International Journal of Research in Education

Volume 4, Issue 1, January 2024, pp. 1 – 11

e-ISSN: 2745-3553

DOI: : https://doi.org/10.26877/ijre.v4i1.15282

Development Of Math Blind Game With Voice And QR-Code As Learning Media For Blind Students

Qyara Melia Arimbi [1*], Luthfia Ulva Irmita [1], Anton Wardaya [1]

[1] *SMA Wardaya, Indonesia*

*Corresponding author's email: luthfiairmita@gmail.com

ARTICLE INFO

Received: April 30, 2023

Revised: August 23, 2023

Accepted: December 01, 2023

Keywords:

Blind students, Math Blind Game, Math education

ABSTRACT

Math is a lesson that is difficult for children in Indonesia to understand. Especially in children with visual or blind disorders. This disorder makes it difficult for metematics to study, for in matematics it takes sight to read material to enhance the learning system. This study was developmental research that aimed to describe the result of instructional media development of math blind game with voice and QR code and describe their understanding after using math blind game with voice and QR code as learning media at special needs elementary school. The subject of this study is blind students grade 4th – 6th . The research model used was ADDIE development model (analysis, design, development, implementation, and evaluation). Data were collected using test and questionnaire to know their understanding of math blind game with voice and QR code as lerning media. The result showed that blind students responded positively with an average score of SUS score 83,75 (grade A). Therefore, it can be concluded that math blind game with voice and QR code can be used in teaching and learning activity to improve blind students' understanding about matematics.

Introduction

Effective teaching and learning of mathematics is essential for achieving good results during an academic and professional career (Maćkowski et al., 2020). Mathematics is one of the most difficult subjects so it requires strategies in the learning process. The mathematical ability of Indonesian students based on PISA 2018 is still relatively low. In 2018, the PISA ***(****Program for International Student Assessment)* score of Indonesian mathematics was below the average, if the average score was 489, Indonesia's mathematics score was 379 (Nurqamar & Nur, 2022). For normal students, mathematics is considered difficult, especially for students with special needs. Blind students need special attention in the process of learning mathematics. This is in accordance with the results of research conducted by Singla, (2022) which states that in learning mathematics, blind students need the help of technological media including voices and braille mathematics.

Based on the results of interviews with blind students at SLB Kemala Bhayangkari 1

Trenggalek, students still have difficulty learning about integers. Students need a learning media to more easily understand integer material. Integer material consists of addition, subtraction, division and multiplication which is the basic material of mathematics. Blind students are expected to be able to understand the basic material of mathematics easily. In addition, at the school there is no media that can help students learn mathematics more easily. The student only uses braille.

Based on research Igirisa et al., (2019) states that there is still a lack of learning media for blind students. Though the learning process is important for blind children to develop. The use of visual AIDS in various forms among students ensures a more successful adaptation of the material and increases students' interests, knowledge and skills (Abdusamatova, 2022). In 2016, there were 3,750,000 blind people and 40% of the total blind people were aged 6-18 years. At this age, they must learn and develop (Pertuni, 2017).

Most of the learning media used by blind students today are using braille (Amalia, 2022). Learning activities for blind children such as writing, reading, and arithmetic require braille, and some blind people require a magnifying glass or large print, media that can be felt and heard or enlarged. In addition, orientation and mobility exercises are also required (Lupetina, 2022). One of the weaknesses of this braille-based game is that it is less time efficient and its usability is low (Hoskin et al., 2022). Blind students can learn by using braille, but they can also optimize their hearing to make the learning process easier. Along with the development of technology, learning media for visually impaired students are also developing. Digital-based media can be developed to facilitate students in learning.

One alternative method that can be used as a support for blind learning is by simulating blind math games as semi-digital math games for sound-based vision and QR codes. Based on the results of research Afifah et al., (2021) it is stated that the learning process using a pocketbook with a QR code can improve learning outcomes. In addition, the results of research conducted by Kim et al., (2018) stated that learning media using QR code based mobile voice can help blind students to learn. The results of Al-Jaleeli & Galimyanov, (2018) research stated that the use of braille code and QR code technology can be an alternative for learning for blind students.

This research will focus on designing, manufacturing, and quantifying the usefulness of blind math games which are semi-digital math education games for visually impaired people based on sound and QR codes. QR codes are one type of bar code or two-dimensional matrix. QR codes can store information and all kinds of data, such as numeric, alpha, kanji, hana, symbols, hiragana, and binary codes. The QR code also has a smaller size than the log code (Alif, 2020).

Based on this background, there are several problem formulations, namely: 1) How to design the Math Blind Game as a math educational game for the blind 2) What are the results of measuring usability and excellence Math Blind Game as a math educational game for the visually impaired.

Research Methods

This study was development research using ADDIE development model consisting of Analyze, Design, Development, Implementation and Evaluation. In this study just adapted three stages consisting of Analyze, Design and Development. Subjects of this study were 10 students grade 4^{th} – 6^{th} at SLB Kemala Bhayangkari 1 Trenggalek. Subject were selected by random sampling. The math blind game test will involve 10 participants by playing math blind game. Participants will performan usability math blind games assessment by filling the Usability System Usability scale (SUS). Thus, it can be known the extent of usability and the effectiveness of the math blind games. Ramly et al., (2022) the following explaines these three stages of development adapted to this study.

Table 1. ADDIE Developmental Model Stages

Stages of Development	Activity
Analysis	Initial planning. So some analysis to procure new media products. Conduct needs analysis, student analysis and curriculum analysis. So that the product procuced can meet axisting needs according to the characteristics of student and contained in the learning curriculum in SLB Kemala Bhayangkari 1 Trenggalek
Design	Design the materal to be used. Learning media products and intructions for use Arrange the learning implementation plan used. Design instruments for media enhancements
Development	Develop product device with media validation by validator. Repaired according to the advice given. Tested at SLB Kemala Bhayangkari 1 Trenggalek

The compatibility rate of the math blind game is made by using the questionnaire from SUS. The total result of the SUS score can be argued worthy or does not use the following SUS scoring matrix.

Table 2. SUS Scoring Matrix

SUS Score	*Grade*	Information
80,3 - 100	A	Acceptable
74 – 80,2	B	
68 – 73	C	
51 – 67	D	Not Acceptable
0 – 50	F	

Source: (Sauro & Lewis, 2011)

To obtain research data, the researcher compiled sus questions. the sus questions are presented in table 3.

Table 3. Sus Questionnaire

No	Question	Score				
		1	2	3	4	5
1	*I will be using this system on a regular basis*					
2	*I think this system is too complex*					
3	*I consider that the system is easy to use*					
4	*I think I need technical assistance to use the system*					
5	*I think the functions or features provided on this system are well designed*					
6	*I rate too many discrepancies in this system*					
7	*I have a feeling most people will find this system easy to use quickly*					
8	*I think the system is very complicated to use*					
9	*I feel very confident when using this system*					
10	*I need to learn many things before I can use this system properly*					

Findings

This research produced a new product of math blind game with voice and QR codes as learning media for blind students. The subjects of this study were 10 blind students grade 4th – 6th at SLB Kemala Bhayangkari 1 Trenggalek.

Analysis Stage

Needs analysis was conducted using interviews to teachers and students at SLB Kemala Bhayangkari 1 Trenggalek to know the problems related to the process of lerning mathematics. Based on the results of interviews with blind students and teachers at SLB Kemala Bhayangkari 1 Trenggalek, students still have difficulty learning about integers. Students need a medium to more easily understand integer material. Integer material consists of addition, subtraction, division and multiplication which is the basic material of mathematics. Blind students are expected to be able to understand the basic material of mathematics easily. In addition, at the school there is no media that can help students learn

mathematics more easily. The student only uses braille. Thus, It was necessary to develop media that could help students learn about integer operations. Furthermore, the student analysis such as characteristics and the level of student blindness found were low vision, partial sighted and totally blind students, and analysed the level of students' interest in using learning media. So blind math games which are semi-digital math education games for visually impaired people based on sound and QR codes can be learning media for blind student.

Design Stage

Designing Math Blind Games begins by drawing the design and size of the Math Blind Games, the size of Math Blind Games is 35 x 25 x 6,5cm (length x width x height with 6 section and 1 question in section box. The types of questions in the Math Blind Games are include addition, subtraction, multiplication, division, power, and root form. The questions are arranged from easy to difficult questions. Each question has different points according to the difficulty level of the 6 questions. For the division of the level of the question consists of 4 (four) parts, namely: 1) Addition and subtraction problems (worth 0.5 points), 2) Addition, subtraction, and multiplication problems (worth 1 point), 3) Multiplication and division problems (worth 2 points), 4) Questions to the ranks and roots (worth 3 points). When a player answers the question incorrectly, the player has to take the penalty card. In each box, there will be 2 buttons in the form of questions and answers, the questions are on the left, and the answers are on the right, besides that in each box there are also braille numbers to direct players (blind) in playing Math Blind Games. Besides there are 6 boxes or 6 questions, on the Math Blind Games board there is a card holder that is used to put down penalty for players who give the wrong answer.

On the card, there is a QR Code that is useful for making it easier for blind people to read the commands on the card. The QR Code contains a question, a ten second countdown, and the answer. The function of this QR Code is to make it easier for blind people to read the commands on the card.

Picture 1. Math Blind Games

Development Stage

Usability Measurement and Advantages of Math Blind Games as a Math Educational Game for the Blind. In measuring the usability of the Math Blind Games, the SUS questionnaire was filled with 10 participants. Participants Iin considered Math Blind Games to have excellent usability (Grade A), Ye participants considered Math Blind Games to have good usability (Grade A), Fe participants considered Math Blind Games to have quite good usability (Grade C), In the participant Na assessed that the Math Blind Games had good usability (Grade B), in the participant Jo considered the Math Blind Games to have very good usability (Grade A), the Ay participants considered the Math Blind Games to have excellent usability (Grade A), Fa's participants considered Math Blind Games to have good usability (Grade B), Al's participants considered Math Blind Games to have excellent usability (Grade A), Ra's participants considered Math Blind Games to have good usability (Grade B), at Ca participant considered the Math Blind Games to have excellent usability (Grade A). Thus, based on the 10 participants, the average total value of the SUS Score was obtained that this product was declared feasible, namely with an average value of 83.75 (Grade A).

Math Blind Games has advantages and disadvantages as a math educational game for the visually impaired. The advantage of the Math Blind Game is that there are questions and explanations in the form of sound, making it easier for blind people to play and use this product. Then, Math Blind Games can be played anywhere and portable, because they can be printed easily. In addition, Math Blind Games can also make learning mathematics more enjoyable among children who feel difficult in the process of learning mathematics. On the other hand, the drawback of Math Blind Games is that it still requires an instructor as a companion to oversee the game process for blind children. In addition, Math Blind Games is not waterproof because it is made of electronics which will die if it is hit by water. In the future, Math Blind Games can be modified into digital-based math games for the visually impaired.

Table 4. Usability Results Assesment of Math Blind Game

No	Player	*Assessment SUS Questionnaire										Total SUS Score
		1	2	3	4	5	6	7	8	9	10	
1	Ii	5	5	5	5	1	5	1	3	5	5	95,0
2	Ye	5	5	5	5	2	4	1	1	4	5	92,5
3	Fe	4	5	3	5	2	5	4	5	4	5	70,0
4	Na	3	5	5	5	2	5	2	3	4	4	80,0
5	Jo	4	5	5	5	1	5	1	3	5	5	92,5
6	Ay	4	5	4	5	2	5	1	3	4	5	85,0
7	Fu	3	5	4	5	2	4	2	3	4	5	77,5
8	Al	4	4	4	5	2	4	1	3	5	5	82,5
9	Ra	3	4	4	5	1	4	2	2	3	5	77,5
10	Ca	3	5	5	5	1	5	1	3	4	4	85,0
Total Mean SUS												**83,75**

Usability Measurement and Advantages of math blind games as a math educational game for the blind. In measuring the usability of the Math Blind Games, the SUS questionnaire was filled with 10 participants. Thus, based on the 10 participants, the average total value of the SUS Score was obtained that this product was declared feasible, namely with an average value of 83.75 (Grade A).

This section is the most important section of your article. The analysis or results of the research should be clear and concise. The results should summarize (scientific) findings rather than providing data in great detail. Please highlight differences between your results or findings and the previous publications by other researchers. (Cambria, 12pt, spacing 1.15)

Discussion

This study aims to find out how to design the Math Blind Game as a math educational game for the blind and how the results measure the usefulness and superiority of the Math Blind Game as a math educational game for the blind. This research was conducted at SLB Kemala Bhayangkari 1 Trenggalek. The type of research used is research and development (R&D) with 3 stages, namely analyze, design and develop.

The analyze phase was carried out to obtain information regarding the needs of learning media for blind students at SLB Kemala Bhayangkari 1 Trenggalek. Information collection was carried out by interviewing teachers and students. The results of the needs analysis show that students of SLB Kemala Bhayangkari 1 Trenggalek need learning media other than braille to be able to improve learning outcomes, especially math.

Based on the results of the needs analysis, then the design of learning media for blind students was carried out. Learning media is designed with a minimalist design to make it more flexible. Learning media uses cardboard material and is equipped with audio which can be accessed via the QR Code found on the paper. This is in accordance with the results of research (Sari et al., 2019) which shows that audio-based learning media can increase the cognitive value of blind students. Designing Math Blind Games begins by drawing the design and size of the Math Blind Games, the size of Math Blind Games is 35 x 25 x 6.5cm (length x width x height with 6 sections and 1 question in the section box. On the card , there is a QR Code that is useful for making it easier for blind people to read the commands on the card.The QR Code contains a question, a ten second countdown, and the answer.The function of this QR Code is to make it easier for blind people to read the commands on the card.

After making the design, then a validity test was carried out to measure the usefulness and advantages of math blind games. Usability was measured using the SUS questionnaire. based on the 10 participants, the average total value of the SUS Score was obtained that this product was declared feasible, namely with an average value of 83.75 (Grade A). Blind students think that math blind games are very useful for helping students learn math.

The development of learning media for math blind games with voice and qr code as learning media for blind students was declared to have high eligibility with an SUS score of

83.75%. Students have a good response when the math blind game with voice and qr code is presented to students in learning mathematics. This is in accordance with the results of research (Wardhani et al., 2021) which states that learning media using braille texts and QR codes that link to video explanations for blind students can improve student learning outcomes in biology subjects. Math blind games are equipped with sound, this is very helpful for blind students when learning. This is in accordance with the results of research Aziz et al., (2021) and Fadiana et al., (2014) which says that learning media with audio is very effective for blind students.

Blind students need special media in learning. Math blind games can be an alternative for students to increase their ability to count in an easy and fun way. Math blind games can train students to focus and can improve hearing. This is in accordance with the results of research (Jannah, et al., 2021) which states that learning media with braille and audio over speech can improve tactile and hearing abilities so that blind students besides being able to improve their cognitive development can also increase vocabulary by repeating information. obtained independently so that their memory increases.

The media that are often used as learning media for blind students include braille and audio-based learning media. Audio-based learning media is proven to improve the cognitive abilities of blind students. Based on the results of the study (Ridiani & Irda Murni, 2019) stated that there was an increase in the ability to operate arithmetic addition series through blokjes media. Where blockjes media consists of square cubes and there are small cubes that publish braille numbers. This shows that audio-based learning media can help blind students in the learning process.

Math Blind Games has advantages and disadvantages as a math educational game for the visually impaired. The advantage of the Math Blind Game is that there are questions and explanations in the form of sound, making it easier for blind people to play and use this product. Then, Math Blind Games can be played anywhere and portable, because they can be printed easily. In addition, Math Blind Games can also make learning mathematics more enjoyable among children who feel difficult in the process of learning mathematics. On the other hand, the drawback of Math Blind Games is that it still requires an instructor as a companion to oversee the game process for blind children. In addition, Math Blind Games is not waterproof because it is made of electronics which will die if it is hit by water. In the future, Math Blind Games can be modified into digital-based math games for the visually impaired.

Conclusion

Based on the research that has been done, conclusions could be reached as follows:

1. Math Blind Games has a size 35 x 25 x 6,5cm (length x width x height) with 6 section and 1 problem in each section. The types of questions in the Math Blind Games discuss addition, subtraction, multiplication, division, power, and root form. Math Blind Game can be played by using a button and a special smartphone for blind people to scan the QR Code and bring up the sound output.

2. Based on the assessment of 10 (ten) participants, the total value of the SUS Score was 83.75 (grade A) which can be concluded that the Math Blind Game has very good usability. In addition, Math Blind Game has advantages or advantages over math educational games for the visually impaired, which are equipped with voice features, are portable to use, and make learning mathematics more enjoyable. Thus, it can be concluded that the Math Blind Game is effective and appropriate to be used as a math education game for the blind.
3. The material paper that used to make math blind games can be change to other materials to make it more durable. The mathematic subject that contained in the Math Blind Games which is elementary school mathematics level, can be added with mathematics material for the next level, such as junior high and high school levels, could be supplemented with further mathematical subject, such as junior and high schools.

References

Abdusamatova, N. (2022). Role of Visual Aids in Teaching English Grammar in Secondary Classes. Scientific Progress, 3(1), 62–66.

Afifah, N. L., Murtono, Santoso, & Ardianti, S. D. (2021). Development of Pocket Book Based on Science Literacy. Journal of Physics: Conference Series, 1823(1). https://doi.org/10.1088/1742-6596/1823/1/012075

Alif, M., 2020. Pengertian QR Code. [Online] Available at: https://www.mastekno.com/id/pengertian-kode-qr/ [Diakses 28 Mei 2020].

Al-Jaleeli, Y. A. R., & Galimyanov, A. F. (2018). Supporting education of people with visual disabilities using braille codes and QR code technology. Amazonia Investiga, 7(15), 150–156. https://www.amazoniainvestiga.info/index.php/amazonia/article/view/433

Amalia, N. R. (2022). The Implementation Of Distance Learning In English Subjects To Visually Impaired Students At Slb-A Pembina.

Aziz, N., Ahmad, S. Z., Rahman, W. R. Z. W. A., & Binsaleh, S. (2021). Design and Development of Affective 4-Dimensional Mobile Mathematics for Low Vision Alpha Generation. TEM Journal, 10(4), 1828–1837. https://doi.org/10.18421/TEM104-46

Fadiana, M., Seftia, I., Widiyanti, R., & Mizan, S. (2014). Development of Tactile Audio Media for Low Vision Students. 6(1), 59–66.

Hoskin, E. R., Coyne, M. K., White, M. J., Dobri, S. C. D., Davies, T. C., & Pinder, S. D. (2022). Effectiveness of technology for braille literacy education for children: a systematic review. Disability and Rehabilitation: Assistive Technology, 0(0), 1–11. https://doi.org/10.1080/17483107.2022.2070676

Igirisa, S. S., Fuad, Y., & Ismail, S. (2019). Development of Braille Number Card As Learning Media on Integer Materials for Blind Students. International Journal for Educational and Vocational Studies, 1(4), 268–272. https://doi.org/10.29103/ijevs.v1i4.1604

Jannah, D., Samsiah, E., Dewi Widyandana, L. A., Hadist, E. T., Maharani, F. E., & Soemantri, S. (2021). Penguatan Konsep Bangun Datar Dan Satuan Panjang Pada Siswa Tunanetra Melalui Media Blind's Playpad. *Program Studi Pendidikan Matematika*, 1023-1029.

Kim, J. H., Kim, M., Yang, T., Kim, I., Seo, J., & Kang, S. (2018). Compressed QR code-based mobile voice guidance service for the visually disabled. International Conference on Advanced Communication Technology, ICACT, 2018-Febru, 423–425. https://doi.org/10.23919/ICACT.2018.8323780

Lupetina, R. (2022). the Braille System: the Writing and Reading System That Brings Independence To the Blind Person. European Journal of Special Education Research, 8(3), 1–13. https://doi.org/10.46827/ejse.v8i3.4288

Maćkowski, M., Żabka, M., Kempa, W., Rojewska, K., & Spinczyk, D. (2020). Computer aided math learning as a tool to assess and increase motivation in learning math by visually impaired students. Disability and Rehabilitation: Assistive Technology, 0(0), 1–11. https://doi.org/10.1080/17483107.2020.1800116

Nurqamar, D., & Nur, I. R. D. (2022). Comparative Study of Indonesian Students' Mathematical Literacy Abilities with Other Countries in Terms of PISA Type HOTS. Eduma: Mathematics Education Learning …, 11(1), 45–56. https://www.syekhnurjati.ac.id/jurnal/index.php/eduma/article/view/9924

Persatuan Tunanetra Indonesia (Pertuni) Pertuni. [Online]

Available at: http://pertuni.or.id /siaran-pers-peran-strategis-pertuni-dalam-memberdayakan-tunanetra-di-indonesia/ [Diakses 24 Mei 2020].

Ramly, S. N. F., Ahmad, N. J., & Mohd Said, H. (2022). The Development of Innovation and Chemical Entrepreneurship Module for Pre-University Students: An Analysis Phase of ADDIE Model. Journal of Natural Science and Integration, 5(1), 96. https://doi.org/10.24014/jnsi.v5i1.16751

Rindiani, & Irdamurni. (2019). Media Blokjes untuk Meningkatkan Kemampuan Operasi Hitung Anak Tunanetra. *Jurnal Penelitian Pendidikan Kebutuhan Khusus*, 148-153.

Sari, A. C., Fadillah, A. M., Jonathan, J., & Prabowo, M. R. D. (2019). Interactive gamification learning media application for blind children using android smartphone in Indonesia. *Procedia Computer Science*, *157*, 589–595. https://doi.org/10.1016/j.procs.2019.09.018

Singla, A. (2022). Trends And Challenges In The World Of The Blind For. 6(4), 1213–1229.

Wardhani, Y. S., Al Muhdhar, M. H. I., Prasetyo, T. I., & Sumberartha, I. W. (2021). Developing islamic values-based biology smart cards for the eleventh-grade students of special school. Jurnal Pendidikan Biologi, 12(2), 146–157.