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A Comparison of the Reading Performance of Students with Low Vision and Sighted Peers *

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Abstract

Visual limitations can negatively affect academic achievement. Prior research conducted in international contexts revealed that the reading performance of students with low vision is poorer than that of their sighted peers. No study has compared the reading performance of Turkish students with low vision with that of their peers. Language features are among the factors that affect reading comprehension and development. In this context, it is necessary to determine whether there is a difference in the reading skills of Turkish students with low vision compared with their sighted peers. This study aimed to compare the reading skills (reading comprehension, reading rate, types of reading error, and total reading error percentages) of 3rd-, 4th-, and 5th-grade students with low vision and normally sighted students according to their grade levels and to examine whether the reading skills of both groups differed as they moved on to the next grade. A causal-comparative research model was applied to compare the reading skills of the two groups, and a correlational model was used to determine whether reading skills differed according to grade level. The participants were 3rd-, 4th-, and 5th-grade students from eight different cities studying at general education primary and secondary schools (n=87) and students with low vision (n=78) studying at primary and secondary schools for the visually impaired. The reading performance of students with low vision and normally sighted students was assessed using the Nonformal Reading Inventory developed by Karasu (2011). The reading rate of students with low vision was found to be low at all grade levels, and their total reading errors were high compared to normally sighted students. Regarding reading comprehension and types of reading error, different findings were obtained depending on grade level. As students moved to the next grade, their reading comprehension levels increased. When normal-sighted students moved to the next grade, their reading rates increased gradually. The findings are discussed in light of the related literature. Suggestions for further research and implementation are provided.

Keywords

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Introduction

Education stakeholders emphasise the necessity of integrating the skills and competencies that guide 21st-century education policy and practice into current research and applications. Numerous proposals have been made on how to outline the combinations of skills and competencies that students should acquire within the education system (Kuzminov, Sorokin, & Froumin, 2019). When examining educational policies across different nations, educators, parents, and civil society organisations have emphasised the need to integrate the competencies that are vital for students to be successful across various domains of their lives. These competencies include academic skills such as reading, writing, mathematical operations, problem solving, and independent living skills. Within this context, visually impaired students must acquire these competencies to become self-assured, independent, and active members of the workforce (Wolffe et al., 2002). According to a study conducted by the American Foundation for the Blind (2018), sight is a crucial aspect of the learning process, and current education systems are heavily reliant on visual input. This paper underscores the significance of employing suitable tools and equipment, and offering essential modifications to visually impaired individuals to alleviate the constraints of their limited vision. Additionally, the authors recommend the provision of educational opportunities by proficient personnel capable of accommodating the specific requirements of visually impaired students. In other words, this paper highlights the importance of recognising individualised adaptations and tailored educational settings for visually impaired students based on their unique needs.

Behavioural optometry, which emphasises the importance of effectively utilising an individual's current vision to positively impact visually related behaviours such as reading and writing, as well as the development of visual skills throughout an individual's life, also leads to interventions designed to improve visual skills (Harris, 2007). Maples (2003), a researcher in the field of behavioural optometry, investigated the differential effects of ethnicity, socioeconomic status, and visual limitations on academic achievement in a descriptive study conducted with elementary school students in the United States. Although the researcher found the effects of ethnicity and socio-economic status on academic achievement to be significant, he revealed that the greatest impact on academic achievement came from visual limitations. This study is important in the field of education for the visually impaired because it revealed the risk factors related to visual ability and emphasised the necessity and importance of medical and educational interventions. However, in behavioural optometry studies, the effect of limitations in visual ability on academic skills, especially reading skills, has not yet been clearly explained (Harris, 2007; Maples, 2003).

Reading is a fundamental skill that one acquires during school (Doğanay-Bilgi & Güzel-Özmen, 2013; Güzel, 1998). Reading skills, which are used throughout life from the beginning of the early school process, not only positively affect success in the school process, but also directly or indirectly affect students' adaptation skills in life (Karasu, 2011). Reading is a fundamental life skill critical for effective participation in both society and the workplace (Jerrim & Moss, 2019). Reading is an important skill not limited to children. Reading skills also appear to be a predictor of and prerequisite for skills that individuals are expected to possess in adulthood (National Center for Educational Statistics, 2002). In this context, reading is one of the most basic skills that helps visually impaired students to live independently and maintain their professional lives in adulthood, similar to other special needs groups.

Visually impaired individuals with a heterogeneous structure are a subgroup of the umbrella term 'low vision', which refers to individuals who have a certain degree of visual function that limits their normal visual activities despite using standard or traditional optical correction devices (Recep, Erdoğan, & Hasıripi, 2008). Students with low vision differ depending on their functional vision, socioeconomic variables, cultural and social backgrounds, age at onset of visual impairment, presence of additional disabilities, and cognitive abilities (Gürsel, 2012). Research has shown that the reading speed of students with low vision is slower than their sighted peers (Douglas, Grimley, Hill, Long, & Tobin, 2002), and their reading performance falls behind their sighted peers as the grade level advances (Douglas et al., 2002; Douglas, Grimley, McLinden, & Watson, 2004). Previous studies have also shown that students with low vision have limited reading performance compared to their sighted peers (Corley & Pring, 1993a, 1993b, 1993c, 1993d; Fellenius, 1999; Gompel, van Bon, Schreuder, & Adriaanseti, 2002; Tobin, 1985; van Bon, Adriaansen, Gompel, & Kouwenberg, 2000). Discussions in the literature suggest that the poorer reading performance of students with low vision may be due to their limited interactions with printed materials compared to their sighted peers (Fellenius, 1996). Another view suggests that their limited reading performance is associated with negative learning experiences compared to their sighted peers (Koenen, Bosman, & Gompel, 2000). Gompel, Janssen, Schreuder, and van Bon (2003) reported that limited sensory input due to limitations in the visual senses of students with low vision is considered the main factor that negatively affects their reading ability, which also has a physiological aspect. This negative effect results in students with low vision experiencing difficulties in reading, decreased motivation to read, and ultimately, very limited reading experiences (Gompel et al., 2003).

Low-level functioning in reading skills among students with low vision can occur across all reading dimensions. Indeed, Douglas et al. (2002) compared the reading performance (accuracy, comprehension, and speed) of students with low vision with that of sighted students using the Neale Analysis of Reading Ability, a standardised reading skills test. The study revealed that students with low vision had significantly lower reading accuracy, comprehension, and speed than sighted students. The study also found that the level of difference in reading skills between students with low vision and their sighted peers increased significantly, severely, and linearly from the age of 6 to 16. In light of these findings, the importance of revealing the current situation regarding the reading skills of students with low vision and planning appropriate educational arrangements is clear. Although descriptive studies have focused on the reading performance of students with low vision (Corley & Pring, 1993a, 1993b; Fellenius, 1999; Gompel et al., 2002; Tobin, 1985; van Bon et al., 2000), no descriptive studies have compared the reading speeds, reading errors, and reading comprehension of students with low vision with their sighted peers in Turkey. Language characteristics have been identified as factors affecting the acquisition and development of reading skills (Öney & Durgunoğlu, 1997). Turkish has a transparent orthography and letter–sound relationship. This positively affects the learning process of reading skills and fluent reading. In this context, describing the reading performance results of Turkish students with low vision will contribute to the literature both in Turkey and abroad. Additionally, the research findings are expected to guide the necessary measures for teaching reading skills to students with low vision. In conclusion, this study aimed to compare the reading performance (comprehension, speed, types of reading error, and total percentages of reading errors) of 3rd-, 4th-, and 5th-grade students with low vision with those of their sighted peers and to determine whether the reading skills of visually impaired and sighted students differ according to grade level in schools for the visually impaired.

Method

Research Design

A causal-comparative research design (Gay, Mills, & Airasian, 2011) was utilised to compare the reading skills of sighted and low-vision groups, and a correlational research design (Creswell, 2008) was used to determine whether reading skills differed according to grade level.

Population and Sample

The study population consisted of students with low vision attending 3rd, 4th, and 5th grades in Turkey. Two stages were followed to select the samples. First, a stratified sampling method, a purposeful sampling method, was used to obtain students who represented the population. For this, 8 provinces with schools for the blind were identified from 12 provinces all over the state, and the schools in these provinces were listed. Criterion sampling was used in line with the purpose of the research and applied to students in the selected schools. At this stage, students with low vision who met the prerequisites set by the researchers were selected.

To provide a comparison point for the results of students with low vision, a selection based on criterion sampling was conducted to select sighted students. To keep the variables constant, the schools for sighted students were selected from the same region of the province of the schools for the blind.

The sample consisted of 87 sighted students and 78 students with low vision studying in the 3rd, 4th, and 5th grades in 8 different provinces. The selection criteria for students with low vision included a) being a Turkish print reader, b) not having additional disabilities, and c) having literacy skills. The selection criteria for sighted children were (a) no disability and (b) literacy skills. To reach participants with low vision, the researchers contacted the administrators of 12 visually impaired primary and secondary schools in Turkey. The researchers asked the administrators whether they wanted to participate in the research. The researchers were informed of the number of 3rd-, 4th-, and 5th-grade students with low vision enrolled in primary and secondary schools for the blind. Based on the information obtained, students with low vision who agreed to participate in the research process were selected from eight provinces and nine schools for visually impaired students. The first researcher visited the schools to inform the 3rd-, 4th-, and 5th-grade teachers about the purpose of the research and asked for a list of students with low vision, those who could read printed materials, and those who did not have any additional disabilities. All students who met the criteria according to the teacher's report and were allowed to participate in the study by their parents were included. In addition, student assessments were obtained for each participating student before data collection.

To identify sighted students, the researchers requested lists of schools located in middle socioeconomic regions from the National Education Directorates. They randomly chose a school and one class for each grade level. Among the students who met the criteria from the selected class, sighted students were randomly selected, as many as the number of students with low vision in that city. Even if the number of students with low vision in a city was less than three at each grade level, it was arranged so that the number of sighted students studying at that grade level was not less than three. Consent was gained from the sighted students and their parents. The first researcher interviewed classroom teachers and parents of students with low vision, as well as sighted students, and obtained information about the students' demographic information, educational background, and degree of vision through information forms. Table 1 presents information on the provinces and schools reached and the number of students with low vision and sighted students. Letters are used instead of school names.

Table 1. Cities and Schools of the Participants

		Students with low vision		Sighted students	
Province	**Grade level**	**School name**	**N**	**School name**	**N**
Ankara	3	A Primary School for the Visually Impaired	1	B Primary School	3
	4	A Primary School for the Visually Impaired	4	B Primary School	4
	5	A Secondary School for the Visually Impaired	1	C Secondary School	3
İstanbul	3	D Primary School for the Visually Impaired	3	E Primary School	3
	4	D Primary School for the Visually Impaired	3	E Primary School	3
	5	D Secondary School for the Visually Impaired	2	F Secondary School	3
Konya	3	G Primary School for the Visually Impaired	1	H Primary School	3
	4	G Primary School for the Visually Impaired	1	H Primary School	3
	5	G Secondary School for the Visually Impaired	3	I Secondary School	3
Adana	3	J Primary School for the Visually Impaired	3	K Primary School	3
	4	J Primary School for the Visually Impaired	3	K Primary School	3
	5	J Secondary School for the Visually Impaired	5	L Secondary School	5
Kahramanmaraş	3	M Primary School for the Visually Impaired	3	N Primary School	3
	4	M Primary School for the Visually Impaired	2	N Primary School	3
	5	M Secondary School for the Visually Impaired	4	O Secondary School	4
Gaziantep	3	P Primary School for the Visually Impaired	6	Q Primary School	6
	4	P Primary School for the Visually Impaired	7	Q Primary School	7
	5	P Secondary School for the Visually Impaired	6	R Secondary School	6
Diyarbakır	3	S Primary School for the Visually Impaired	6	T Primary School	6
	4	S Primary School for the Visually Impaired	5	T Primary School U Öğretmen	5
	5	S Secondary School for the Visually Impaired	6	Mehmet Sabri Güzel Secondary School	6
Şanlıurfa	3	V Primary School for the Visually Impaired Primary	3	X Primary School	3
	4	V Haliliye Primary School for the Visually Impaired	-	-	-
	5	W Haliliye Secondary School for the Visually Impaired	-	-	-
Total number of students with low vision			78	Total number of sighted students	87

Table 2 presents the distribution of the students by grade.

Table 2. Distribution of Students by Grade Level

Grade	**Low Vision (n=78)**		**Sighted(n=88)**	
	Number of Participants (n)	**Percentage (%)**	**Number of Participants (n)**	**Percentage (%)**
3. Grade	26	33,3	30	34,1
4. Grade	25	32,1	28	31,8
5. Grade	27	34,6	30	34,1

Table 3 presents data on the reading materials of students with low vision.

Table 3. Reading Tools of Students with Low Vision

	Enlarged Print	Braille and Enlarged Print
3rd grade	11	15
4th grade	11	14
5th grade	10	17

Data Collection Tools

Third-, 4th-, and 5th-grade stories in A and B forms from the Informal Reading Inventory (FOOE), reading comprehension questions, and question-answer forms prepared according to the stories were used in data collection. In addition, a reading error type frequency form, total reading error evaluation form, reading error percentage form that occurred in the whole text, and a reading rate chart were used.

Stories

Stories from the FOOE developed by Karasu (2011) were used. There were two stories on forms A and B suitable for every grade level, including 8th grade, starting from preschool. Table 4 displays the readability levels of the stories used within the scope of the FOOE.

Table 4. Readability Levels for the Stories Used within the Scope of the FOOE

Level	Form	Title of Story	Word count	Number of T-unit	Average length of T-units	Number of Sentences	Clause Index	Number of Different Words	Word Difference Score
3. grade	A	Ömer and the Dove	174	26	6.69	53	2.03	118	6.32
	B	The Kitten	173	26	6.65	54	2.07	119	6.39
4. grade	A	İpek in the Jungle	235	32	7.34	71	2.21	168	7.75
	B	Arda on Vacation	236	32	7.37	71	2.21	168	7.73
5. grade	A	The flood	287	36	7.97	92	2.55	209	8.72
	B	The fire	287	36	7.97	92	2.55	207	8.64

Question-Answer Forms

Questions prepared for the stories in the FOOE included question types such as implicit text, explicit text, and knowledge experience. According to Marschark and Wauters (2008), comprehension questions in the form of explicit text are questions whose answers are directly in the text, while those in the form of implicit text are questions in which students should make inferences based on the text. In addition, knowledge/experience-type questions are defined as questions that students need to answer using their past life experiences and knowledge. Table 5 presents the type and number of reading comprehension questions of the 3rd-, 4th-, and 5th-grade stories resulting from the validity study. A question-answer form was used to record answers to the reading comprehension questions. This form was for the researchers and included a space in which questions and answers could be written (Karasu, 2011).

Reading Error Type Frequency Form

The researchers developed this form to record the types and numbers of reading errors. This was based on Davenport's (2002) classification of reading errors. The aim was to record the number of errors made by the students for each type of error (addition, omission, substitution, pause, partial, repeated, and complicated).

Total Reading Error Evaluation Form

The researchers developed this form to determine the total number of reading errors made by students. This form was based on Davenport's (2002) classification of reading errors. It included addition, omission, substitution, pause, and partial error types to prevent the repetition of reading errors because it aimed at recording the total reading errors.

Table 5. Number and Type of Questions Used in the Stories

	Types of questions			
Grade level	**Text implicit**	**Text explicit**	**Knowledge-Experience**	**Total**
3. grade	4	4	2	10
4. grade	4	4	2	10
5. grade	4	4	2	10

Data Collection

The data were collected by the first researcher, who asked parents and teachers to fill out the information forms for the demographic and educational information of the students in the study group. The researcher assessed the reading performances of students with low and normal vision in two separate sessions. The assessments were conducted either in a well-lit class isolated from noise, including a table and two chairs, or in individual study rooms. In the first session, the researcher assessed reading comprehension and reading rate through the story on form A, whereas in the second session, the researcher used the story on the form to assess reading rate. A tape recorder was used to record student reading performance.

In the first session, the researcher first instructed them to read the story in front of them out loud. While the student was reading the story out loud, the researcher noted reading errors on his copy. When the student finished reading, the researcher said, 'Now, read the story in front of you silently.' After asking the students reading comprehension questions, he wrote down the students' answers on the question-answer form. After the first session, he took a 10-min break and began the second session. In the second session, students were given the story on form B and instructed to read it in front of them out loud with their best reading. When the students began reading, the researcher started the stopwatch, and ended the assessment at the end of the first minute.

Reading adaptations were made for students with low vision. These adaptations were made to the font, size, and inline. Based on the visual acuity research results of Çakmak, Karakoç, Şafak, and Kan (2014), Comic Sans was used as the font. To determine the font size of the stories to be read, story sections were prepared in 16, 18, 20, 24, and 28 font sizes with 1.5 line spacing. The stories were derived from Turkish textbooks appropriate for the grade level. To avoid the potential effects of reading repetitions of different stories for each font size at each grade level, we eliminated the effects of repeated reading. A section that did not impair the integrity of the stories was prepared based on the size of the aforementioned font, which did not exceed one page. During story selection, the researchers focused on the fact that topics were suitable for the students' relevant age and grade levels and could attract the attention of both male and female students. Before starting to assess students with low vision, the researcher asked the students to read stories written in various font sizes and decided on the appropriate font size by assessing the students' interaction with the paper on which the text was written (e.g. bringing the paper very close to the eyes so that there was no distance between the eyes and the paper), their reading fluency, and the general difficulty. To determine the appropriate line spacing, the researcher instructed the students to read the story parts in the order of 1.5 and 2 line spacing, written

in a font size suitable for them; thus, he decided the appropriate line spacing. This process was applied to each student before assessment. Within the scope of the information obtained from the information form given to the teachers, the researcher allowed students to use the visual aids they used during reading. Apart from these material adaptations, in accordance with the individual needs of the students, spatial arrangements were made regarding the position of the table and chair in the room and the lighting conditions (daylight, room lamp, or reading lamp), considering student preferences and teachers' opinions.

To organise the stories to be read by sighted students, the 3rd-, 4th-, and 5th-grade Turkish textbooks published by the Ministry of National Education and other publishers were examined. The font size was 14 for 3rd-grade students but 12 for 4th- and 5th-grade students. The Comic Sans font which was chosen for students with low vision was also used for sighted students.

In the second session, the reading rate was assessed using the story on form B. Shinn's (1989) reading rate assessment process was applied to determine students' reading rates. The researcher had two copies of the text to be used in assessing the reading rate and placed one copy in front of the student and the other in front of himself. The researcher instructed them to 'Read the story in front of you aloud with your best reading.' When the student began to read the first word, the researcher started a stopwatch. If the student lingered on a word for more than three seconds, the researcher uttered the word instead. When skipping a word, the researcher warned the student and asked them to continue on the same line. The researcher marked the words (which the student misread, skipped, or had read to them instead) on the text in front of him, which he used to assess the reading rate. The researcher marked the last word that the student had read in his/her text at the end of one minute and allowed the student to finish the text. The entire process was recorded with a tape recorder. The results were recorded on a reading rate record chart.

Scoring the Data

Scoring Reading Errors Data

Two different data points were scored for reading errors. First, to determine the student's error type, the number of additions, subtractions, substitutions, regressions, pauses, partial errors, and repeated and complicated errors that the students made in the text were noted on the reading error-type frequency form based on Davenport's (2002) classification. Examples of Turkish errors are presented in Table 6. Second, to identify the total number of students' reading errors, Davenport's (2002) classification of reading error types was used as the basis, and the Total Reading Error Evaluation Form was used. Repeated and complicated errors were not considered while calculating the total number of errors. To calculate the percentage of total errors, the number of student errors was divided by the number of words found in the story that the student read, multiplied by a hundred. In Table 6, some reading errors are given in Turkish for clarity (for example, suffixes).

Scoring Reading Comprehension Data

Reading comprehension was assessed out of 100 points based on the FOOE score using 10 questions (each question was scored out of 10 points). Each story included 10 comprehension questions. Considering text-explicit questions, if the student's answer and the answer in the text were the same, or their meanings were the same, the student earned full points. However, if the student gave half the answer or a half-right answer, five points were scored. If the majority of the answer was wrong or contained only one word of information in the text, the student earned two points. Regarding the scoring of text implicit questions, if the correct answer consisted of four or more events or information, the student's knowledge of all or one of the correct answers was scored with full points; if they said half of the correct answers, they were given five points. The student's identification of only one of the correct answers was scored as two points.

Text-implicit questions may not provide standard answers. Therefore, if the student's answer covered the information units in the text, it was given full points; if the student could not provide a direct and clear explanation, the answer was scored five points. Even if an answer was related to the text, it was not scored if it was unrelated to the question. For answers to knowledge- and experience-related questions, full points were given if the student could combine the event or information in the text with their own knowledge. If the answer was unrelated to the text, no points were awarded. No score reduction was incurred if the error did not change the meaning.

Error percentage in total was calculated that the number of errors made by the student divided by the number of words in the story read by the student and multiplied by one hundred. Within the scope of the research, Table 6 presents some examples of reading errors by students with low vision.

Table 6. Example Error Types

Error Types	Examples of Error Types
Addition	When he went down, he ***suddenly*** heard a sound. (word addition)
	Okullar kapamış***tı.*** (affix addition) (no English equivalent)
Omission	What are you doing here ***alone***? (word omission)
	He was ***getting*** impatient to show this photo to his parents. (affix omission)
Substitutions*	…. fotoğraf makinesini alarak gezmeye başladı***mış.*** (affix addition) (no English equivalent)
	.... you can get lost in the forest ***there***. (word substitution).
Regression	…. the weather was getting ***getting*** warmer. (word repetition)
Pause	…. Uncle Mehmet got out of (***5 seconds pause***) breath.
Partial error *	Aşağı ***iner***—ininice bir ses duydu. (no English equivalent)
Complicated error	That morning, ***again*** (word addition) while his mother and (word omission) father were asleep, İpek woke up early again. (Multiple errors in the sentence).
Repeated error	Yavru ***yarvu*** güvercin… (the case of the error in the same sound that occurs in the whole story) (no English equivalent)

Scoring Reading Rate

The correct number of words read by the student per minute was considered for the reading rate assessment. The reading rate was calculated by subtracting the number of misread words from the total number of words read by the student per minute. When the student read a word incorrectly, the words that the researcher read in place of the student and the words that the student skipped without vocalisation were scored as 'false'. If the student misread a word but corrected it within three seconds, it was accepted as correct. If the student added words, it was not evaluated as true or false and was not considered in the scoring process (Shinn, 1989).

Inter-Observer Reliability

Interobserver reliability was calculated for 20% of the data randomly selected for each variable, including each group (students with low vision and normal sight). The observer was a research assistant who was a specialised postgraduate student. The observer took two hour to score. The second researcher then independently rated the data that were not included in the 20%. When a consistency of 80% or above was achieved between the observers for all variables, the trained observer was asked to score the audio recordings. Inter-observer reliability was calculated after the observer completed the scoring (House, House, & Campbell, 1981). Among students with low vision, the reliability was 92.4% for reading rate, 86.2% for reading comprehension, 85.3% for addition, 86.4% for omission, 85.7% for substitution, 86.3% for regression, 87.7% for complicated error types, and 86.7% for total reading errors. Among the sighted students, the reliability was 94.1% for reading rate, 85.1% for reading comprehension, 88.3% for addition, 81.7% for omission, 86.6% for substitution, 88.3% for regression, 84.2% for complicated error types, and 87.9% for total reading errors.

Procedural Fidelity

Implementation reliability helps examine whether the researcher performed the procedures as planned during the assessment. The researcher's behaviour during the assessment was noted separately for the first and second assessment sessions and turned into a checklist; then, an assessment reliability form was prepared. After selecting the assessment samples from the first, middle, and last sessions of both groups, 10% of the audio recordings were given to a research assistant, who was also a postgraduate student in special education. The procedural fidelity estimate was calculated as observed practitioner behaviour/planned practitioner behaviour × 100 (Billingsley, White, & Munson, 1980). For students with low vision, the average value was 99.49% (95.45–100%) in the first session and 100% in the second session. Regarding the sighted students, it was 98.66% (88.2–100%) in the first session and 100% in the second session.

Data Analysis

To compare the reading skills of both groups according to grade level, the assumption of normality was investigated for the reading performance of students with low vision and normal sight. These results indicated that the assumption of normality was not met. Therefore, the Mann-Whitney U test was conducted. To examine the effect of the grade level of students with low vision on their reading performance, the assumption of normality was tested. Because the assumption of normality was not met, the Kruskal–Wallis test was used.

Results

The results included defining the reading performance of both groups, investigating the differences between them, and evaluating their performance according to their grade level.

1. Descriptive Statistics of Reading Performance

Descriptive statistics of reading performance are presented in Table 7.

Table 7. Descriptive statistics of reading performance

		Low Vision		Sighted	
	Grade	**n**	**Median (Min-Max)**	**n**	**Median (Min-Max)**
Reading Rate	3.Grade	26	26.5 (9-98)	30	82 (44-147)
	4.Grade	25	31 (11-117)	28	107 (47-127)
	5.Grade	27	49 (22-143)	30	120 (79-156)
Reading Comprehension	3.Grade	26	67.5 (35-90)	30	78 (38-93)
	4.Grade	25	80 (40-95)	28	85.5 (38-98)
	5.Grade	27	83 (45-100)	30	87 (70-100)
Types of Reading Error					
Addition	3.Grade	26	0.76 (0-2.27)	30	0.76 (0-1.07)
	4.Grade	25	0.65 (0-2.35)	28	0.65 (0-1.30)
	5.Grade	27	0.83 (0-1.32)	30	0.59 (0-1.45)
Omission	3.Grade	26	0.76 (0-1.70)	30	0.76 (0-1.86)
	4.Grade	25	0.92 (0-2.61)	28	0.55 (0-1.46)
	5.Grade	27	0.59 (0-1.67)	30	0.30 (0-1.32)
Substitution	3.Grade	26	1.31 (0-3.39)	30	0.76 (0-1.31)
	4.Grade	25	0.92 (0-2.61)	28	0 (0-1.96)
	5.Grade	27	1.02 (0-1.77)	30	0.59 (0-1.32)
Regression	3.Grade	26	1.87 (0-3.16)	30	1.00 (0-2.65)
	4.Grade	25	1.73 (0-3.46)	28	1.00 (0-2.00)
	5.Grade	27	2.00 (1-2.83)	30	1.21 (0-2.65)
Pause	3.Grade	26	0 (0-1.73)	30	0 (0-0)
	4.Grade	25	0 (0-2.00)	28	0 (0-4,36)
	5.Grade	27	0.5 (0-1.73)	30	0 (0-1.00)
Complicated Error	3.Grade	26	0 (0-15.09)	30	0 (0-7.55)
	4.Grade	25	0 (0-5.63)	28	0 (0-5.63)
	5.Grade	27	1 (0-7.61)	30	0 (0-2.17)
Total Reading Error	3.Grade	26	2.21 (0-3.94)	30	1.31 (0-2.27)
	4.Grade	25	1.30 (0,65-4.38)	28	1.13 (0-3.97)
	5.Grade	27	1.45 (0-2.77)	30	0.83 (0-2.21)

Min=Minimum, Maks=Maksimum

Table 7 includes the median values for reading rate, reading comprehension, types of reading error; the total reading error levels of students with low vision and sighted students; and the lowest and highest values.

2. Difference between Students with Low Vision and Sighted Students in Terms of Reading Performance Levels

Table 8 shows the relationships between students with low vision and sighted students in terms of reading rates and reading comprehension levels.

Table 8. Investigating the Difference between Students with Low Vision and Sighted Students in Terms of Reading Rate and Reading Comprehension Level

		3. Grade			4. Grade			5. Grade		
	Disability Situation	**n**	**Median (Min-Max)**	**Z; p**	**n**	**Median (Min-Max)**	**Z; p**	**n**	**Median (Min-Max)**	**Z; p**
Reading Rate	Low Vision	26	26.5 (9-98)	-5.867; **0.000*****	25	31 (11-117)	-4.893; **0.000*****	27	49 (22-143)	-5.260; **0.000*****
	Sighted	30	82.0 (44-147)		28	107 (47-127)		30	120 (79-156)	
Reading Comprehension	Low Vision	26	67.5 (35-90)	-1.926; **0.049***	25	80.0 (40-95)	-2.109; **0.035***	27	83 (45-100)	-1.297; 0.195
	Sighted	30	78.0 (38-93)		28	85.5 (38-98)		30	87 (70-100)	

*:p<0.05 **:p<0.01 ***:p<0.001; Min=Minimum Max=Maximum; Z=Mann Whitney U Test p= Significance Level

3rd-Grade Students: The Mann–Whitney U test showed a statistically significant difference between the two groups in terms of reading rate and reading comprehension levels (p<0.05). Thus, the reading rates and reading comprehension levels of students with low vision were significantly lower than those of sighted students.

4th-Grade Students: The Mann–Whitney U test showed a statistically significant difference between the two groups in terms of reading rate and reading comprehension levels (p<0.05). Thus, the reading rate of students with low vision (M=31) was significantly lower than that of sighted students (M=107), and the reading comprehension level of students with low vision (M = 80.0) was significantly lower than that of sighted students (M=85.5).

5th-Grade Students: According to the Mann–Whitney U test, while there was no statistically significant difference between the groups in terms of reading comprehension level (p<0.05), a statistically significant difference was observed in terms of reading rate (p <0.05). Accordingly, the reading rate of students with low vision (M=49) was significantly lower than that of the sighted students (M=120).

Table 9 shows the relationship between students with low vision and sighted students in terms of the reading error type and total reading error level.

Table 9. Difference between Students with Low Vision and Sighted Students in Terms of Reading Error Types and Total Reading Error Level

		3. Grade			4. Grade			5. Grade		
Types of Reading Error	**Disability Situation**	**n**	**Median (Min-Max)**	**Z; p**	**n**	**Median (Min-Max)**	**Z; p**	**n**	**Median (Min-Max)**	**Z; p**
Addition (%)	Low Vision	26	0.80 (0-2.27)	-2.321;	25	0.65 (0-2.35)	-0.724;	27	0.83 (0-1.32)	-2.214;
	Sighted	30	0.76 (0-1.07)	**0.020***	28	0.65 (0-1.30)	0.469	30	0.59 (0-1.45)	**0.027***
Omission (%)	Low Vision	26	0.76 (0-1.70)	-0.711;	25	0.92 (0-2.61)	-1.848;	27	0.59 (0-1.67)	-2.138;
	Sighted	30	0.76 (0-1.86)	0.477	28	0.55 (0-1.46)	0.065	30	0.30 (0-1.32)	**0.032***
Substitution (%)	Low Vision	26	1.31 (0-3.39)	-3.356;	25	0.92 (0-2.61)	-3.226;	27	1.02 (0-1.77)	-4.113;
	Sighted	30	0.76 (0-1.31)	**0.001****	28	0.00 (0-1.96)	**0.001****	30	0.59 (0-1.32)	**0.000*****
Regression (%)	Low Vision	26	1.87 (0-3.16)	-3.728;	25	1.73 (0-3.46)	-3.352;	27	2.00 (1-2.83)	-3.198;
	Sighted	30	1.00 (0-2.65)	**0.000*****	28	1.00 (0-2.00)	**0.001****	30	1.21 (0-2.65)	**0.001****
Pause (%)	Low Vision	26	0 (0-1.73)	-1.533;	25	0 (0-2.00)	-2.847;	27	0.50 (0-1.73)	-2.342;
	Sighted	30	0 (0-0)	0.125	28	0 (0-4.36)	0.400	30	0.00 (0-1.00)	**0.039***
Complicated Error (%)	Low Vision	26	0 (0-15.09)	-1.411;	25	0 (0-5.63)	-1.645;	27	1.09 (0-7.61)	-2.982;
	Sighted	30	0 (0-7.55)	0.158	28	0 (0-5.63)	0.100	30	0.00 (0-2.17)	**0.048***
Total Reading Error (%)	Low Vision	26	2.21 (0-3.94)	-3.134;	25	1.30 (0.65-4.38)	-2.784;	27	1.45 (0-2.77)	-3.944;
	Sighted	30	1.31 (0-2.27)	**0.002****	28	1.13 (0-3.97)	**0.005****	30	0.83 (0-2.21)	**0.000*****

*p<.05, **p<.0.01, ***p<0.001

3rd-Grade Students: According to the Mann-Whitney U test, there was no statistically significant difference between the groups in terms of omission, pause, and complicated error levels (p> 0.05), but a statistically significant difference was observed between them in terms of addition, substitution, regression, and total reading error levels (p <0.05). The addition, substitution, regression, and total reading error levels of students with low vision were significantly higher than those of sighted students.

4th-Grade Students: The Mann-Whitney U test showed that while there was no statistically significant difference between the groups in terms of addition, omission, pause, and complicated error levels (p> 0.05), there was a statistically significant difference between them in terms of substitution, regression, and total reading error levels (p <0.05). Thus, the substitution error level of students with low vision (M=0.92) was significantly higher than that of sighted students (M=0.00). The regression error level of students with low vision (M=1.73) was significantly higher than that of sighted students (M=1.00), and the total error level of students with low vision (M=1.30) was significantly higher than that of sighted students (M=1.13).

5th-Grade Students: The Mann–Whitney U test showed a statistically significant difference between both groups in terms of all types of reading error and total reading error level (p <0.05). Accordingly, the addition error level of students with low vision (M=0.83) was significantly higher compared to sighted students (M=0.59); the omission error level of students with low vision (M=0.59) was significantly higher compared to sighted students (M=0.30); the substitution error level of students with low vision (M=1.02) was significantly higher compared to sighted students (M=0.59); the regression error level of students with low vision (M=2.00) was significantly higher compared to sighted students (M=1.21); the pause error level of students with low vision (M=0.50) was significantly higher compared to sighted students (M=0.00); the complicated error level of students with low vision (M=1.09) was significantly higher compared to sighted students (M=0.00); and the total error level of students with low vision (M=1.45) was significantly higher compared to sighted students (M=0.83).

3. Investigating the Reading Performance of Students with Low Vision and Sighted Students in Terms of Grade Level

Table 10 shows the findings regarding the difference in the reading performance of students with low vision and sighted students according to grade level.

Table 10. Difference in the Reading Performance of Students with Low Vision and Sighted Students According to Grade Level

		Low Vision				**Sighted**			
	Grade	**n**	**Median (Min-Max)**	**x^2; p**	**Difference**	**n**	**Median (Min-Max)**	**x^2; p**	**Difference**
Reading Rate	3. Grade	26	26.5 (9-98)	12.479; **0.002****	3-5	30	82 (44-147)	33,.45; **0.000*****	3-4,5 4-5
	4. Grade	25	31 (11-117)			28	107 (47-127)		
	5. Grade	27	49 (22-143)			30	120 (79-156)		
Reading Comrehension	3. Grade	26	67.5 (35-90)	26,.12; **0.000*****	3-4,5 4-5	30	78 (38-93)	30.115; **0.000*****	3-4,5 4-5
	4. Grade	25	80 (40-95)			28	85.5 (38-98)		
	5. Grade	27	83 (45-100)			30	87 (70-100)		
Types of Reading Error									
Addition	3. Grade	26	0.76 (0-2.27)	2.254; 0.324	-	30	0.76 (0-1,07)	1.131; 0.568	-
	4. Grade	25	0.65 (0-2.35)			28	0.65 (0-1.30)		
	5. Grade	27	0.83 (0-1.32)			30	0.59 (0-1.45)		
Omission	3. Grade	26	0.76 (0-1.70)	3.296; 0.196	-	30	0.76 (0-1.86)	8.319; **0.016***	3-5
	4. Grade	25	0.92 (0-2.61)			28	0.55 (0-1.46)		
	5. Grade	27	0.59 (0-1.67)			30	0.30 (0-1.32)		
Substitution	3. Grade	26	1.31 (0-3.39)	4.768; **0.049***	3-4,5	30	0.76 (0-1.31)	6.050; **0.049***	3-4
	4. Grade	25	0.92 (0-2.61)			28	0 (0-1.96)		
	5. Grade	27	1.02 (0-1.77)			30	0.59 (0-1.32)		
Regression	3. Grade	26	1.87 (0-3.16)	0.641; 0.726	-	30	1.00 (0-2.65)	1.388; 0.500	-
	4. Grade	25	1.73 (0-3.46)			28	1.00 (0-2.00)		
	5. Grade	27	2.00 (1-2.83)			30	1.21 (0-2.65)		
Pause	3. Grade	26	0 (0-1.73)	5.819; 0.055	-	30	0 (0-0)	1.963; 0.375	-
	4. Grade	25	0 (0-2.00)			28	0 (0-4.36)		
	5. Grade	27	0.5 (0-1.73)			30	0 (0-1.00)		
Complicated Error	3. Grade	26	0 (0-15.09)	1.125; 0.570	-	30	0 (0-7.55)	0.792; 0.673	-
	4. Grade	25	0 (0-5.63)			28	0 (0-5.63)		
	5. Grade	27	1 (0-7.61)			30	0 (0-2.17)		
Total Reading Error	3. Grade	26	2.21 (0-3.94)	2.566; 0.277	-	30	1.31 (0-2.27)	4.684; **0.048***	3-4,5 4-5
	4. Grade	25	1.30 (0.65-4.38)			28	1.13 (0-3.97)		
	5. Grade	27	1.45 (0-2.77)			30	0.83 (0-2.21)		

*p<.05, **p<.0.01, ***p<0.001

Students with Low Vision: As shown in Table 10, the results of the Kruskal-Wallis test showed that there was no statistically significant difference between grades in terms of total time, types of reading error (except substitution), and total error level (p> 0.05), while there was a statistically significant difference between grades in terms of reading rate, reading comprehension, and substitution error level. Thus, the reading rate level of 3rd-grade students was significantly lower compared to 5th-grade students, as their reading comprehension level increased as they moved on to the next grade. The substitution error type of 3rd-grade students was significantly higher than 4th- and 5th-grade students.

Sighted Students: According to the results of the Kruskal–Wallis test, there was no statistically significant difference between grades in terms of the level of addition, regression, pause, and complicated errors as well as total errors ($p > 0.05$), but a statistically significant difference was found between grades in terms of reading rate, reading comprehension, and total time as well as omission and regression errors. Accordingly, the reading rate, reading comprehension, and total time levels of students increased as they moved to the next grade. Although the omission error level (M=0.76) of 3rd-grade students was significantly higher than that of 5th-grade students (M=0.30), the substitution error level (M=0.76) of 3rd-grade students was significantly higher than that of 4th-grade students (M=0.00).

4. Investigating the Trends in Differences in Reading Performance in Terms of Grade Level

Figure 1 displays the differences in the reading rate scores of students with low vision and sighted students according to grade level.

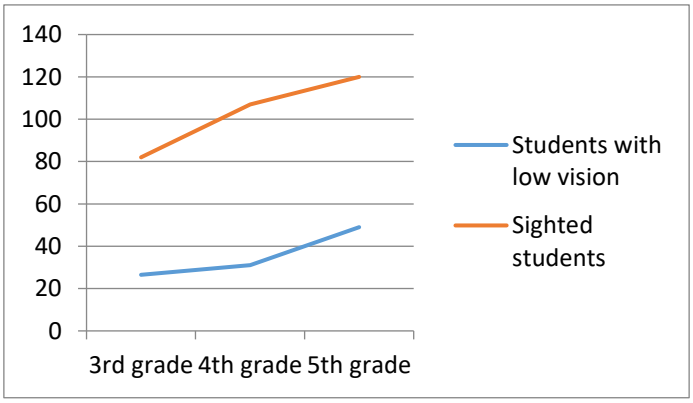

Figure 1. Differences in reading rates of students with low vision and sighted students according to grade level.

As Figure 1 makes clear, both groups showed an increasing trend in reading rate according to grade level. The median values of reading rate increased between 3rd and 4th, 4th and 5th, and 3rd and 5th grades in both groups. The difference between the median values of the reading rate of students with low vision and sighted students was lowest at the 3rd-grade level.

Figure 2 shows the differences in the reading comprehension scores of students with low vision and sighted students according to their grade.

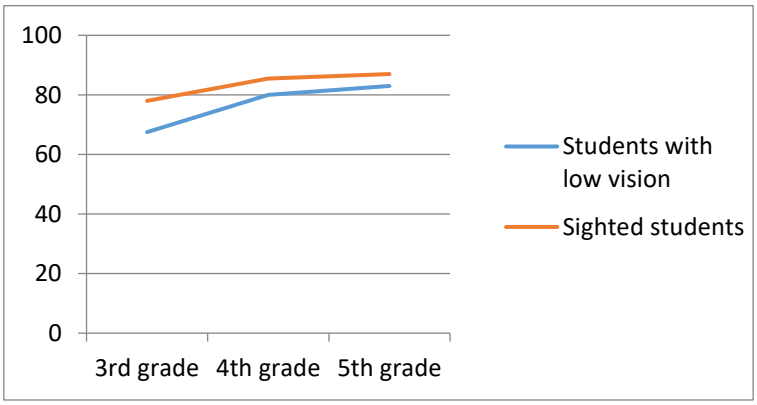

Figure 2. Differences in the reading comprehension scores of students with low vision and sighted students according to grade level.

As shown in Figure 2, both groups showed an increasing trend in reading comprehension according to grade level. The median reading comprehension increased between 3rd and 4th, 3rd and 5th, and 4th and 5th grades in both groups. The difference in the median reading comprehension values between students with low vision and sighted students decreased as they moved to the next grade.

Figure 3 shows the changes in the total reading error percentages of students with low vision and sighted students according to grade level.

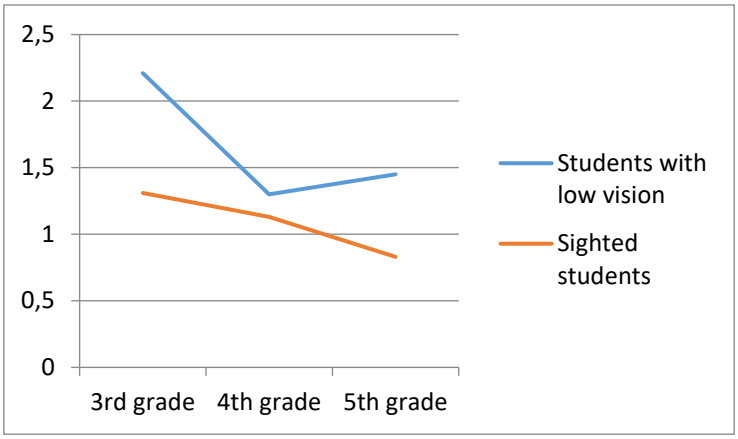

Figure 3. Differences in total reading errors of students with low vision and sighted students according to grade level.

As shown in Figure 3, while the median values of the total reading error percentages of students with low vision tended to decrease at the 3rd–4th and 3rd–5th-grade levels, they increased at the 4th–5th-grade levels. For sighted students, there was a decreasing trend in the median values of the total reading error percentages as they moved on to the next grade. As shown in Figure 3, the difference between the total reading error percentages of students with low vision and sighted students was highest at the 3rd-grade level and lowest at the 4th-grade level.

Discussion

In this study, data were obtained from students with low vision and sighted students in the 3rd, 4th, and 5th grades in eight provinces in Turkey. Statistical analyses were conducted to reveal the research findings. The literature on comparisons of reading performance between students with low vision and those with high vision is quite limited (Corley & Pring, 1993a, 1993b, 1993c, 1993d; Fellenius, 1999; Gompel et al., 2002; Tobin, 1985; van Bon et al., 2000). No study in Turkey has compared the reading skills of students with low vision with those of sighted students. Therefore, the research findings will be discussed within the limited scope of previous studies.

Regarding the reading speed variable in the research findings, students with low vision in grades 3, 4, and 5 had lower reading speeds than sighted students. One of the factors underlying the slower reading speeds of students with low vision is low visual acuity (American Optometric Association [AOA], 2018). The limitations of visual acuity in the medical and educational diagnoses of students with low vision and the limiting effect of this limitation on vision-related functions are emphasised (Tuncer, 2003). Owing to their low visual acuity, students with low vision may exhibit problems seeing letters, sentences, and lines in reading materials, thus exhibiting repeated reading errors, and they may need to spend more effort and time on the analysis dimension of reading skills to overcome this limitation. According to the AOA (2018), another characteristic of students with low vision that negatively affects their reading skills is their visual field, which determines the spatial area they can see. The limited visual field of visually impaired readers can lead to their inability to see a certain part of a line or word in the text. The results of this study parallel these findings by showing that visually impaired readers have a lower reading speed. Additionally, these findings are similar to previous research results in the literature (Douglas et al., 2002; Mohammed & Omar, 2011).

When the findings of the study were examined, it was determined that the reading comprehension levels of visually impaired readers at the 3rd- and 4th-grade levels were significantly lower than those of sighted readers. The international literature reveals that English-speaking students with low vision have lower reading comprehension levels than their sighted peers (Douglas et al., 2002; Mohammed & Omar, 2011). The findings of this study are consistent with those of other studies. Studies on the reading comprehension skills of visually impaired readers suggest that they may have lower levels of comprehension than their sighted peers. Gompel, van Bon, and Schreoder (2004) attributed the limited reading comprehension skills of students with low vision to their processing capacity and working memory. They suggested that visually impaired students give less weight to syntactic and semantic processing because they spend more effort decoding words. Gompel et al. (2004) also emphasised that visually impaired students who focus more on encoding skills during the reading process may experience limitations in allocating their memory capacity for comprehension. In fact, the low reading speed of the visually impaired students in this study may indicate that they exert less cognitive effort in comprehending what they read because of difficulties in decoding.

In this study, no significant difference was found in reading comprehension skills between visually impaired and sighted 5th-grade students. While a difference was found between the 3rd- and 4th-grade levels, the lack of a difference between the 4th- and 5th-grade levels was unexpected. Therefore, it is important to redesign this study to use different samples so as to generalise the findings.

In this study, the total error percentages of the low-vision readers were significantly higher than those of the sighted readers for all grades. Similar findings have been reported in the literature (Douglas et al., 2002; Gompel et al., 2004; Mohammed & Omar, 2011), and it has been suggested that the limitations of visually impaired readers' visual fields and acuity are the reason for this (AOA, 2018). In other words, limitations in visual field and acuity can restrict the analysis and perception of printed materials.

The findings on the types of reading error revealed differences in error rates among different grade levels. At all grade levels, low-vision readers exhibited reversal and substitution errors at higher levels. When the structures of substitution and regression errors were examined, it was found that they were related to the characteristic features of visual impairment in readers who experienced low vision. A substitution error is defined as a reading error in which a word or morpheme is replaced by another word or morpheme (Davenport, 2002). In the informal observations conducted during the evaluation process in this study, it was noted that low-vision readers experienced difficulty in seeing parts of words because of their reduced visual acuity and visual field and were able to substitute another similar-sounding word in its place. When the implementation of the regression error type was examined, it was found that low-vision readers attempted to correct misread words by reading and repeating them. However, although the percentage of this error was higher in students with low vision than in normally sighted students, the regression error should not be treated as a *negative* error. Regression errors should be evaluated as an effort towards correct reading because low-vision readers try to correct their mistakes and read words correctly. Another important finding was the total error percentage according to grade level. The findings indicated that the highest total error occurred at the 3rd-grade level in both groups. The 3rd grade can be considered a transition class in which students acquire decoding skills and concentrate on their understanding skills (Chall, 1983). Students' increased reading experience and fluent reading skills may have resulted in fewer total errors in the 4th and 5th grades.

Reversal occurs as a result of low-vision readers' efforts to recognise and correct a word that they have misread in order to read it correctly. Therefore, this type of mistake should be considered an effort towards correct reading, rather than a negative aspect. Another important finding was that the percentage of total errors differed according to the grade level. According to the findings, the total error level exhibited at the 3rd-grade level was the highest rate for both low-vision and sighted readers. Third grade can be stated as the grade level of primary school age, where students acquire decoding skills and focus on reading comprehension (Chall, 1983). The increase in students' reading experiences and their acquisition of fluency in reading skills may have led to a lower total number of errors at the 4th- and 5th-grade levels.

The research findings revealed that the reading comprehension levels and reading speeds of sighted and low-vision readers gradually increased as the grade level progressed. Although the comprehension level and reading speed point averages of sighted readers were higher than those of their low-sighted peers, the increasing trend was similar in both reader groups, which can be interpreted as the development of low-sighted students in both variables occurring similarly to their sighted peers. Similar results have been obtained in a limited number of studies in the literature (Douglas et al., 2002; Yovanoff, Duesbery, Alonzo, & Tindal, 2005). The increase in word knowledge and reading speed due to the increase in students' reading experience as the grade level increased may have played a role in this finding. In this context, Yovanoff et al. (2005) showed in their study that comprehension skills were related to word knowledge and reading speed from the 4th to 9th grade. In the present study, a similar development was not observed in terms of reading errors. The research findings showed that the total reading errors of low-sighted readers did not differ as the grade level progressed. The lack of a significant decrease in the reading error rates of students with low vision as the grade levels progressed supports the previously emphasised comment that visual acuity and deficiencies have a negative effect on reading errors (AOA, 2018). In addition, these findings indicate the need for special educational interventions to reduce reading errors among low-vision readers.

The present study had some limitations. First, it used a single text type and assessment tool for data collection. Additionally, the study participants were selected from schools for the visually impaired, which may have limited the generalisability of the results. For improved generalisability, future studies should be conducted with visually impaired students in different educational environments using different types of text and assessment tool. Based on the results of this study, reading experiences should be enhanced to support the reading performance of visually impaired readers and effective interventions should be systematically incorporated. Individual adaptations should be made to reading materials and environments, and continuity should be ensured in these adaptations.

In conclusion, visually impaired readers demonstrate limited performance in reading, one of the most fundamental skills in the social and academic areas. Identifying the limitations of the existing situation provides a basis for future research and implementations.

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