

## The "MATHEMA" application as a Mathematics Learning Media for Children with Down Syndrome

Fadilah Halfa Amatullah, Sunardi, Mughni Puspa Annisi

Universitas Pendidikan Indonesia, Bandung, Indonesia

E-mail: [fadilahhalfa@upi.edu](mailto:fadilahhalfa@upi.edu)

**Abstract:** This research aims to create application-based learning media to help ease children with Down syndrome in learning mathematics. The research method used is a qualitative method, with research subjects of teachers, parents, and children with Down syndrome grade three SDLB. In accordance with the results of the analysis of objective conditions of the ability, inability, and needs of the subject, as well as theoretical analysis of learning mathematics, a 'Mathema' application was developed, namely an interactive learning media in which there are features to learn about the concept of numbers, number sequences, number symbols, and addition and subtraction operations, which based on conceptual validation is feasible to use and based on empirical validation has proven effective for improving the ability to learn mathematics in the subject so that the findings of the 'Mathema' media are expected a solution for teachers in helping ease learning mathematics in children with Down syndrome.

**Keywords:** Mathema, learning media, down syndrome

### INTRODUCTION

Humans need the knowledge to be able to adapt to the environment in the form of meeting their needs. The learning process is the process of acquiring knowledge and knowledge in humans (Ahdar & Wardana, 2019). Therefore, it is appropriate for everyone to get the right to learn to improve their abilities.

For children with special needs, an educational service is needed to support their learning and development process according to their individual learning needs to be more optimal (Sukadari, 2019). One of them is by creating learning media that will support the learning process of children with special needs in class. Learning media is a component that supports the teaching and learning process in the classroom (Muhtar, et al., 2020). Learning media is developed in accordance with the program objectives that educators want to achieve (Haifa et al., 2022). Learning media helps children to understand the material being studied, besides that for children the existence of learning media for teachers also makes it easier to be clearer in explaining material either in the support of semi-concrete media or concrete media. This is in line with research (Nurrita, 2018) which explains that learning media makes the teaching and learning process interesting and easy for students to convey material. Delivering material to children with special needs, of course, must be adapted to the child's condition, namely based on the results of an assessment that includes what is the child's ability, the child's inability, and the child's needs. All subjects studied by children with special needs would be better if using learning media as a support so that children understand more, this is in line with the explanation regarding media according to the Association for Education and Communication Technology (AECT), which defines the word media as all forms and channels that used for information processing (Nurseto, 2011). So learning media can be interpreted as an intermediary to facilitate the process of guiding learning information. As we know that children with intelligence barriers include children with Down syndrome, who have three main characteristics, namely: low intellectual intelligence (IQ), physical and mental

disabilities, and a weak immune system (Swamilaksita, 2022; Sartinah et al, 2023). Therefore, in the learning process, children with Down syndrome are unable to learn abstractly and this is in line with the statement of McGuire & Chicoine (2006), that mentally retarded children are less capable of thinking about abstract, difficult, and convoluted things. Also explained by Rochyadi (2012), one of the academic characteristics of children with intelligence inability is that if they are given arithmetic lessons that are only able to range for a few minutes they will immediately say bored, difficult, and lonely, so the teacher's creativity in providing interesting learning media and being able to improve children's enthusiasm during the learning process.

Counting is synonymous with learning mathematics (Susanti, Yantoro, & Kurniawan, 2020). Depdiknas (2003) states that mathematics is the science of numbers, correlations between numbers, and operational procedures used to solve numbers-related problems. Math is used in everyday life; without it, the world would be missing an important component in its makeup (Mad Amin et al., 2020). A person's ability to think logically will be increasingly strained by studying mathematics because mathematics lessons require careful thinking and reasoning about numbers or numbers. However, mathematics is often considered difficult for some students due to the demands of careful and logical thinking in studying mathematics. This is in line with the problem of a child experiencing intelligence inability (down syndrome), where children have inability in the learning process, especially in mathematics. Down syndrome children have difficulties in learning mathematics abstractly. This is in line with the results of the mathematical assessment carried out by researchers. Not only that, researchers confirmed to class teachers and parents of children with Down syndrome. From the results of the interview, it was justified that this child with Down syndrome had difficulties in learning mathematics. Children do not understand the concept of arithmetic operations (addition and subtraction) and are not familiar with symbols in arithmetic operations (addition and subtraction). Based on the results of the assessment that has been carried out, the existence of this media is very necessary, the existence of semi-concrete objects such as pictures, or concrete objects such as objects around children can make it easier for children to learn mathematics. However, there are problems encountered in the field, for teachers, it is difficult to provide appropriate media in teaching mathematics material. Like the concept of counting, maybe the media used in problems in this field is less varied apart from number cards, apart from the lack of variety in the provision of learning media, the large number of conventional media made by teachers does not last long due to material and strength factors which are prone to damage, and the level of high complexity for teachers in developing conventional learning media, especially in mathematics learning material if it has entered into the process of adding and subtracting number operations.

From the description of the problems above, several preliminary studies conducted by (Yeni, et al., 2013) state that PowerPoint media can improve the ability to recognize numbers 1 to 5 in children with Down syndrome in class VI SLB Luki Padang. Furthermore, research (Dianasari, et al., 2022; Putri et al, 2022) shows that mini billiard game media is appropriate for use in the learning process for the introduction of numbers 0 to 9 for students with Down syndrome. Research from (Saputra, 2021) explains that there is a change in learning outcomes for recognizing the numbers p 1 to 20 in children with Down syndrome with server-based educational games. As for research (Bakhtiar, 2022), the Busy Book learning media is effective for use in material for counting objects from 1 to 10. In research (Dico et al., 2023) explains the use of CAI media (Computer Game Educational Mathematics Based Assisted Instructional (GEMA)) influences the ability to count 1-10 in mentally retarded students. And also research (Abdulrahaman et al, 2020)

states that there is an increase in students' recognition of numbers 11 to 20 through computer animation media. From the preliminary studies described earlier, learning media generally only contains number recognition as in research. Through the results of existing preliminary studies, researchers offer a solution by developing high-tech-based learning media for children with Down syndrome, namely by making an android-based application, namely the Mathema application. The use of Android-based applications as learning media for children with special needs has a positive impact such as students being happy and attracting their attention (Maulana et al., 2015). The Mathema application as a learning medium is made to help make it easier for children to understand the material which includes the concept of counting, the concept of numbers, the concept of addition, and the concept of subtraction. Apart from that, it also increases the enthusiasm of children in learning by involving gadgets or cellphones as one of the objects that children like, besides making it easier for children, it also makes it easier for teachers to deliver the mathematics learning material.

## **METHOD**

The method used is a qualitative method. The subjects in this study were class teachers, parents, and children with Down syndrome class III SDLB. The information extracted using qualitative methods is how the process of learning mathematics for children with Down syndrome is in grade 3 SDLB and how is the child's ability to learn academic mathematics so far at SLBN B Garut. Based on these needs, the method used is a qualitative method to obtain an overview of the problems that are explored to contribute to the development of application-based learning media to improve children's ability to learn to count. Then proceed with the development of application-based learning media to improve children's ability to learn mathematics in children with Down syndrome at SLBN B Garut, at this stage the researcher makes application-based media and then validates it by a team of media experts according to the profile of children with down syndrome. After the application is declared valid and feasible to apply to children. After that, trials were carried out to determine the effectiveness of the Mathema application. The data collection techniques used in this research are interview and observation techniques. After the data has been collected, data analysis is carried out with the following steps: (1) data reduction, which is checking and re-recording the data that has been collected; (2) data presentation, which is data arranged systematically in the form of narrative text (in the form of field notes); and (3) conclusion drawing, based on the analysis of observation results that have been adjusted to the research objectives.

## **FINDING AND DISCUSSION**

Researchers observed the initial conditions of cases in one of the special schools in Garut. The first stage carried out by researchers was identification and assessment (Irvan, 2020). The process of identifying this problem involves interviewing class teachers and parents to find out whether there are children who experience an inability in academic development. After the identification is carried out, refer to one of the children with Down syndrome in grade 3 of SDLB who experiences an inability in learning mathematics. After the identification results, the researcher conducted an assessment of the child who had been referred (Dewi, 2018). The assessment used is a formal test assessment, namely a mathematical assessment. Based on the results of the assessment of children with Down syndrome, ability, inability, and needs can be identified, this is what is known as the child's profile.

**Table 1. Profiling**

<b>Ability</b>	<b>Inability</b>	<b>Needs</b>
Children can name numbers 1-10 abstractly and sequentially.	Children are not yet able to show number symbols according to the concrete objects provided	Shows the number symbol according to the concrete object provided.
The child can understand the concept of time (morning, afternoon, evening), by matching the activities according to the semi-concrete description of time using pictures	Children do not understand the concept of the amount of a number	Match numbers with the number of objects
Children already understand the concept of the number of objects that are more/less in concrete, semi-concrete and abstract terms.	Children are not yet able to recognize symbols in number operations.	Match the number operation symbols as mentioned by the teacher
Children can recognize 2 currencies, namely Rp. 1000-, and Rp. 2000-,	Children are not yet able to understand all the concepts of number operations both concretely, semi-concretely, and abstractly.	Provide concrete addition and subtraction operations concept training with Barura.
	Children are not yet able to distinguish the types of currency	Group the types of currencies based on their value Sort the types of currencies based on their value from smallest to largest and/or vice versa
		Train Pre-requisite mathematics in classification

After conducting an assessment and knowing the child's profile, in general, children with Down syndrome experience difficulties in learning mathematics in the abstract. So the researchers compiled appropriate learning media for children with Down syndrome based on their needs. One of the roles of learning media is to be able to concretize things that are abstract in nature and help children to make it easier to understand the subject matter, especially in mathematics lessons (Susanti, 2020).

Based on the problems described, the researchers offer a solution by designing high-technology-based learning media for children with Down syndrome, namely by making an android-based application, namely the Mathema application. After the researcher has finished designing the Mathema application-based learning media, it will be validated by the validator. The validator for this learning media is the lecturer as a team of media experts. Validation was carried out twice when presenting the results of the learning media design. In the first validation, the researcher designed three learning media before finally establishing one learning media that was validated by the lecturer. After that, the researcher designed a concept regarding the Mathema application. With the design concept of the Mathema application is as follows. Mathema application is an Android-based application that is specifically designed based on the subject's conditions, which include the subject's ability, inability, and needs. The mathema application is a learning medium that supports and helps subjects to easily understand mathematics learning material. The scope of material in the Matema application is based on KI/KD Mathematics for SDLB grade 3 regarding the introduction of natural numbers up to 40 using objects around them and the introduction of arithmetic operations on natural numbers. Judging from the contents of the math KI/KD presented, this Mathema application develops material coverage regarding the concept of counting, ordering numbers, the concept of sum, and the concept of addition and subtraction operations. This application can be used on various types of Android-based mobile phones and can be used offline or without a network. The

functions of making this mathema application are (1) to make it easier for children to learn mathematics with visual and auditory support, (2) to make it easier for children to learn mathematics in a semi-concrete and abstract manner, (3) to make children learn mathematics with pleasure. There are steps for using the Mathema application, which are as follows: (1) register by filling in your name, age and class, (2) enter into the application by entering your name and class, (3) click the Mathema learning feature to start learning mathematics, (4) learning mathematics in the mathema application will start from the level of group numbers ranging from 1-10 (but optionally can be selected according to the needs and conditions of the child, (5) then select the features of learning mathematics content according to needs (counting, number concepts, subtraction and summation, (6) if you have used the learning feature, then click the evaluation feature, (7) select the mathematics learning content to be evaluated, (8) do the questions that appear in the application, (9) the application will give a correct mark if the question done correctly, and vice versa the application will give an error sign if the question is not correct, (10) the application has a score feature to see the score obtained from the results of working on evaluation questions, (11) users can see all your score values in the profile feature, ( 12) if you are already using the application, the application will automatically log out of the user account. The description of the contents of the Mathema application is as follows.



Figure 1. Display of mind mapping-based teaching materials



Figure 2. Display of the Mathema application

After the design of this learning media was completed, a second presentation was carried out to validate the learning media. The results of the presentation stated that the Mathema application was valid so that the Mathema application-based learning media was feasible to be applied to children with Down syndrome. The next researcher conducted trials on subjects who experienced inability in learning mathematics.

In testing the use of the Mathema application, the learning process became easier to provide children with an understanding of the concept of counting and sorting, the concept of quantity, and the operations of adding or subtracting numbers. Through the use of the Mathema application, children can survive learning for a longer duration than usual. In content counting and sorting numbers, it makes it easier for children and also teachers to introduce numbers both in form (visualization) and how to pronounce them (auditory), for content to understand the concept of numbers with the help of egg illustration objects in

the application, while for the concept of addition operations and subtraction helps make it easier for children to understand the addition and subtraction process starting with introducing the signs used in the subtraction and addition operations, such as the plus sign (+), minus sign (-), and equals (=), in addition to introducing the sign - With this sign, through the Mathema application it becomes easy for children to carry out addition and subtraction operations because of the image of an egg as a child's visualization aid when adding or subtracting numbers. Children show pleasure when they get a correct mark visually and auditory as a form of appreciation given by the application, and children also become more enthusiastic if they get a "wrong" sign by trying to do the next question correctly, then through the Mathema application it makes it easier for the teacher to recap the results of the value obtained by the child when working on evaluation questions. Therefore, learning media based on the Mathema application can be said to be effective because it meets the predetermined criteria, namely accuracy in learning objectives, suitability for the content of the subject matter, ease of obtaining media, teacher skills in its use, availability of time in use, by the stage of thinking of students (Nurrita, 2018).

There are advantages and disadvantages to the mathema application after testing the subject. The advantages are (1) the mathema application makes learning mathematics fun, (2). The mathema application can make children interested in learning mathematics, (3) the mathema application can provide a different sensation of learning mathematics such as educational games, (4) the mathema application helps visual and auditory mathematics learning, (5) the mathema application helps semi-concrete mathematics learning and abstracts, (6) the mathema application can be used on all types of android cellphones, (7) the mathema application can be used when offline or without a network, (8) the mathema application can make it easier for teachers to recapitulate children's acquisition scores in learning mathematics. While the drawbacks are (1) only being able to learn mathematics in the use of numbers ranging from 0-40 and (2) only using image visualization with one shape. The development of the mathema application is in line with research (Revita, 2021) which revealed that based on field observations by utilizing this interactive learning media for students with special needs, it was found that several things students were interested in the pictures that came out of the media, students were motivated in learning can be seen from repeating the media continuously and the teacher finds it easy to convey the material and this can all be seen when the subject uses the mathematic application.

## CONCLUSION

The development of mathematics application-based learning media is based on objective conditions on the ability, inability, and needs of children in learning mathematics. The trial phase which was carried out with media experts met the predetermined criteria so that the Mathema application developed was suitable for use in learning activities. Test trials conducted on the Mathema application are said to be effectively used in learning mathematics with material on the concept of numbers, the concept of number sequence, the concept of number symbols, and the concept of arithmetic and subtraction operations. The Mathema application is expected to be one of the solutions for teachers to help facilitate the learning of mathematics in children with Down syndrome.

## REFERENCES

- Abdulrahman, M. D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T., Olawoyin, L. A., Mejabi, O. V., ... & Azeez, A. L. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, 6(11).
- Ahdar, A., & Wardana, W. (2019). Belajar dan pembelajaran: 4 pilar peningkatan kompetensi pedagogis. [Learning and study: 4 pillars of improving pedagogical competence]

- Bakhtiar, A. M. (2022). Pengembangan Media Busy Book untuk Materi Membilang Benda Anak Tunagrahita Ringan [Development of Busy Book Media for Numbering Materials for Children with Mild Tunagrahita]. *Didaktika: Jurnal Pemikiran Pendidikan*, 28(2), 103-108.
- Depdiknas. 2003. Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional [Law of the Republic of Indonesia Number 20 Year 2003 on the National Education System]. Jakarta: Depdiknas.
- Dewi, D. P. (2018). Asesmen sebagai upaya tindak lanjut kegiatan identifikasi terhadap anak berkebutuhan khusus [Assessment as a follow-up to identification activities for children with special needs]. *Wahana*, 70(1), 17-24.. <https://doi.org/10.36456/wahana.v70i1.1563>
- Dianasari, E. L., Khairiyah, K. Y., & Uswatun, P. (2022). Pengembangan Permainan Biliar Mini Untuk Pengenalan Angka 0 Sampai 9 Pada Siswa Down Syndrome Di Slb Negeri Karimun [Development of a Mini Billiards Game for the Introduction of Numbers 0 to 9 for Down Syndrome Students at Slb Negeri Karimun]. *Jurnal Judikhu*, 2(1), 55-62.
- Dico, A. M., Hastuti, W. D., & AM, M. S. (2023). Math Educational Game (GEMA) Based on CAI (Computer Assisted Instruction) in Learning Simple Counting for Mentally Impaired Students. *Journal of ICSAR*, 7(1), 159-166. <https://doi.org/10.17977/um005v7i12023p159>.
- Haifa, N., Respati, R., & Chairunnisaa, C. (2022). Word Cards Design as Learning Media for Dyslexia Students in Elementary School. *Journal of Education for Sustainability and Diversity*, 1(1), 109-117. <https://doi.org/10.57142/jesd.v1i1.11>
- Irvan, M. (2020). Urgensi Identifikasi Dan Asesmen Anak Berkebutuhan Khusus Usia Dini [The Urgency of Early Identification and Assessment of Children with Special Needs]. *Jurnal Ortopedagogia*, 6(2), 108-112. <https://doi.org/10.17977/um031v6i22020p108-112>
- Mad Amin, A., Tahar, M., & Zakaria, A. (2020). Mathematical Learning Approach for Special Education Pupils: The Effectiveness of Mauselis Board in Improving Adding Skills. *Journal of ICSAR*, 4(2), 1–6.
- Maulana, G. R., Widyastono, H., & Rahman, A. (2015). Android Needs Analysis as A Mobile Learning Media in Special School. 1, 13–21.
- McGuire, D., & Chicoine, B. (2006). Mental wellness in adults with Down syndrome. *Bethesda, MD: Woodbine*.
- Muhtar., dkk. (2020). Pengembangan Media Pembelajaran IPA berbasis Information Communication and Technology (ICT) [Development of Science Learning Media based on Information Communication and Technology]. *PEDADIDAKTIKA: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, 7(4), 20–31. <https://doi.org/10.17509/pedadidaktika.v7i4.26455>
- Nurrita, T. (2018). Pengembangan media pembelajaran untuk meningkatkan hasil belajar siswa. [Development of learning media to improve student learning outcomes] *Jurnal misykat*, 3(1), 171-187.
- Nurseto, T. (2011). Membuat media pembelajaran yang menarik [Creating interesting learning media. *Journal of Economics and education*]. *Jurnal Ekonomi dan pendidikan*, 8(1), 19–35. <https://doi.org/10.21831/jep.v8i1.706>
- Putri, R. S., Siswanto, W., Sunandar, A., Sumarsono, R. B., Junaidi, A. R., & Ediyanto, E. (2022). Pengembangan media finger coloring untuk anak down syndrome dalam melatih keterampilan mewarnai. *Jurnal ORTOPEDAGOGIA*, 8(1), 6-11.
- Revita, E. (2021). Pengembangan Media Pembelajaran dan Game Interaktif Bagi Anak Berkebutuhan Khusus. [Development of Interactive Learning Media and Games for Children with Special Needs] *Jurnal Edik Informatika Penelitian Bidang Komputer Sains dan Pendidikan Informatika*, 8(1), 53-60.
- Rochyadi, E. (2012). Karakteristik dan Pendidikan Anak Tunagrahita [Characteristics and education of children with disabilities]. *Pengantar Pendidikan Luar Biasa*, 1-54.
- Samsu. (2017). *Research Methods: Theory and Application of Qualitative, Quantitative, Mixed Methode, and Research & Development Research* (Print I ed.). Center for Religious and Social Studies (PUSAKA).
- Saputra, M. R. (2021). *Game Edukasi Berbasis Server Sebagai Evaluasi Pembelajaran Pada Anak Down Syndrome* [Server-based Educational Game as Learning Evaluation for Down Syndrome Children] (Doctoral dissertation, Universitas 17 Agustus 1945 Surabaya). <https://www.gameart2d>.
- Sartinah, E. P., Andajani, S. J., & Pamuji, P. (2023). Prototype Development of Social Personal Guidance Guide using Role-Playing Techniques to Improve Social Interaction of Children with Intellectual Requirements. *Journal of ICSAR*, 7(1), 125-129. doi:<http://dx.doi.org/10.17977/um005v7i12023p125>.

- Susanti, E., Yantoro, Y., & Kurniawan, A. R. (2020). Strategi Guru dalam Pembelajaran Berhitung Pembagian di Sekolah Dasar. *Jurnal Al-Adzka*, 1(1), 53.
- Susanti, Y. (2020). Pembelajaran Matematika Dengan Menggunakan Media Berhitung Di Sekolah Dasar Dalam Meningkatkan Pemahaman Siswa. [Learning Maths Using Counting Media in Primary Schools to Improve Student Understanding] *EDISI: Jurnal Edukasi Dan Sains*, 2(3), 435–448. <https://ejournal.stitpn.ac.id/index.php/edisi>
- Swamilaksita, P. D. (2022). Overcoming Health Risk of Down Syndrome Child with Obesity: Systematic Review. *Journal of ICSAR*, 6(2), 205-215. <https://doi.org/10.17977/um005v6i22022p205>
- Yeni, M. F., Fatmawati, F., & Yunus, M. (2013). Meningkatkan Kemampuan Mengenal Angka 1 Sampai 5 Melalui Media Power Point bagi Anak Down Syndrom (Single Subject Research di Kelas D6/C SLB Luki Padang). [Improving the Ability to Recognise Numbers 1 to 5 through Power Point Media for Children with Down Syndrome (Single Subject Research in Class D6/C SLB Luki Padang)] *Jurnal Penelitian Pendidikan Khusus*, 2(3). 845–853. <http://ejournal.unp.ac.id/index.php/jupekhu>