number of regressions for question stem AOIs in terms of overall [$t(26)=3.501$, $p<.05$, $r=0.54$], difficult questions [$t(26)=3.250$, $p<.05$, $r=0.52$], easy questions [$t(26)=3.160$, $p<.05$, $r=0.50$], paragraph completion questions [$t(18.479)=3.736$, $p<.05$, $r=0.58$], main idea questions [$t(26)=2.357$, $p<.05$, $r=0.40$], and supporting idea questions [$t(25)= 4.085$, $p<.05$, $r=0.61$], having higher regressions in the S-FS group.

Table 4. Descriptive Statistics for the effects of using different strategies on the number of regressions

Question	AOI	Strategy	N	Mean	SD
Overall	Paragraph	S-FS	13	8.68	4.14
		P-FS	14	7.08	2.37
	Answer Choice	S-FS	13	6.35	2.68
		P-FS	15	5.65	2.06
	Question Stem*	S-FS	13	6.88	2.21
		P-FS	15	4.44	1.45
Difficult	Paragraph	S-FS	13	9.64	5.04
		P-FS	13	7.50	2.07
	Answer Choice	S-FS	13	7.74	3.20
		P-FS	15	6.56	2.14
	Question Stem*	S-FS	13	7.07	2.15
		P-FS	15	4.68	1.74
Easy	Paragraph	S-FS	13	7.72	3.41
		P-FS	15	6.47	2.37
	Answer Choice	S-FS	13	4.95	2.39
		P-FS	15	4.78	2.20
	Question Stem*	S-FS	13	6.69	2.59
		P-FS	15	4.20	1.52
Paragraph Completion	Paragraph	S-FS	13	8.38	3.26
		P-FS	15	8.08	2.39
	Answer Choice	S-FS	12	5.29	1.54
		P-FS	15	6.30	1.67
	Question Stem*	S-FS	13	6.37	1.78
		P-FS	14	4.27	0.99
Main Idea	Paragraph	S-FS	12	6.83	3.06
		P-FS	13	5.60	2.21
	Answer Choice	S-FS	13	6.13	3.08
		P-FS	15	4.78	1.71
	Question Stem*	S-FS	13	6.50	2.56
		P-FS	15	4.28	2.41
Supporting Idea	Paragraph	S-FS	12	8.67	3.94
		P-FS	14	7.20	3.22
	Answer Choice	S-FS	13	6.73	2.65
		P-FS	14	5.17	2.67
	Question Stem*	S-FS	13	7.77	3.05
		P-FS	14	4.02	1.53

4. DISCUSSION and RESULTS

The present study should be considered within two limitations. First, besides university entrance exam scores, some other variables such as reading ability scores or short term memory types can be also taken into consideration. Second, existing literature on strategy use in answering the multiple choice reading comprehension questions is generally based on non-academic resources and common recommendations. Therefore, lack of empirical evidence may cause a theoretical limitation for this study (Ozkan & Kaya, 2015).

4.1. Reading Achievement

According to the results of this study, the subjects' reading achievement in the questions with different types and difficulty levels does not differ according to the strategy used. That is, starting to read the paragraph or question stem first did not have any effect on students' reading achievement scores. This result can be explained by the absence of time limitation in the experiment. Therefore, being able to use different strategies after applying the strategy to be assigned may have removed the potential differences. This situation may have decreased the effect of the treatment and caused no significant difference in the reading achievement in terms of the strategies used. Anderson, Bachman, Perkins & Cohen (1991), also found similar result in

their study that the test-taking strategy and the difficulty of the question are not related to the achievement of the students. However, contrary to the present study finding, Hsu (2008) and Mousavi (1999) stated a positive relationship exists between test performance and skills in taking tests. More specifically, Basaran (2013) stated that the S-FS may provide advantage in terms of both the achievement and the time spent on the questions.

4.2. Dwell Time, Fixation Counts and Number of Regressions

The results for the effects of the test-taking strategy on dwell time showed that the total dwell time spent do not differ according to different types and difficulty levels. On the other hand, during the AOI based detailed analysis, the dwell time on the question stem AOI in S-FS group was significantly higher than the P-FS group. In other words, the subjects of the P-FS group, spent significantly less time on the question stem AOI than the subjects of the S-FS group. Similarly, Cerdán, Vidal-Abarca, Martínez, Gilabert & Gil (2009) have concluded that reading the text about the question before solving it had a positive effect on reading comprehension. Especially in difficult questions that require much inference, it is important to read the text of the question (paragraph section) firstly to increase the comprehension of the whole text and make it easy to remember. Otherwise, the text cannot be fully understood since readers have to focus on a specific point while reading the related text.

The time loss in S-FS group has importance in exams in which even milliseconds are valuable. In contrast with the main claim of proponents of S-FS is that this strategy may cause difference in terms of the time spent on the questions rather than the achievement (Basaran, 2013; Craven & Jones, n.d.; Turk Dili ve Edebiyati, 2007), it does not seem to have any favorable effect on dwell time, even it has a negative effect. This result can be explained by the limited capacity of the short-term memory (Kalyuga, Chandler & Sweller, 1999; Senemoglu, 2015; Sweller, 1988). For this reason, the subjects in S-FS group may have forgotten the question stem after reading the paragraph and needed to read it again due to the long period of time spent on the paragraph. In addition to the limited capacity of the short-term memory, the possibility of reading the question stem rapidly at first might make this situation worse. In their study, Sung et al. (2015) stated increased reading speed may cause missing of the important information and as a result, the number of regressions may increase. Similarly, the present study found out that the number of regressions to the question stem AOIs and the fixation counts on these AOIs were significantly higher than P-FS group. Therefore, the claim of Sung et al. (2015) is supported by the present study.

Similar to the results of the dwell time, fixation counts, and number of regressions to the question stem AOIs of the S-FS group were significantly higher than the P-FS group. This result can be explained by the fact that reading the question stem first might increase the cognitive load of subjects (Kalyuga, Chandler, Sweller, 1999; Sweller, Van Merriënboer, & Paas, 1998). For instance, while S-FS subjects were solving a paragraph question, they were required to simultaneously keep the question stem in mind and associate with the paragraph by comprehending it. The rise of cognitive load might cause an increase in the number of regressions (Leeuw, Segers & Verhoeven, 2016) on the question stem AOIs, consequently an increase in fixation counts and dwell time in the same area occur. As stated by Radach (1998), a regression to an area which cannot be comprehended causes new fixations to be done in this area. Therefore, the new fixations naturally cause an increase in dwell time on this area (Rayner, 1998).

Although the subjects in P-FS group were assigned to a test-taking strategy that they were not used to, the results were concluded in the favor of the ones who used the P-FS. As explained in the method section of the study, most of the subjects (87%) in P-FS group use the S-FS in their daily life. Bax and Weir (2012), Erdem (2015), and Nevo (1989) also found that most of the subjects firstly focused on the question stem before reading the paragraph.

As a conclusion, no significant difference was found in terms of reading achievement, overall dwell time, fixation counts, and number of regressions between S-FS and P-FS groups. However, AOI based analysis showed that there were significant differences with regard to the number of regressions, fixation counts and dwell time on question stem AOIs in favor of P-FS group. These differences can be interpreted as successive outcomes of each type of eye tracking measurement. That is, an increase in the number of regressions on the question stem AOIs might cause an increase in fixation counts and consequently a higher dwell time in the same AOI. Although S-FS is a commonly used strategy in practice and most of the subjects in P-FS group are used to using S-FS in their daily life, results are in favor of P-FS. When the results obtained from the study are examined in general, it is seen that the question solving strategies to be proposed to the students should be tested with scientific methods. Test procedures should be done by means of robust data such as eye tracking device.

For further studies, comparisons can be made by grouping the subjects according to their reading styles or their level of reading skills. In other respects, the eye tracking patterns of the subjects who give right and wrong answers can be analyzed. Besides, the eye tracking metrics can be compared by making a distinction according to the importance of the question stems (for the ones that provide extra information other than those given in the paragraph so that the paragraph can be comprehended and the questions can be answered). In addition to these, to minimize the individual differences, the data can be obtained from two groups of equal questions that the same individual answers by using different strategies. Lastly, the effects of the S-FS on answering the questions in the double-question stimulus format (in which more than one question stems exist for a single paragraph) can be studied.

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Genişletilmiş Özet

Yazılı bir metnin okuyucunun bilgisini artırarak okuma hedefine ulaşmasını sağlayacak ölçüde anlaşılması, kullanılması, yansıtılması ve ilişkilendirilmesi okuma becerisi kapsamında ele alınmaktadır. Bu kapsamda ele alınan okuduğunu anlama genellikle okunan bir metni öğrenme veya metinden anlam çıkarma olarak tanımlanabilir. Okuduğunu anlama aslında insanın yaşamı boyunca sıklıkla kullandığı bir süreçtir. Bu makaleyi okurken, gazete okurken ya da bir matematik problemini anlamaya çalışırken okuduğumuzu anlamak kritik öneme sahiptir. Soru çözme süreci de öğrencilerin kendilerinden isteneni tam olarak anlayıp doğru cevap vermelerini gerektirdiği için okuduğunu anlamayı kapsayan bir süreç olarak ele alınabilir. Özellikle paragraf sorusu olarak adlandırılan sorularda öğrencilerin okuduklarını anlamaları, kendilerine yöneltilen soruları cevaplandırabilmeleri açısından oldukça önemlidir. Çünkü bu tür sorularda, öğrencilere kendi içinde anlam bütünlüğü olan bir paragraf sunularak bu paragrafta yönelik farklı türlerde sorular yöneltilmektedir. Bu nedenle paragraf soruları okuduğunu anlamanın ölçülmesinde sıklıkla kullanılmaktadır. Öyle ki Türkiye’de öğrencilerin üniversiteye girmek için katıldıkları Yüksek Öğretime Geçiş Sınavı’nın (YGS) Türkçe testinde yer alan soruların yarısından fazlası paragraf sorusundan oluşmaktadır.

Soru çözme sürecinde öğrencilerin okuduklarını anlama düzeylerini ve bu doğrultuda elde ettikleri başarıyı etkileyen birçok unsurdan söz edilebilir. Bu unsurlar; konu alanı ve zorluk düzeyi gibi çözülen sorulara ilişkin olabileceği gibi okuma becerisi, önbilgi düzeyi, ilgi düzeyi ve soru çözerken kullanılan okuma stratejileri gibi öğrencilere ilişkin unsurlar da olabilir. Bu unsurlardan biri olan soru çözme stratejisi öğrenciler tarafından sıklıkla kullanılmaktadır. Öğrenciler soru çözerken kendilerine özgü stratejiler geliştirerek kullandıkları gibi, gerek öğretmenleri, gerekse akranları tarafından kendilerine önerilen farklı soru çözme stratejilerini de uygulamaktadırlar. Bu stratejilerden biri “Soruyu anla - paragrafı oku- uygun seçeneği bul” stratejisidir. Bu stratejiye göre; çoktan seçmeli paragraf soruları çözülmeye önce soru kökü okunarak soruda istenenin tam ve doğru bir şekilde anlaşılması gerekmektedir. Soruda istenenin anlaşılmasının ardından ise paragrafın okunması ve doğru seçeneğin bulunması şeklinde bir sürecin izlenmesi gerektiği öngörülmektedir. Fakat bu stratejinin etkili olup olmadığı konusunda tartışmalar bulunmaktadır. Bir taraftan paragraf sorularının çözümünde önce soru kökünün okunması gerektiği savunulurken diğer taraftan önce paragrafın okunması gerektiği savunulmaktadır. Bu bağlamda bu çalışmanın amacı; farklı tür ve zorluktaki paragraf sorularının çözümünde başvurulan soru çözme stratejilerinin (önce soru kökü (Ö-SkS), önce paragraf (Ö-PS)) başarı, soru çözme süresi, odaklanma sayısı ve okunulan alana tekrar geri dönme sayısı üzerindeki etkisini araştırmaktır.

Bu çalışmada tam deneysel desenlerden rastgele sınıfta karşılaştırma grupları deseni kullanılmıştır. Örneklemdeki 28 katılımcıdan 13’ü deney grubuna 15’i karşılaştırma grubuna rastgele atanmışlardır. Rastgele atama sonrası oluşan grupların denkliliğini doğrulamak üzere katılımcıların Türkiye’de ortaöğretim öğrencilerinin üniversiteye yerleştirilmesinde kullanılan merkezi bir sınav olan Yükseköğretime Geçiş Sınavı’ndan (YGS) aldıkları YGS sözel puanları bağımsız örneklem t testi ile karşılaştırılmış ve grupların YGS sözel puan ortalamaları açısından gruplar arasında istatistiksel olarak anlamlı bir farklılık olmadığı görülmüştür. Deney grubundaki katılımcılar kendilerine verilen materyalde bulunan soruları önce soru kökünden başlayarak, karşılaştırma grubundaki katılımcılar ise önce paragraftan başlayarak farklı stratejilerle çözmüştür.

Çalışma kapsamında kullanılan uygulama testi, Türkiye’de ortaöğretim öğrencilerinin üniversiteye yerleştirilmesinde kullanılan merkezi bir sınav olan Yükseköğretime Geçiş Sınavı’nda (YGS) çıkmış 12 Türkçe paragraf sorusundan oluşmuştur. Çalışmada kullanılan paragraf sorularının seçiminde araştırmanın amacı doğrultusunda soru türü ve zorluk düzeyi dikkate alınmıştır. Bu kapsamda 3 farklı paragraf sorusu türü kullanılmıştır. Bunlar; (a) paragraf içerisinde bir boşluk bırakılmasıyla boşluğa uygun cümlenin bulunmasını gerektiren paragraf tamamlama sorusu, (b) paragrafta anlatılanların ana fikrinin veya amacının bulunmasını gerektiren paragrafta ana fikir sorusu ve (c) paragrafta anlatılanlar doğrultusunda ulaşılabilecek veya ulaşılamayacak olan farklı anlamların veya yargıların bulunmasını gerektiren paragrafta yan anlam sorusudur.

Çalışmadan elde edilen sonuçlara göre, katılımcıların farklı tür ve zorlukta paragraf sorularındaki başarıları, soru çözme stratejisine göre farklılık göstermemektedir. Uygulanan soru çözme stratejisinin başarı üzerinde etkisinin olmaması farklı şekillerde açıklanabilir. Bu doğrultuda deney sırasında herhangi bir zaman sınırlaması konulmaması ve katılımcıların başlangıçta kendilerine verilen stratejiyi kullandıktan sonra farklı stratejiler kullanabilmeleri, başarı üzerinde ortaya çıkabilecek farkları ortadan kaldırmış

olabilir. Yani katılımcıların yeterli zamana sahip olmaları, kendilerine verilen stratejiyi uyguladıktan sonra süreç içerisinde alışkın oldukları soru çözme stratejilerine dönmelerine neden olmuş olabilir. Bu durum ise müdahalenin etkisini azaltıp, başarı üzerinde stratejilere göre fark çıkmamasına neden olmuş olabilir.

Uygulanan stratejilerin soru çözme süresi üzerindeki etkisine yönelik sonuçlara bakıldığında, katılımcıların farklı tür ve zorluktaki paragraf sorularını toplam soru çözme süreleri, kullanılan soru çözme stratejisine göre farklılık göstermemektedir. Ancak ilgi alanı bazlı yapılan ayrıntılı incelemelerde, soru kökü alanlarında harcanan sürenin Ö-SkS grubunda anlamlı olarak daha fazla olduğu görülmüştür. Yani soruyu çözerken Ö-PS'ni kullanan gruptaki katılımcılar, Ö-SkS'ni kullanarak soruyu çözen gruptaki katılımcılara göre soru kökü alanında anlamlı olarak daha az süre harcamışlardır. Saniyelerin bile önemli olduğu sınavlar için bu farklılık önem arz etmektedir. Önce soru kökü stratejisinin aslında sürekli tavsiye edilenin aksine olumlu bir etkisi olmadığı, hatta olumsuz yönde, toplamda anlamlı olmasa da, soru kökü alanında anlamlı olarak fazla süre harcanmasına neden olduğu görülmektedir.

Soru çözme süresine yönelik sonuca benzer olarak, odaklanma sayısı ve soru kökü ilgi alanına geri dönüş sayısı da yine Ö-PS'ni kullanarak soruları çözen grupta soru kökü ilgi alanında anlamlı olarak daha düşük çıkmıştır. Yani, önce paragrafı okuyarak soruyu çözen grubun, soru kökü ilgi alanındaki odaklanma sayısı ve geri dönüş sayısı anlamlı olarak daha azdır. Bu sonuca göre, soru kökünü önce okumanın, bireyin bilişsel yükünü artırdığı söylenebilir. Çünkü bireyin paragrafı okurken bir taraftan okuduğunu anlamaya çalışması, diğer taraftan önceden okuduğu soru kökünü aklında tutarak okuduğu paragrafla soru kökünde isteneni ilişkilendirmeye çalışması söz konusudur. Bilişsel yükün artmasının ise bireyin soru kökü alanına yapmış olduğu geri dönüşlerini artırmasına, buna bağlı olarak da soru kökü alanındaki odaklanma sayısını ve süresini de anlamlı olarak artırmasına neden olduğu söylenebilir. Sonuç olarak, uygulamada yaygın olarak tavsiye edilenin aksine, soru çözerken önce soru kökünün okunmasının başarı ve soru çözme süresi açısından avantaj sağlamadığı görülmüştür. Bununla birlikte, Ö-SkS'nin kullanımının soru kökü alanında harcanan süreyi, odaklanma sayısını ve okunulan alana geri dönme sayısını anlamlı derecede artırdığı ortaya çıkmıştır. Çalışmadan elde edilen sonuçlar genel olarak incelendiğinde, öğrencilere önerilecek soru çözme stratejilerinin bilimsel yöntemlerle test edilmesi gerektiği görülmektedir. Test prosedürleri göz izleme cihazı gibi güçlü ve güvenilir veriler sağlayan araçlar ile yapılmalıdır.