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The Influence of Screen Reader Usage on the Ability to Understand Mathematical Word Problems for 6th Grade Blind Students in Special Schools (SLB) Across Solo Raya

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ABSTRAK
Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan *screen reader* terhadap kemampuan memahami soal cerita matematika bagi siswa tunanetra kelas 6 SD di SLB se-Solo Raya. Jenis penelitian ini merupakan penelitian kuantitatif dengan desain eksperimen dan menggunakan model *one group pretest posttest design*. Teknik pengambilan sampel yang digunakan dalam penelitian ini ialah sampling jenuh. Teknik pengumpulan data dilakukan dengan memberikan soal tes dan dokumentasi. Teknik Teknik analisis data yang digunakan pada penelitian ini ialah statistik nonparametrik melalui analisis *wilcoxon sign rank test*. Hasil penelitian ini menunjukkan bahwa berdasarkan pengujian hipotesis melalui wilcoxon sign rank test, didapat bahwa Asymp.sig. (2-tailed) bernilai 0.007. Karena nilai 0.007 lebih kecil dari < 0.05 maka dapat disimpulkan bahwa penggunaan *screen reader* berpengaruh secara signifikan terhadap kemampuan memahami soal cerita matematika bagi siswa tunanetra kelas 6 SD di SLB Se-Solo Raya
Kata kunci: *Screen reader*, kemampuan memahami, soal cerita matematika, siswa tunanetra

ABSTRACT
This research aims to determine the effect of using a screen reader on the ability to understand mathematics story problems for blind students in grade 6 elementary schools in special schools throughout Solo Raya. This type of research is quantitative research with an experimental design and uses a one group pretest posttest design model. The sampling technique used in this research is saturated sampling. Data collection techniques are carried out by providing test questions and documentation. The data analysis technique used in this research is non-parametric statistics through Wilcoxon sign rank test analysis. The results of this study show that based on hypothesis testing via the Wilcoxon sign rank test, it was found that Asymp.sig. (2-tailed) is worth 0.007. Because the value of 0.007 is smaller than <0.05, it can be concluded that the use of a screen reader has a significant effect on the ability to understand math story problems for blind students in grade 6 elementary schools in SLB throughout Solo Raya.
Keywords: Screen reader, comprehension ability, mathematics story problems, blind students.

PENDAHULUAN

Blind students are those who experience limitations or obstacles in seeing objects, whether from a distance or up close (Mulyani et al., 2023). Due to the impact of visual impairment, blind students have limited access to various visual information, requiring them to have special services (Mayori, Yusuf, & Subagya, 2021). This is also stated by Yusbikhuridlo (2019), that blind students have limited access, particularly in obtaining visual information, and are only able to acquire information through auditory or tactile means. The limitations in accessing various visual information naturally affect the learning process of blind students, necessitating media that can assist them in accessing various learning content.

One accessible medium for blind students to help them gather information, including accessing learning content, is assistive technology in the form of a screen reader, which has been integrated into various types of operating systems on electronic devices, such as Windows, macOS, Apple, and Android. According to the Indonesian Blind Union (Pertuni, 2015), a screen reader is a software that can convert visual displays on electronic devices, whether text in articles or labels on menu items, into speech (text-to-speech). This allows blind students to operate various electronic devices independently by simply listening to what the screen reader says and following the instructions independently. This technology greatly assists blind students in accessing various learning content and taking digital-based written exams, enabling them to keep up with the times like other students and improving their ability to understand various informative readings available through electronic books and websites.

According to Ramdani & Apriansyah (2018), the ability to understand refers to the level at which a person can comprehend the meaning, concept, situation, and facts not only verbally but also grasp the concept of the problem being asked. The ability to understand in the context of learning is an indicator of a student's conceptual understanding of the material being studied, whether from the teacher's explanation or the instructional materials in the books. One way to assess students' conceptual understanding is through giving mathematical word problem tests. Mathematical word problems are presented in the form of everyday stories that require students to be able to read narrative texts well, reason, analyze, and solve the problems presented, as well as apply basic mathematical formulas to answer the problems correctly (Putri et al., 2020). Based on this, presenting mathematics problems in the form of stories indirectly trains students' ability to understand abstract concepts, including for blind students.

Due to the impact of visual impairment experienced by blind students, they find it difficult to understand mathematical concepts often encountered in math problems. This aligns with Anggoro's (2019) view that the difficulty for blind students in solving math problems lies in the frequent use of abstract symbols, making it challenging for them to complete calculations and requiring relatively more time to finish them. Based on this issue, this study will discuss the influence of using screen readers on the ability to understand mathematical word problems for 6th grade blind students in Special Schools (SLB) across Solo Raya.

METODE

This research is a quantitative study with an experimental type and uses a one-group pretest-posttest design approach. The one-group pretest-posttest design is one of the models of pre-experimental design that involves only one group without a control group for comparison (Sugiyono, 2014). The subjects used in this study consisted of 9 blind 6th-grade students spread across 3 Special Schools (SLB) in the Solo Raya area. The sampling technique used was saturation sampling, where the entire sample

population is used as research subjects. The distribution of the identities of the 9 subjects is described in the following table:

Table 2.1. Distribution of Research Subject Identities

No	Subject	Age	Gender	Class	School of Origin
1.	AP	13	F	VI/6	SLB-A YKAB Surakarta
2.	NH	13	F	VI/6	SLB-A YKAB Surakarta
3.	AF	13	M	VI/6	SLB-A YKAB Surakarta
4.	IA	13	M	VI/6	SLB-A YKAB Surakarta
5.	MA	14	M	VI/6	SLB-A YKAB Surakarta
6.	NF	12	F	VI/6	SLB Negeri Cangakan Karanganyar
7.	SZ	14	M	VI/6	SLB-A YAAT Klaten
8.	TA	13	M	VI/6	SLB-A YAAT Klaten
9.	EA	13	M	VI/6	SLB-A YAAT Klaten

The data collection technique used in this study was a summative test, by administering 10 objective questions containing mathematical word problems to the subjects, both in the pretest and posttest phases. The pretest was conducted by dictating 10 mathematical word problems to the 9 subjects, who then wrote their answers using braille. The posttest was conducted by providing 10 objective mathematical word problems via Google Forms to the 9 subjects, who completed the test on their phones equipped with screen reader technology. The categorization of test scores obtained by the subjects is detailed in the following table:

Table 2.2. Categorization of Test Score Ranges

No	Ranges	Category
1	86-100	Very High
2	71-85	High
3	56-70	Moderate
4	41-55	Low
5	<40	Very Low

Reference: Septiani & Aini (2023).

The data analysis technique used in this study is non-parametric statistics with the Wilcoxon signed-rank test. This analysis technique aims to determine the difference between two paired data groups, in this case, testing whether there is a difference between the subjects' scores in the pretest and posttest.

HASIL DAN PEMBAHASAN

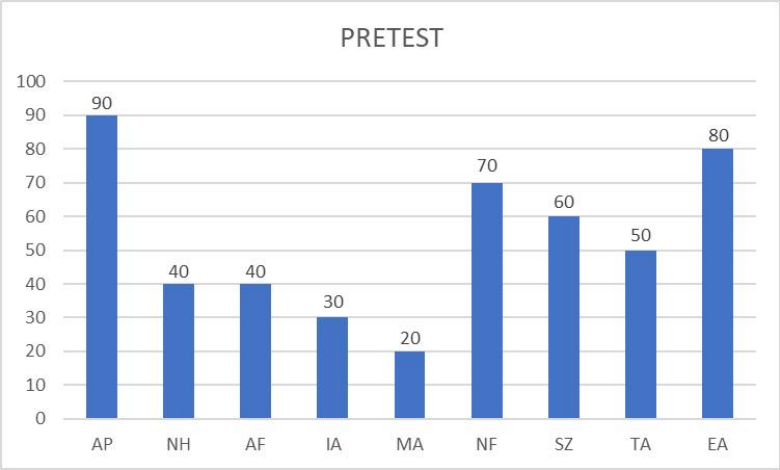
a. Hasil

This study was conducted at 3 different school locations: SLBA YKAB Surakarta, SLB Negeri Cangakan Karanganyar, and SLBA YAAT Klaten. The research was carried out in 3 stages: pretest, intervention/treatment, and posttest. The pretest

involved dictating 10 objective mathematical word problems to 9 subjects, i.e., 6th-grade blind students from each designated school in rotation. The time required for this stage ranged from 60 to 120 minutes due to some blind students requesting the researcher to repeat the reading of the questions and specific options.

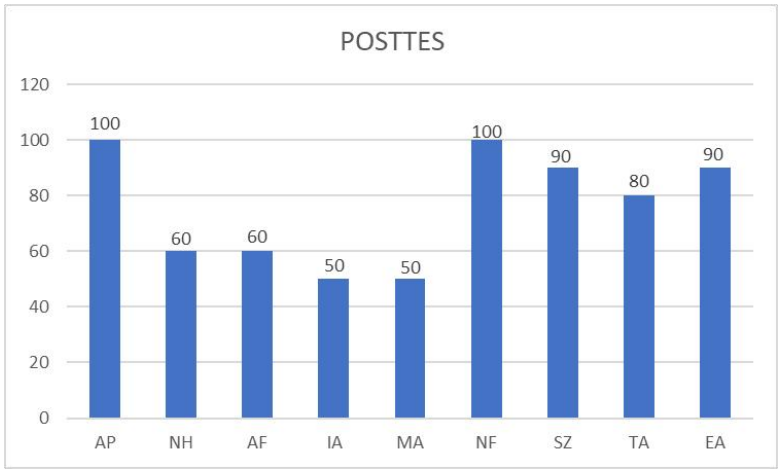
After the pretest, the researcher provided training on how to operate Google Forms through phones equipped with screen reader technology, specifically TalkBack, as a medium for conducting online-based tests for each blind student and school in rotation. The training involved teaching the blind students gestures used in operating phones with screen reader technology, particularly in accessing test questions through Google Forms. The gestures included: swipe left on the screen to read the previous question or option, swipe right to read the next question or option, double-tap on the checkbox to select an answer, and double-tap on the send menu to submit the answer. During this intervention phase, the blind students practiced these gestures using 5 practice questions with objective mathematical word problems. The goal was to help the blind students become accustomed to operating their phones independently and to understand the content read by the screen reader. This intervention stage took approximately 60 to 120 minutes.

After all the blind students had completed the intervention, they proceeded to the final stage, the posttest, which involved providing the same 10 mathematical word problems, but formatted digitally through Google Forms, allowing the blind students to access it on their own phones. The posttest was conducted at the 3 schools in rotation according to the pre-scheduled timetable, and this stage took between 30 to 60 minutes. The results of the pretest and posttest scores will be presented in the graph below:



Picture 3.1. Diagram of Pretest Scores for Mathematical Word Problems for 6th Grade Blind Students in Special Schools (SLB) Across Solo Raya

Based on the above graph 3.1, it is known that the average ability of blind students to understand mathematical word problems is in the low category, at 53.33. This can be seen in Table 2.2, which categorizes the understanding ability scores for mathematical word problems, where 53.33 falls into the low classification with a score range of 41-55. The posttest scores for mathematical word problems for blind students are detailed in the following graph:



Picture 2.2. Diagram of Pretest Scores for Mathematical Word Problems for 6th Grade Blind Students in Special Schools (SLB) Across Solo Raya

Based on the above graph 3.2, it can be observed that the average ability of blind students to understand mathematical word problems is in the high category, at 75.56, which represents an increase of 23.3 from the pretest average. This category can be seen in Table 2.2, which categorizes the range of scores for understanding mathematical word problems, where the average score of blind students in the posttest falls within the range of 71-85 (high category). After determining the average results from the pretest and posttest, the data was then processed using the Wilcoxon signed-rank test to determine if there was a significant difference between the two paired data groups. The results of the Wilcoxon signed-rank test can be seen in the table below:

Table 3.1. Test Results Wilcoxon Sign Rank Test

Test Statistics[a]

	Post Test - Pre Test
Z	-2.701[b]
Asymp. Sig. (2-tailed)	.007

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Based on the output of the "Wilcoxon signed-rank test statistic," the Asymp. sig. (2-tailed) is 0.007. Since the value of 0.007 is less than 0.05, it can be concluded that the "Hypothesis is accepted (H1)." This means there is a difference between the understanding of mathematical problems in the pretest and posttest. Therefore, it can be concluded that "the use of screen readers has a significant effect on the ability to understand mathematical word problems for 6th grade blind students in Special Schools (SLB) across Solo Raya."

b. Pembahasan

Based on the presentation and data analysis described previously, it can be observed that there has been an improvement in the understanding of mathematical word problems among the 9 blind 6th-grade students in Special Schools (SLB) across Solo Raya after the intervention involving the use of screen reader technology integrated into electronic devices, specifically Android phones with the TalkBack screen reader. The application of this technology has facilitated blind students in accessing various learning content, such as reading digital books, completing assignments, and

taking online-based tests, as done in the posttest stage of this study. Before the technology was applied, tests were conducted conventionally, by dictating the questions to blind students. However, there were some drawbacks to this method, including students frequently requesting the reader to repeat the questions or answer options, inefficiency in time, and difficulties for blind students in understanding the intent of the questions due to the varied ways of dictation. This is also noted by Wijayanto (2017), who stated that teaching mathematical word problems solely through lectures can impact students' ability to solve these problems, as the understanding levels among blind students vary greatly.

One approach that can be applied, especially in conducting tests, is using electronic devices integrated with screen readers. The goal is to make blind students more interested in taking tests, thereby fostering motivation and enthusiasm for completing the tests independently. This was evidenced in the posttest phase, which showed a significant improvement in the scores of the 9 blind students. Based on these results, the use of screen readers indeed offers several benefits, including enhancing the independence of blind students in learning activities, increasing their interest in learning, and improving the efficiency of online test administration. This is supported by research conducted by Hermawan et al. (2023) on the application of TalkBack in the learning process for 11th-grade blind students at SLB Negeri Branjangan Jember. The study found that the use of the TalkBack application helped blind students more freely access materials and made it easier for teachers to provide educational content in digital text formats, such as Word documents, PDFs, and others, as students could access these materials independently through their phones.Regarding the ability to understand mathematical word problems, the implementation of screen reader technology significantly enhances blind students' ability to comprehend the content of these problems, as they can repeat the content or answers read by the screen reader to better grasp the essence of the questions. Additionally, blind students can adjust the screen reader's speech rate according to their preferences, allowing them to understand each word more clearly.

SIMPULAN

Based on the data obtained from the pretest and posttest stages, it is evident that there is a significant improvement in the blind students' ability to understand mathematical word problems before and after the intervention involving the use of screen reader technology for online-based mathematical word problem tests. Based on these results, it can be concluded that the use of screen reader technology has an impact on the ability to understand mathematical word problems for 6th grade blind students in Special Schools (SLB) across Solo Raya.

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