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User-Friendly Level Differences in Learning Mathematics Using Braille Books with Talking Books for the Student with Visual Impairment

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ABSTRAK

Media pembelajaran bagi siswa tunanetra berpengaruh terhadap kecepatan dan proses pemahaman dalam pembelajaran. Penggunaan buku Braille dan buku berbicara memiliki kelebihan dan kekurangan masing-masing. Penelitian ini bertujuan untuk menguji perbedaan tingkat user friendly siswa tunanetra yang belajar matematika menggunakan buku Braille dan talking book. Pendekatan penelitian ini menggunakan kuantitatif dengan desain yang digunakan dalam penelitian ini adalah quasi-experimental-posttest-only Control design. Subyek dalam penelitian ini adalah 38 siswa yang terdiri dari 8 SLB di 6 provinsi di Indonesia. Teknik pengumpulan data menggunakan angket dan tes. Validitas instrumen menggunakan validitas isi dan uji reliabilitas menggunakan teknik interpreter. Teknik analisis data yang digunakan dalam penelitian eksperimen ini adalah analisis data t-test atau uji-t. Hasil penelitian menunjukkan bahwa penggunaan buku braille memiliki perbedaan yang signifikan dengan buku berbicara. Perbedaan tersebut ditunjukkan dengan nilai t hitung sebesar -4,955 dengan sig 0,00 yang berarti terdapat perbedaan yang signifikan antara penggunaan buku Braille dan talking book dalam memperoleh kemudahan belajar.

ABSTRACT

Learning media for students with visual impairment affects the speed and process of understanding in learning. The use of Braille books and talking books have advantages and disadvantages of each. This study aims to examine the difference in user-friendly levels of students with visual impairment learning mathematics using Braille books and talking books. This research approach uses a quantitative with the design used in this study being a quasi-experimental-posttest-only Control design. The subjects in this study were 38 students consisting of 8 special schools in 6 provinces in Indonesia. Data collection techniques used questionnaires and tests. The validity of the instrument uses content validity and the reliability test using the interpreter technique. The data analysis technique used in this experimental research is t-test or t-test data analysis. The results show that the use of braille books has a significant difference from talking books. The difference is shown by the t count of -4.955 with sig 0.00 which means that there is a significant difference between the use of Braille books and speaking books in gaining ease of learning.

1. INTRODUCTION

All children have the right to learn at all stages of their development and can use appropriate methods with easy access. Data compiled by World Statistics shows that less than 2% of children with disabilities have the opportunity to attend school (Dardzińska-Głębocka & Zdrodowska, 2021; Fansury et al., 2019). One type of child with special needs is blind. Students with visual impairment have big problems in obtaining educational or learning opportunities because of discrimination in education based on gender, race, or disability (Putri, 2020; Rahimi et al., 2019). This affects the learning process of students with visual impairment. Children with visual impairment of the total blind categories in obtaining information utilize the sense of hearing and the sense of touch. Meanwhile, children with low vision categories are still able to use the sense of sight to obtain information, but they must use visual aids. For students with visually impaired this manner of receiving information is a challenge (Hashim et al.,

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2021; Toenders et al., 2017). The most difficult challenge for blind children in learning among subjects at school is mathematics. Besides being abstract, the material is presented in the form of symbols, graphs, tables, pictures, and various forms of equations.

Learning mathematics is an important part of learning for all students because mathematics is a subject that is widely applied in real life. The impact of vision loss on learning mathematics is that direction, quantity, form, and logical attributes are at the heart of mathematics. Teaching/Learning and understanding mathematical concepts are quite hard for primary and secondary education of blind people, which subsequently hinders their career choices and career growth (Nahar et al., 2022; Vandana & Singla, 2022). The difficulties in math accessibility encountered by students with visual impairment often lead to those individuals having more problems with science than sighted people (Buhagiar & Tanti, 2011; Spinczyk et al., 2019). Research conducted by previous study found that blind and visually impaired students in Bangladesh face difficulties in the first step due to their limitations in writing and reading mathematical notation (Nahar et al., 2022). Students with visual impairmenttheirmselvcan can access any document more easily if they are prepared in braille. Mathematics contains a large number of symbols, and the braille notation for all these symbols has made the braille system long and sometimes complicated to understand and remember (McDermott-Wells, 2016; Wongkia et al., 2012). This can be caused by the lack of facilities in the form of professional experts or qualified teachers coupled with poorly made braille materials which can make long braille systems very difficult to learn (Kway et al., 2010; Wongkia et al., 2012). The use of unique Braille mathematical symbols has its difficulties for stud students with visual impairment. The provision of mathematics Braille books requires special skills such as expertise in mathematical concepts and Braille codes. This lack of competence is the reason for the limited number of Braille Mathematics books. The Braille code of mathematics varies from country to country (Fischer-Baum & Englebretson, 2016; Wongkia et al., 2012). Learning mathematics with Braille books for students with visual impairment takes quite a long time compared to students aware and able to read printed letters. According to previous study the readers absorb written information through visual fixation (eye gaze), where the perceptual field of each eye gaze includes at least 15 letters (Hollins, 2021). In terms of reading Braille, tactile fixation (fingertip palpation) is not comparable to visual fixation, because tactile reading involves coordinating finger, hand, and arm movements. The speed of reading Braille cannot be compared with the speed of reading printed letters by alert learners. This is caused by different modalities, but there is a relationship between cognitive capacity and Braille reading speed (Martiniello & Wittich, 2022; Veispak et al., 2013). One way to overcome this problem is to use audio fixation in learning, which comes with mathematics audio books equipped with tactual fixation through tactual mathematics supplements. This is the concept of digital development that advances the realm of education, with the development of audio fixation, which can foster student skills in competing in the digital world (Ivashova et al., 2019; Wongkia et al., 2012).

Although a lot of educational software has been introduced for blind children, very little educational software is available to students sent with visual impairment. Audio-book production in Indonesia, such as the Mitranetra Foundation, the Ministry of Education and Culture's BPMR, the Indonesian Braille Printing Center tend to produce audio-books that are text-based and not numeric-based or math and statistics books, which are accompanied by tactual supplements. In addition to the unavailability of materials, mathematics learning equipment for visually impaired students is very expensive and most rarely on found in developing countries (McDermott-Wells, 2016; Ry-Kottoh et al., 2022). However, current there're is the development of a an audio-book recorder students with visual impairment with the name math+T. The main purpose of audio-books is to help students with visual impairment and further developments now audio-books are enjoyed by many people with vision because by having audiobooks, people can read books without having to read. They can do it by listening through car tape, at home, or on the go. It is explained by previous study that 3D audiobooks are effective as a learning supplement for class discussion (Bertulfo et al., 2017). The respondents were amazed at the 3D Audiobook and its whole concept whilst there were so those who strongly suggested that the voice selection be reconsidered. Additionally, the materials (sound effects avoiceoversers) were commendable they majorly contributed to the overall quality of the 3D Audiobook. Furthermore, the teachers explained that they had used the add audiobooks as a supplement to the lesson and it was effective. Mathematics audio student books for visually impaired students can be developed with analog (cassette) and digital recordings. Digital audio student books can be developed with MP3, MP4, and DAISY (Digital Accessible Information System) applications. The production steps between analog and digital recordings are the same, the difference is the equipment and technology used in production and storage media. DAISY is designed to be a complete audio replacement for printed materials and is specifically designed for use by people with visual impairments including blind, low vision, and dyslexic students. DAISY multimedia can be a book, magazine, newspaper, journal, computerized text, or presentation of synchronized text and audio (Kerscher, 2001; Nattaya Wongrukmitr, 2021). It provides up to six embedded "navigation levels" for content, including embedded objects such as images, graphics, and MathML (Kerscher, 2001; Rattanaphinyowanich & Nunta, 2021). The results of the research by previous study in Thailand showed that: (1) the efficiency of the DAISY format audiobook in reading comprehension for blind students reached the standard criteria of 70/70 at 80.00/75.80; (2) The DAISY audio book effectiveness index on reading comprehension is at 0.70; (3 and higher reading comprehension learning outcomes after using DAISY audiobooksTheuse of different media, of course, affects the level of user-friendliness in utilizing existing developments (Nattaya Wongrukmitr, 2021).

Based on this case, it encourages researchers to test the user-friendliness of ststudentsith visual impairment learning by using Braille books and mathematic talking books. User-friendly media or friendly to users, in this case, students with visual impairment who will use talking books means thatalkingig book can be used by the visually impaired because it is easy to learn, and e, unand derstand so it is hoped that the problems of the blind in obtaining complete information through textbooks, especially in mathematics, can be completed and learning objectives can be achieved. The aims of this study is to examine the difference in user-friendly levels of students with visual impairment learning mathematics using Braille books and talking books.

2. METHOD

The research uses a quantitative research approach. The research design used in this research is the "Nonequivalent Control Group Design" research, namely the Posttest-only Control Group Design. Subjects were determined by purposive sampling, namely 38 children with visual impairment in class VII consisting of 8 special schools from 6 provinces in Indonesia. The determination of the control group and the experimental group was done randomly. Each group consisted of 19 children with visual impairment. The control group was taught by using a mathematics Braille book, while the experimental group was given learning using a mathematics audiobook. At the end of the lesson, a post-testest is given.

Data collection techniques with tests. Instrument validity uses content validity. Content validity ty a validity that focuses on what elements are in the measure, so rational analysis is the main process carried out in content validity analysis (Azwar, 2017; Coaley, 2010). The validity of this study uses expert judgment, namely 2 linguists, 2 construct arts, and 2 substance experts. In this case, after the instrument is constructed about the aspects to be measured based on a certain theory, then it is then consulted with the competent one or through the Reliability expert judgment using the interrater technique through Kappa coefficient analysis from Cohen and Intraclass Correlation Coefficients (ICC). To find out the difference in userfriendly level between the experimental group and the control group, the t-test data analysis technique was used.

3. RESULT AND DISCUSSION

Result

The difference in the effect of user-friendly between the use of Braille Mathematics books and talking books were tested for the difference in the difference in data between the two groups, in this case, conducted with an independent sample t-test. The results of the user-friendly independent sample t-test in learning mathematics using Braille books and talking-book can be seen in Table 1.

Table 1. T-Test Results

		F	Sig.	t	Df	sig. (2-tailed)	Mean Difference	Std Error Difference	95% Confidence interval of the Difference	
									lower	Upper
VAR0001	Equal variance assumed	2.267	0.141	-4.955	36	0.000	-8.526	1.72073	-12.016	-5.036
	Equal variance not assumed			-4.955	32.739	0.000	-8.526	1.72073	-12.016	-5.024

Base Table 1, it is known that the value of F = 2.267 with probability (sig) 0.141. The decision-making provisions using the Ho rule as a user-friendly variance between Braille books and booking books have no significant differences, and user-friendly friendly variance with Braille math books and books have significant differences. The rules used are a) if the probability (sig) > 0.05, then Ho is accepted; b) if the probability (sig) <0.05, then Ho is scored. Then, Table 1 shows that the calculated F value = 2.267 with a sig of 0.141, then Ho is accepted. The conclusion is that there is no difference in variance in Braille and talking book data, so the data is called homogeneous. To test the difference in user-friendly level between learning to use Braille books and talking books using the provision that Ho as the variance there is no significant difference in the level of user friendly between learning with Braille books and talking books, while H1 as a variant there is a significant difference in the effect on the user-friendly level between learning with Braille books with talking book. The rule used is Ho is accepted if the probability value (sig) > 0.05 and Ho are rejected if the probability value (sig) < 0.05. Table 2 shows that the t count is -4.955 with sig 0.00 which means Ho is rejected, which means that there is a significant difference between the use of Braille books and talking book in gaining ease in learning. Differences in means between groups is show in Table 2.

Table 2. Differences in Means Between Groups

VAR00002		N	Mean	Std. Deviation	Std. Error Mean
VAR00001	1.00	19	28.1579	4.38765	1.00660
	2.00	19	36.6842	6.08324	1.39559

Referring to Table 2, using a 95% confidence level tolerance, the mean range of differences between the use of Braille books and talking books is -12,016 to -5,036. The ease between learning with Braille books and talking books has a different mean value with a difference of 8,527 (36,684-28,157) which means that the use of Braille math books with audio is user-friendly in learning to choose a significantly different mean.

Discussion

Graphs, charts, diagrams, pictures, and drawings are used as mathematical tools to communicate large amounts of data or relationships between variables in a simplified and concise manner. The material for pictures, graphs, and graph is visual, and therefore many students with visual impairment face considerable challenges in their reading. That difficulty can be done by making tactile graphics. Tactile graphics are created using elevated lines and textures to convey images and graphics with touch. They are often used by blind and visually impaired people because tactile modalities are the best for understanding their graphic images (Övez, Filiz, Tuba, Dikkartin & Akar, 2018; Quero et al., 2021). The provision of friendly teaching materials is needed to fulfill their rights in learning like other students. The use of assistive devices for children with visual impairment has been increasing, and several electronic aid devices have been introduced over the past few years, called electronic travel aids, which can replace with existing aid apparatus, such as white canes. Combining different types of sensors, cameras, or feedback channels can work with different implementation approaches and improve mobility for the visually impaired. Assistive systems based on computer vision or machine learning methods have been emerging, and assistive technology has been expanded according to technological advancement (Bagon et al., 2018; Hwang et al., 2020).

Braille's reading speed is difficult to increase through technology because it is related to the strength of finger touch. Another great power is hearing. The research results of previous study concluded that optimal spatial auditory sensitivity has no prerequisites in visual abilities, even a lack of vision leads to a general improvement of auditory-spatial skills (Battal et al., 2020). As technology advances, the demand for literacy increases very rapidly. As the volume of reading requested increases, a student with visual impairment is encouraged or taught to supplement their reading of Braille text with digital books, talking books/ other digital recordings (Kway et al., 2010; Melfi et al., 2020). With talking book is considered a necessary tool to improve access to information not only to compensate for slow reading rates but also because Braille printed material is not always available when needed.

It was explained that there were significant differences in the results of studies related to the user-friendliness of Braille books and audiobook media. From the results, it can be seen that the use of talking book media is more user-friendly than the use of braille books. The use of talking books with Braille books has a significant *difference*. This shows that the user-friendly use of math books for visually impaired students in Class VII with talking books equipped is significantly better than using Braille books. Research conducted by previous study using cellular tactile audio media is suitable for introducing learning environments and evaluating systems by comparing three interaction methods with tactile graphics: Tactile graphics coupled with (1) documents with key index information in Braille, (2) digital documents with key index information and (3) the iPad system, an audio-tactile solution that meets specific needs in a school context (Melfi et al., 2020). Added by other researcher who developed a platform that shared graphical mathematical content (graphs, geometric numbers, etc.) in audio-tactile form for visually impaired students, preliminary research on test groups showed better assimilation of mathematical knowledge and improvement of participants' positive sentiments and their cognitive abilities (Maćkowski et al., 2020). Testing several types of charts and obtaining evidence that visual augmentation can offer clear advantages for the exploration of tactile charts, even participants with small residual vision can complete tasks with visual augmentation more quickly and accurately (Götzelmann, 2018; Martiniello & Wittich, 2022).

Many studies have identified a positive relationship between self-efficacy to use technologies and online learning performance. However, some studies show that the use of technology in certain areas does not benefit students (Hoskin et al., 2022; Sumuer, 2018). This is by the results of this study that the use of talking books in mathematics subjects students' understanding is lower when compared to using Braille mathematics books. After the talking book mathematics supplement was added to tactual/Braille (talking book+) supplements, the comprehension score was higher than the use of talking book mathematics without tactual/Braille supplements. In addition, the use of tactile audio books contributes to the students with visual impairment in inclusive schools in bonding activities during learning. Children can release their emotions and fantasies and show that each child experiences an exchange with themselves and the world (Edirisinghe et al., 2018; Tederixe et al., 2021).The use of mathematical Braille is believed to create new difficulties for the student with visual impairment, so the use of talking books or audio math can help students understand the use of formulas in mathematical concepts. In terms of user-friendliness, visually impaired students prefer to use audiobooks to capture existing material. Talking book technology presents new ways to communicate and reach users who may be limited by print or want other convenient ways to consume content while multitasking (Hashim et al., 2021; Ry-Kottoh et al., 2022). The implication of this research is to encourage other researchers to develop assistive technology for visual impairment students that is more friendly as a form of friendly service for learning mathematics. The limitation of the results of this study is that the subject is relatively small, and does not represent the representation of visual impairment students in Indonesia. This is due to the small number of clients with visual impairment in special schools. The results of the research can at least be used as inspiration for similar research with a wider scope and more detail.

4. CONCLUSION

Friendly mathematics teaching materials are needed by blind students. This is not only to provide access to blind students in learning mathematics, but this is a right that must be fulfilled by education providers. The use of talking book learning media gives more freedom to blind students in mathematics subjects than using Braille books. The convenience in question is speed and understanding in learning mathematics. User-friendly includes ease and comfort in learning mathematics.

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