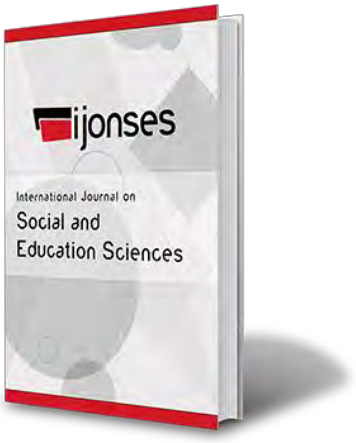

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Determining the Reading Comprehension Levels of Students Who are Braille-Readers on Informative Texts

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Abstract

The purpose of this study was to determine the reading comprehension levels of middle school students who are braille readers in informational texts and to examine whether they differ in terms of certain variables. 23 of the participants were male and 16 were female; 11 of them were attending 6th grade, 18 were attending 7th grade, 10 were attending 8th grade. The data of the study were collected through the 'Reading Comprehension Achievement Test', which was prepared by the researchers and included 24 open-ended questions. The data were analyzed using descriptive statistics analysis and one-way analysis of variance test. The significance level of $p<0.05$ was taken into consideration in the interpretation of the results obtained from the statistical tests conducted in the study. As a result of the study, middle school students who are braille readers needed to improve their reading comprehension performance in informative texts. The study also found that using braille abbreviations had a great effect on reading comprehension. Findings showed that the reading comprehension levels of male and female students who read braille were similar to each other and the reading comprehension levels of students who read braille were similar to each other regardless of their grade level.

Introduction

As a prerequisite for academic skills (Begeny & Silber, 2006; Pikulski & Chard, 2005) reading is a process that consists of the development of two basic skills: analyzing written or printed symbols within the framework of certain rules and making sense of these symbols (Güzel-Özmen, 2011). Reading comprehension, on the other hand, is a skill that enables students to read a text, interact with it and make sense of it (Honig, Diamond, Cole & Gutlohn, 2008). In other words, we can define reading comprehension as 'the process of making sense of written texts based on a series of information sources in a complex coordination' (Mastropieri & Struggs, 1997).

Competent readers not only read a text but also create meaning through interactions with the text (Durkin, 1993). There is a continuous interaction between the reader and what they read. Competent readers continuously construct and reconstruct meaning while reading. However, competent readers activate their prior knowledge before reading. They follow the strategies used while reading the text as well as during reading, and they realize reading comprehension by including strategies after reading. These strategies are automatically activated in

competent readers. However, some students may not have these strategies, which is an important problem in reading comprehension (Johnson, Graham & Harris, 1997; Pressley, Johnson, Symons, McGoldrick & Kurita, 1989). For this reason, it is very important to teach strategies that support reading comprehension, which is an important component that affects school success, to these students.

The literature has identified many factors affecting reading comprehension. Tompkins (2009) lists these factors as the reader's prior knowledge and experiences and vocabulary, reading fluency, use of comprehension strategies, affective factors such as motivation and text-related features. At this point, we can mention two main elements that come to the fore. These are the characteristics related to the reader and the text read. The literature lists the factors related to the reader as reading accurately and fluently, the reader's knowledge of text structure, the harmony between the content of the text and the reader's prior knowledge, and the use of cognitive and metacognitive strategies (Sanford, 2015). The factors related to the text are text type, whether the text is structured or not, the subject of the text and the written language (Güzel-Özmen, 2011).

As the basic material of comprehension and expression skills (Kurnaz & Akaydın, 2015), text can be defined as printed materials that students are asked to read. Texts can be of different types and structures. There are different classifications about text types in the literature. However, Turkish Language Teaching Programs (MoNE, 2018) mention three types of texts: story-type texts, informative texts and poetry-type texts. Informative texts, which are the subject of this study, are texts created to provide information on a determined subject (Güzel-Özmen, 2011). In addition, we observe that informative texts are the texts in Science, Social Studies and Life Science books, criticism articles, articles, news in newspapers and magazines, letters, columns and interviews. According to Klein (1988), expository texts have a stronger logical structure than narrative or poetry texts and the characters in expository texts are non-fictional.

Informative texts, which constitute the main source of school and out-of-school learning (Armbruster, Anderson & Ostertag, 1987), are texts that students encounter especially from middle school onwards and use as a means of understanding and expression throughout their lives. Informational texts, can also be considered as texts that students encounter more frequently on the internet and scientific journals with technological developments (Müldür & Şimşek, 2020). Therefore, students learn a lot of new information through informational texts and apply it in their lives. Since informational texts contain different concepts and information, it is difficult for the reader to read and understand them. The literature has conducted studies on the level of comprehension of different types of texts. For example, Rasool and Royer (1986) evaluated the reading comprehension performance of 44 who are at third grade students. The researchers evaluated the comprehension performances of the students on four different texts, two of which were stories and two of which were informational texts, using the sentence verification technique. The results of the study showed that students were more successful in story-type texts than in informational texts. Demirel (1996), in his study with 166 sixth grade students, found that students' level of learning informational text types and their reading comprehension levels changed in parallel.

The literature has paid little attention to the cognitive processes involved in braille reading. However, braille is still the most basic written communication tool for students who cannot use vision as the primary sense in

educational activities and instead need tactile and auditory materials. Yet braille has a number of unique characteristics compared to visual script (Carreiras & Alvarez, 1999). The braille alphabet, invented by Louis Braille in the 1800s, uses various combinations of six dots to create numbers, letters and symbols (Kway, Salleh, & Majid, 2010). In other words, the braille system consists of different combinations of six raised dots (Kwon, Lee, & Lee, 2009; Ren, Liu, Lin, Wang, & Zhang, 2008; Tai, Cheng, Verma, & Zhai, 2010; Yeh & Liang, 2007; Yeh, Tsay, & Liang, 2008). The six dots are in the form of a rectangle formed by two dots from left to right and three dots from top to bottom. In order to make it easier to describe the characters, the embossed dots are named as 1st, 2nd, 3rd dots from left to bottom and 4th, 5th, 6th dots from right to bottom. It is possible to create 63 different characters from six dots. In the Braille writing system, some of the letters, numbers and symbols are obtained by embossing a single dot, some two, some three, some four, some five and some six dots (MoNE, 2013).

An abbreviation system was developed to facilitate braille reading, save space and increase reading speed. There are five groups of abbreviations in the braille system. These are (a) one-letter abbreviations, (b) two-letter abbreviations, (c) syllable abbreviations, (d) word root abbreviations, (e) word part abbreviations (MoNE, 2013). In one-letter abbreviations, except for the letter 'o', 28 letters are used as abbreviations for the most frequently used words. Therefore, there are 28 one-letter abbreviations in total. For example; 'v-very, m-more, l-later'. Two-letter abbreviations are formed by taking the first two consonants of frequently used words. There are 87 abbreviations in total and examples of this group are 'bd-body, bc-because, sm-some, mr-more'. The other abbreviation group, syllable abbreviation, was obtained by abbreviating frequently used syllables with certain symbols. Examples of this abbreviation group, of which there are 22 in total, are 'ba, be, one, bu, da'. Word root abbreviations were obtained by placing a fifth dot at the beginning of letters and syllables. '5k-know, 5k-keep, 5s-start' can be given as an example to this group, which has 46 in total. The last abbreviation group is word part abbreviations. Word part abbreviations are formed by abbreviating various parts of words in our language using certain symbols. The letters of our alphabet and the syllable abbreviation symbols were chosen as symbols. These symbols were created by placing 4-5 points or 5-6 points of the hexadecimal set at the beginning.

The literature provides different information about space saving, which is one of the reasons for the development of braille abbreviation system. For example, Kederis, Siems and Hayes (1965) stated in their study that the braille abbreviation system provided 31% space saving, but they said that they made these calculations without taking into account the gaps. Durre (1996), on the other hand, reported a space saving of 1/5 with abbreviated braille. It can be said that different results have been obtained in studies on reading speed, which is another reason for the development of the abbreviation system. For example, Kasapoğlu (2014) reported that students' reading speed was better in abbreviated texts, while Wetzel and Knowlton (2006) reported that there was no significant difference between reading speed in abbreviated and unabridged texts. In addition, Kasapoğlu (2014) examined the effect of braille abbreviations on the reading comprehension performance of braille readers and found that the reading comprehension performance of braille readers was better in unabridged texts. However, this study was conducted with story-type texts, and there is no research on the effect of using braille with or without abbreviations on reading comprehension levels in comprehending informational texts.

Looking at the factors affecting braille reading performance, we can list age of onset of disability, educational

background, tactile sensitivity, cognitive perception mechanisms, and perceptual characteristics (Legge, Madison, Vaughn, Cheong, & Miller, 2008; Veispak, Boets, & Ghesquière, 2012; Veispak, Boets, Männamaa, & Ghesquière, 2012). Again, many researchers in the literature have investigated the effect of braille reading models (reading aloud and silent reading) (Laroche, Boule, & Wittich, 2012; Papadimitriou & Argyropoulos, 2017; Wetzel & Knowlton, 2000; Wright, Wormsley, & Kamei-Hannan, 2009) and braille reading styles (one-handed and two-handed) (Mousty & Bertelson, 1992; Papadimitriou & Argyropoulos, 2017) on braille reading performance. Studies in the literature show that two-handed reading is more effective in reading speed than one-handed reading (Millar, 1997; Mousty & Bertelson, 1992; Wright, Wormsley & Kamei-Hannan, 2009).

Braille reading performance is mainly based on reading speed and reading comprehension (Daneman, 1988; Mohammed & Omar, 2011). Studies show that the reading speed of students who read braille is considerably lower than their sighted peers (Ferrell, Mason, Young, & Cooney, 2006; Simon & Huertas, 1998). While the experts in the literature can be said to be relatively unanimous about the slower reading speed of braille students, there is still a debate in the literature about reading comprehension.

The literature review reveals that there are a limited number of studies examining the reading comprehension performance of students who read braille. For example, Carreiras and Alvarez (1999) investigated reading comprehension processes and found that they were similar to the reading comprehension processes of sighted readers. Kasapoğlu (2014) investigated the effect of reading texts with or without abbreviations on reading comprehension performance on informative text and reported that all students gave more correct answers to comprehension questions in unabridged texts than in abridged texts. In the literature, there are also studies comparing the reading comprehension performance of braille readers with sighted students. For example, Douglas, Grimley, Hill, Long, and Tobin (2002) reported that the reading comprehension performance of braille readers was significantly lower than that of sighted students, while Papastergiou and Pappas (2019) found that the reading comprehension performance of braille readers was better than that of sighted students.

As it shown in the literature, it becomes evident that the question of whether students' reading comprehension performance differs according to gender has also been discussed. When looking at studies conducted with sighted students, it is apparent that many of them suggest that female students exhibit better reading comprehension performance than male students (Ceran, Yıldız & Özdemir, 2015; Çiftçi & Temizyürek, 2008). Conversely, other studies by Eze (2006) and Uroko (2011) indicated that gender has no direct effect on reading comprehension. A study involving braille-reader students yielded the finding that there was no significant difference in comprehension performance between male and female students.

An examination of the literature reveals that research on both braille reading speed and reading comprehension is rather limited. Especially with the technological developments in recent years, braille reading skill has been put into the background (Bickford & Falco, 2012). One of the main reasons for this is the speed of access to information. However, the cost of developing braille materials, difficulties in transportation, and the limited availability of documents prepared in braille format can also be cited among these reasons. For example, screen reading programs play an important facilitating role in the access to information by individuals with visual

impairment. However, it is known that such applications do not replace reading skills (Gote, Kulkarni, Jha & Gupta, 2020).

Blind individuals may need braille reading skills in leisure time activities as well as fulfilling their academic and professional duties (Aslan, Doğuş & Şafak, 2022). Therefore, braille reading will continue to assume the role of a written communication tool that individuals with visual impairment will use both in their academic and daily lives (Koenig & Holbrook, 2000). Considering this there is a need for more studies on braille reading skills in order to contribute to the literature. This study aimed to determine the reading comprehension levels of middle school students who read braille in informational texts and to examine the differences in terms of various variables. For this purpose, our study sought answers to the following questions.

1. What are the reading comprehension levels of middle school students who read braille in informational texts?
2. Do the reading comprehension levels of students who use and do not use braille abbreviations differ?
3. Do the reading comprehension levels of middle school students who read braille in informational texts differ according to gender?
4. Do the reading comprehension levels of middle school students who read braille texts differ according to grade level?

Method

This study employed a quantitative method with a descriptive approach. Descriptive research can be considered a quantitative method design as it collects measurable data for statistical analysis of a sample from a population.

Participants

The participant group of the study consisted of 39 students who are braille readers. All of these students attend a middle school for the visually impaired. Criterion sampling method was used to determine the participant group. Therefore, certain criteria were sought when determining the participant group. These criteria include that the student reads braille and does not have any disability other than visual impairment.

In order to identify the participants, firstly, schools for the visually impaired were visited and information about students who read braille was obtained. A list of students was created in line with the information received. The Turkish teachers of the students on the list of 54 students were interviewed and informed about the purpose of the study. In line with the information received from the teachers, 3 students who were at the beginning level of braille reading performance were not included in the study.

In addition, 6 students did not want to participate in the study and although they stated that they would participate in the study, 6 students could not participate in the study because they were not at school during the data collection period. Therefore, 39 students who read braille participated in the study. Information about these students is presented in Table 1 below.

Table 1. Demographic Information of Participants

Gender	6th Grade	7th Grade	8th Grade	Total
Female	4	7	5	16
Male	7	11	5	23
Total	11	18	10	39

Table 1 shows that 23 of the participants were male and 16 were female. In addition, we observe that 11 of the participants attended Grade 6, 18 attended Grade 7 and 10 attended Grade 8. Therefore, we see that the number of male students is higher than the number of female students and the number of 7th grade students is higher than the other grades

Setting

Data were collected at the schools where the students attended. Data were collected from three different schools in total, so the data collection process was carried out in three different environments. The first environment was the counselor's room on the third floor of the school. In this room, there is a closet, a bookcase, four chairs and a table. The second environment was the assistant principal's room on the ground floor of the school. This room has a total of three guest chairs and a table, a bookcase, two cupboards, a table and 4 chairs. The last environment is the classroom on the first floor. The classroom has six student desks arranged in a U-shape, four cupboards, a teacher's table and chair.

Data Collection Tool

The data of the study were collected through the 'Reading Comprehension Achievement Test' developed by the authors of the study. Certain steps were followed while developing the Reading Comprehension Achievement Test. In this context, firstly, the social and science teachers of the schools attended by the participants were interviewed and the publishing houses they followed in their lessons were learned. The 6th, 7th and 8th grade science and social studies textbooks of the publishing house that the teachers did not use in the lessons were examined and a list of texts that did not refer to visuals was created.

The 21 texts in the list were read and re-examined one by one by the researcher. After the review, 2 texts were removed from the list because they referred to graphs and tables. The readability level of the remaining 19 texts was calculated. The readability level was calculated with the formula developed by Ateşman (1997). The syllable length and sentence length were found by counting the syllables and words of each text separately, and the readability levels of the texts were calculated by writing the values in the relevant places.

The formula was:

Syllable length (X1): Total Number of Syllables

Sentence length (X2): 100/ Total Number of Sentence

Readability formula = 198.825- (40,175.X1 – 2.610.X2).

As a result of the calculation, 9 texts that were found to be of medium difficulty were sent to 3 Turkish language field experts for expert opinion. The experts were asked to evaluate the texts holistically in terms of quality according to 6 items: organization, word choice, sentence structure, grammar rules, coherence and cohesion of the text (Graham & Perrin, 2007) and to evaluate the suitability of the content for the 6th, 7th and 8th grade level according to 3 items: style, ideas in the text and conceptual density (Yalçın & Altunay, 2021). The experts scored the texts between 1 and 5 points. The 2 informative texts with the highest scores according to the expert ratings were used in the study.

After determining the informative texts to be used in data collection, the process of creating comprehension questions began. The researchers read each text in detail and prepared a total of 40 open-ended question pool based on textual knowledge and inferences from the 2 texts. Then, the questions were sent to 2 Turkish language experts and 1 Measurement and Evaluation expert for expert opinion.

The experts were asked to score the questions between 1 and 5 points according to the 'Question Evaluation Form'. The forms received from the experts were examined and the suggestions written by the experts in the explanation section of the form were fulfilled and expert opinion was sought again. Distinctiveness of the items vary above .30 contains 24 items and the reliability coefficient has been found 0.79. This value has exceeded the suggested threshold (Nunnally, 1978). Difficulty indicates of the items has been found between .26 and .81.

Data Collection Process

The data collection process was conducted by the first author of the study. Before collecting the data, the researcher identified the students who read with and without full abbreviations by interviewing their Turkish teachers. Both texts, both with and without full abbreviations, were printed on a braille printer. The braille printer may print the dots incorrectly when printing text. For this reason, the researcher read the texts printed with and without abbreviations and identified some errors. For this reason, the researcher reprinted the texts and had the texts read again by a university student with visual impairment who reads braille. After correcting the errors identified by the student, the researcher re-examined the texts and finalized the braille texts.

The researcher went to the school where the students were located and determined the most appropriate time for each student with the vice principal. The day and time determined separately for each student were notified to the students by the researcher. During the data collection process, the researcher guided the student to the data collection environment at the designated time.

Before starting the data collection process, the environment was described to the student audibly. Then, the researcher sat opposite the student and placed the tools to be used in the data collection process (the first text to be used in data collection, the Reading Comprehension Achievement Test and the voice recorder) on the table. She gave the relevant text to the student according to the student's preference for reading with or without braille abbreviation. Then, she asked the student to examine the text quickly and said, "Yes, now we are going to do the study I told you about, so I want you to read the text I am going to give you aloud once. After completing the

reading, I will ask you questions about the text you read. When you are ready, you can start." She asked, "Are you ready?" and the student said, "I am ready" and started reading.

After the reading process, the teacher said 'Yes, we have completed our reading, now I will ask you questions about this text, listen to me carefully, if you want me to read the question again, tell me and I can read it again. If you are ready, let's start with the first question and when the student said 'I am ready', she made the data collection tool and voice recorder ready and asked the first question. After the student answered the first question, she asked the other questions. After the data collection process for the first text was completed, a ten-minute break was taken and the next text was started. The student read the text and then the researcher asked the questions. After the second text was completed, the student was acknowledged and thanked. The same process was repeated with all participants

Assessing Scores

There are 24 open-ended questions in the Reading Comprehension Achievement Test administered to the participants. Each question was scored as 10 points. The highest score to be obtained from the total test is 240 and the lowest score is 0. The participants' expressing the answer to the question as it was written in the text or with their own sentences was accepted as the correct response and scored 10 points, while their silence to the question, answers related to the text but not related to the question were accepted as incorrect responses and scored 0 points. In questions with more than one item, scoring was made according to the items the participant said. For example, in questions with 5 items, if the participant counted 2 items, it was scored as 4 points.

Validity and Reliability

The study collected both inter-observer reliability and implementation reliability data. Inter-observer reliability data were collected by an academic working in the field of special education. The observer was given a half-hour training on how to score the data and then the audio recording file containing the responses of 12 students and the 'Interobserver Reliability Form' were shared with the observer. The form consists of questions, answers to the questions, scoring and explanation columns.

The observer listened to the audio recording of each student's response and scored them. The researcher analyzed the forms received from the observer and calculated the percentage of responses that agreed with the observer. Inter-observer reliability data was calculated by dividing the total agreement between more than one observer by the sum of the agreement and disagreement and multiplying by 100 (House, House & Campbell, 1981) and the inter-observer reliability data of the study was determined as 98%.

The implementation reliability data was collected by an expert in the field of special education. The expert was interviewed before starting the data collection process, the purpose of the research was explained and a schedule was created to follow 12 of the participants. The expert used the 'Implementation Reliability Data Collection Form' while collecting the implementation reliability data. The form consists of columns consisting of each step

to be followed by the researcher in the data collection process and yes or no boxes to be marked by the expert. The expert came with the researcher to the setting where the data would be collected and followed the researcher and marked on the form whether the researcher followed the specified steps or not. Implementation reliability was calculated by dividing the observed practitioner behavior by the planned practitioner behavior and taking the percentage (Billingsley, White & Munson, 1980) and was found to be 100%.

Data Analysis

The study aimed to determine the reading comprehension levels of middle school students who read braille in informational texts and to examine the differences in terms of various variables. In line with this main purpose, two different informative texts and a test consisting of a total of 24 open-ended questions prepared for these texts were applied to 39 students in the study. For the first research question, descriptive statistics were used for the total scores of the students. Independent samples t-test was used for the use of braille abbreviations by students who read braille texts and the difference according to gender, while one-way analysis of variance (ANOVA) test was used for the difference according to grade level. The significance level of $p<0.05$ was taken into consideration in the interpretation of the results obtained from the statistical tests conducted in the study.

Results and Discussion

In line with the aim of the study, firstly, descriptive statistics of reading comprehension scores were calculated to determine the reading comprehension levels of middle school students who read braille texts in informational texts and are given in Table 2. As seen in Table 2, the lowest score of braille students in the Reading Comprehension Achievement Test consisting of 24 open-ended questions about two texts was 50, the highest score was 230 and the average score was X= 125.03.

Table 2. Descriptive Statistics of Reading Comprehension Levels of Braille Reader Students

N	Min.	Max.	$\bar{X}$	SD	$Z_{skewness}$	$Z_{kurtosis}$
39	50.00	230	125.03	50.70	0.81	-1.34

The second question of the study examined whether students' reading comprehension levels in informational texts differed according to their use of braille abbreviations. The distribution of the scores according to the abbreviation usage status was examined and it was found that the scores of both groups showed a normal distribution. Accordingly, independent samples t-test, one of the parametric tests, was used for the difference between these two groups and the findings are given in Table 3.

Table 3 shows that the reading comprehension levels of students who read braille text according to their use of braille abbreviations are statistically significant ($t=7.75$; $p < 0.05$; $d = 0.62$). Accordingly, results showed that students who used braille abbreviations (X=159.64) had higher reading comprehension levels than students who did not use braille abbreviations (X=80.24). Examining the effect size calculated for the practical significance of this difference, we see that it has a major effect. In other words, we can say that the use of braille abbreviations

has a great effect on the reading comprehension performance of middle school students in informational texts.

Table 3. Independent Samples t-test Results for the Comparison of the Use and Non-use of Braille Abbreviations by Students Who Read Braille

Variable	Abbreviation Use	N	$\bar{X}$	Sd	t	*p*	D
Braille Abbreviation	Abbreviated	22	159.64	37	7.75	0.000*	0.62
	Non-Abbreviated	17	80.24				

The third research question of the study examined whether there was a significant difference in the reading comprehension levels of braille students in informational texts according to gender. The distribution of the scores according to gender was examined and it was found that the scores of both groups showed a normal distribution. Accordingly, independent samples t-test, one of the parametric tests, was used for the difference between these two groups and the findings are given in Table 4.

Examining Table 4, we see that there is no statistically significant difference in the reading comprehension levels of students who read braille according to gender ($t_{37} = 1.21$; $p > 0.05$). Accordingly, we can say that the reading comprehension levels of male and female students who read braille are similar to each other.

Table 4. Independent Samples t-test Results for the Comparison of Students Who Read Braille by Gender

Variable	Gender	N	$\bar{X}$	Sd	t	*P*
Gender	Male	23	116.87	37	1.21	0.233
	Female	16	136.75			

*Note: * p < 0,05*

The fourth question of the study examined whether there was a significant difference in the reading comprehension performance of students who read braille according to their grade level. The distribution of the scores according to the grade level was examined and it was found that the scores of all three grades were normally distributed. Accordingly, ANOVA test, one of the parametric tests, was used for the difference between these three groups and the findings are given in Table 5. Examining Table 5, we see that there is no statistically significant difference in the reading comprehension performance of students who read braille according to their grade level ($F_{2\text{-}36} = 0.56$; $p > 0.05$). In other words, regardless of the grade level, the reading comprehension levels of students who read braille are similar to each other.

Table 5. ANOVA Results for the Comparison of Students Who Read Braille by Grade Level

Variable	Grade	N	$\bar{X}$	Sd	F	P	Difference (Bonferroni)
Grade	6^{th} Grade	11	115.55	2-36	0.56	0.576	No difference
	7^{th} Grade	18	123.17				
	8^{th} Grade	10	138.80				

The findings of this study, which examined the reading comprehension performance of braille reading middle school students in informational texts, revealed that the reading comprehension performance of the students (n=39) was X= 125.03. As a matter of fact, we observe that the lowest score the students received from the Reading Comprehension Achievement Test was 50 and the highest score was 230. Considering the obtained score across participants, the result can be interpreted as indicating that reading comprehension practices need to be implemented for students.

The process of reading braille materials and making sense of them is a complex process. Especially touching each unit letter by letter, syllable by syllable, combining them and attributing meanings to them slows down the decoding process. Each touch is necessary for reading (Simon & Huertas 1998). Therefore, this situation negatively affects the reading speed (Swenson, 2013). As a result, reading comprehension performances may be affected. As a matter of fact, fluent reading is seen among the important factors for reading comprehension in the literature (Özmen, 2005). In addition to this, experts in the literature suggest that among the factors that negatively affect the reading comprehension performance of braille readers, students' inability to access the visual clues used in the texts and their lack of background knowledge (Swenson, 2013). Similar situations were effective in the moderate performance of the students participating in this study.

One of the reasons for the moderate reading comprehension performance of braille readers may be the students' limited interaction with reading materials. While sighted individuals are frequently exposed to reading materials in their daily lives, braille readers may not have access to reading materials except for their educational purposes. For example, while a sighted individual has the opportunity to read an announcement posted at the bus stop while waiting for a bus, an individual with visual impairment is likely not to take advantage of this opportunity even if the announcement is written in braille. Such reasons cause braille readers to exhibit their reading skills less in daily life.

Assuming that reading practice is also effective in reading comprehension, it is not surprising that the reading comprehension performance of braille readers is at a moderate level. Similarly, while sighted students can access the books they want at school and in the library in braille format, students with visual impairment have very limited access to resources prepared in braille format (Altunay Arslantekin, 2012; Yalçın & Altunay, 2021). It can be said that this situation causes them to exhibit reading skills less.

Developing and changing technology has accelerated and continues to accelerate the process of access to information for many individuals with special needs, especially individuals with visual impairment. In particular, many individuals with visual impairment can access the resources they want by using screen reading programs developed with audio support and learn by listening to the content through screen reading programs (Yalçın & Altunay, 2021). Although technological developments offer different opportunities for students to access information, this situation causes students with visual impairment to interact less with texts prepared in braille format. Therefore, many students exhibit braille reading skills less by utilizing such applications. This situation is thought to affect students' reading comprehension performance.

On the other hand, the process of accessing the content of a text with screen reading programs takes place through the act of listening. Many individuals with visual impairment use these programs. Although there is a relationship between listening comprehension and reading comprehension skills in the literature (Hagtvet, 2003; Hedrick & Cunningham, 1995; Hirai, 1999; Wise, Sevcik, Morris, Lovett & Wolf, 2007) both skills involve different processes (Aranyanak, 2014). Reading skill is a visual activity, while listening skill is an ear activity (Emiroğlu & Pınar, 2013). Therefore, eyes focus on words during reading and ears focus on words during listening. Braille reading can be expressed as a finger activity. Therefore, this action can be seen as tiring for students who read braille; as a result, it causes them to perform fewer reading actions and may affect their reading comprehension performance.

The other finding obtained from the study is that the reading comprehension levels of students who read braille are different according to their use of braille abbreviations. As a matter of fact, similar findings were obtained in a limited number of studies in the literature. Kasapoğlu (2014) investigated whether there was a difference between the reading speed and reading comprehension levels of students who read braille texts prepared with and without abbreviations. The results of the study showed that students gave more correct answers to comprehension questions in texts without abbreviations (66.8%) than in texts with abbreviations (60%). Although we did not measure reading speed in the current study, it would not be wrong to associate this situation with reading speed. Therefore, future studies can be designed to consider the effects of the variable of reading speed on reading comprehension.

Another finding of the study is that the reading comprehension levels of students who are braille readers, according to gender, are not statistically significant. We can interpret this finding as indicating that the reading comprehension performance of all students, regardless of whether they are male or female, is similar. An examination of the studies conducted with sighted students in the literature shows that different results were obtained. For example, Çiftçi and Temizyürek (2008) reported that female students were more successful in reading comprehension than male students; similarly, Ceran, Yıldız, and Özdemir (2015) reported that female students were more successful in reading comprehension achievement tests than male students. A restricted number of studies were reviewed, investigating the comprehension skills of braille readers based on the gender variable. In a study involving university students (Udo & Udonna, 2013), it was discovered that reading comprehension performance did not exhibit any differences. Hence, when focusing specifically on braille, these results corroborate the findings of the current study.

The study examined whether students' reading comprehension performances differed according to grade level. The findings show that the reading comprehension levels of braille students according to grade level are not statistically significant. This can be interpreted as that the reading comprehension levels of students who read braille are similar to each other regardless of their grade level. On the other hand, this finding is an important indicator that braille students need reading comprehension instruction regardless of their grade level.

Braille reading speed is thought to affect reading comprehension skills. For this reason, starting from the primary school level, it is necessary to support intensive reading until braille symbols and rules become automatic. The

study recommends the preparation of different types of texts suitable for the grade levels of students who read braille and the preparation and delivery of braille books that they can read in their free time. In addition, evidence-based strategies and techniques should be taught to braille students to increase their reading speed. In a study conducted in the literature (Coşkun Çetinpolat, 2006), the differential effect of reading the text silently beforehand and listening to a friend reading the text on reading fluency was investigated and it was concluded that both methods increased reading speed. This finding shows that the reading speed of students who read braille can be increased with systematic interventions.

It is known that braille literacy is declining worldwide (Ranalli, 2008). Although there are many reasons for this (use of technological tools, difficulty in accessing braille documents), the use of braille is the only way that students with total visual impairment can perform the act of reading and writing. In our country, braille literacy skills are taught in schools for the visually impaired. However, it is known that there are difficulties in teaching braille to students attending inclusive classes who need braille instruction. There are many reasons for this (e.g., teachers' lack of braille literacy). However, it is a necessity to provide literacy skills to every student regardless of his/her disability. Therefore, with support services such as mobile teachers, teachers who know braille literacy can help target students acquire braille literacy skills.

Many strategies and techniques that have proven to be effective in teaching reading comprehension have been used in recent years (e.g., cognitive strategies, Self-Regulation Strategies Development Approach). Reading comprehension strategies should also be taught to students who read braille. As a matter of fact, in a study conducted in our country (Yalçın, 2020), the effectiveness of the Adapted Multilevel Cognitive Strategy in increasing the listening comprehension and summarization performances of braille reading students was investigated. The study investigated whether the students were able to generalize the strategies they learned to their reading comprehension skills and as a result of the study, it was seen that there were significant increases in reading comprehension post-test scores. Therefore, it is recommended that students be taught strategy use in the classroom environment.

Conclusion

Many strategies and techniques that have proven to be effective in teaching reading comprehension have been used in recent years (e.g., cognitive strategies, Self-Regulation Strategies Development Approach). Reading comprehension strategies should also be taught to students who read braille. As a matter of fact, in a study conducted in our country (Yalçın, 2020), the effectiveness of the Adapted Multilevel Cognitive Strategy in increasing the listening comprehension and summarization performances of braille reading students was investigated. The study investigated whether the students were able to generalize the strategies they learned to their reading comprehension skills and as a result of the study, it was seen that there were significant increases in reading comprehension post-test scores. Therefore, it is recommended that students be taught strategy use in the classroom environment.

Future studies can be designed with a larger number of participants. Expanding the participant pool can enhance

the external validity of the research, making it more applicable to a broader population. Hence, the text used can vary in terms of complexity and source across different types of texts. It allows researchers to investigate how different levels of text complexity affect cognitive processes, learning outcomes, or other dependent variables of interest.

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