

A Learning Media Based on Hands-on Activity in Mathematics for Students Special School

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Abstract

The use of hands-on activity-based mathematics learning media for children with mental disability and cerebral palsy is largely unexplored. Meanwhile, observations of children with special needs (mental disability and cerebral palsy) at school have not shown good basic math skills, such as counting, recognizing numbers, recognizing letters, performing math operations (for example, addition and subtraction). This study aims to develop a hands-on activity-based learning media model for children with mental disability and cerebral palsy to improve understanding of mathematics in reading, writing, and arithmetic subjects. The method used is Research and Development, where the subject is the Special School in Bandung, Indonesia. The instruments used in this study were documentation, classroom observation, interviews, and tests of mathematical comprehension abilities. The results showed that a hands-on activity-based learning model could be used to improve basic math skills in reading, writing, and arithmetic for children with mental disability and cerebral palsy.

Keywords: learning media, hands on activity, mathematics, mental disability, cerebral palsy

1. Introduction

The general public's understanding of children with special needs is still very low. Most of them think that they don't have any abilities. Children with special needs are children with special characteristics that are different from children in general without always showing mental, physical, and emotional disabilities (Pankewicz et al., 2020; Rachmat, 2017; Suchyadi, Ambarsari, & Sukmanasa, 2018). One of them is children with mental disability, namely the condition of children whose intelligence is far below the average which is characterized by limited intelligence and inadequate social interaction (Luckasson, 2002; Suchyadi, Ambarsari, & Sukmanasa, 2018; Saputra, Darwis, & Febrianto, 2019; Parmi & Irwandi, 2020). The intellectual ability of children with mental disability is usually only around 51 - 70 (Rejokirono & Dewi, 2018). Mental disability children have difficulty adapting to their environment because they cannot meet community expectations related to mental and physical activity (Hosseini & Gursel, 2012; McKerr et al., 2020; Pursitasari et al., 2020). Cerebral Palsy is usually caused by brain lesions that are

usually diagnosed within the first two years of life. It is most often caused by trauma to the brain in the uterus; at birth; or by other causes in early infancy (Critten, Campbell, Farran, & Messer, 2018). Cerebral Palsy is complex and non-progressive with associated conditions including epilepsy, sleep disorders, vision and hearing problems, eating problems, breathing problems, musculoskeletal dysfunction, and chronic pain (Taylor, Cotter, Lindy, & Lalor, 2018; Lidman et al., 2020). As a result, it is difficult for them to follow educational programs in public schools. However, they also have the same rights as other normal children (Rachmat, 2017). One of the children with mental disability, mild mental disability, is a child with intelligence below the average of 68 to 78, approximately 10 out of 1,000 people (Sari, 2019). They experience underdevelopment in adjusting to the environment, delay in intelligence, social adaptation, and in the academic field. As a result of experiencing these limitations, children with mental disability experience problems in adjusting and getting a job. Therefore, children with mild mental disability need to be given special education and guidance to develop their abilities that might be developed. Children with mental disability also need proper education like normal children without exception.

One of the realizations of education programs as the right of every citizen in a country like Indonesia is by establishing formal educational institutions ranging from elementary to high school for ordinary education and special/special education. The lessons given in public schools must be the same as those given in special schools. One example of an extraordinary school is a school that focuses on children with mental disability and cerebral palsy (Kraemer & Blacher, 2020; Sudarto & Sasongko 2020), which is commonly called SLB C in Indonesia. The mental achievements of children with mental disability and cerebral palsy can be developed if their potential is well cultivated (Jazim et al, 2018; Smidt et al., 2020). The potential for children with mental disability and cerebral palsy can be found by teachers in the educational activities they get in special schools or inclusive schools. Through education, children with special needs can develop their potential even though they have certain limitations.

2. Mental disability

Mild mental disability experienced by students can cause students difficulties in developing the knowledge and skills they have even though they are capable students (Kuswardhana, et al., 2017). The ability to think is limited, low memory, and the difficulty of abstract thinking of the students is the reason students have difficulties in academic fields such as number division skills (Putri, et al., 2017). One Academic area that had widespread application in mathematics. Whether a student's goal is to pursue post-secondary education or go into the workforce and live independently, one can make mathematics applicable to everyday life. Thus, proficiency in mathematics is necessary not only for college and career readiness but also for independent living in adult life and post-secondary opportunities (Gulnoza Yakubova, 2020). A better understanding of the difficulties in mathematics can in turn improve knowledge about the cognitive and

emotional processes involved in arithmetic tasks (Passolunghi, 2011) Based on some surveys to several schools of SLB C in Bandung SLB C, there are some students on the junior school who are not able to count, recognize numbers, recognize letters, spelling out the letters, and perform mathematical operations, such as sum and subtraction (Wehmeyer & Schwartz, 1997; Parmi & Irwandi, 2020). The students with mental disability often experience difficulties due to their learning activities, especially in mathematics (Nuari, et al., 2019). There are fundamental differences between students who have mental disability and cerebral palsy, mental disability is a condition of a child with mental disability. People with mental disability have an IQ below average so that their intelligence level is lower than that of other children. Teachers at SLB-C need extra patience to teach SLB-C students. Cerebral palsy is a condition in which a person experiences movement disorders caused by congenital structural abnormalities, accidents, or other conditions. Although cerebral palsy indirectly affects the cognitive level of children, in some cases children who suffer from cerebral palsy have a normal IQ like other children (Utomo, 2013). Usually SLB-D teachers will provide education and therapy on how to develop self-potential, take care of themselves, and of course be confident in the conditions they are experiencing. Even for students with cerebral palsy and mental disability, they cannot calculate numbers and are able to move their bodies weakly. Based on the above problems, we need to do some efforts to overcome these problems by some alternative methods (Nuari, Prahmana, & Fatmawati, 2019; Rachmat, 2017). For example, Alberto et al. (2010) provided the use of simultaneous prompting used for reading and comprehending individual words and connected text. Students with moderate and severe mental disability can be taught to read by using sight-word instruction (Browder et al., 2006; Widodo, Dwidiyanti, & Hartati, 2020). A study aimed to define the effectiveness of providing middle school students with moderate intellectual disabilities by using letter-sound correspondence instruction based on the Corrective Reading Program was conducted by Bradford et al. (2006). Some special programs have been proposed, such as a self-instructional training program (Van Luit, 1987), and a group self-instructional training program (Whitman & Johnston, 1983). A review studying mathematics interventions for students with mild-to-moderate mental disability can be found in Butler et al. (2001). Moreover, methods for assessment of personal learning outcomes for students with mental disability on primary education are presented by Zvoleyko et al. (2015). Then, the implementation of multimedia was proposed to improve the mathematical knowledge of students with mental disability (Reis, et al., 2010; Sudarto & Sasongko 2020). Another method was also proposed by (Kusrini, 2018) With the use of drill and demonstration methods using objects that are around the school environment to be used as a teaching aid in conducting addition operations in mathematics learning, student learning outcomes have increased.

This research attempts to design and implement a model of learning media for reading, writing, and calculating students with mental disability and cerebral palsy. On the rationale that has been described above, this study is very important to do because

it can provide a picture of how or an alternative solution that could motivate the student in learning mathematics, including able to count, recognize numbers, recognize letters, spelling out the letters, perform the operation mathematics (Suarsana et.al, 2017). This model is built based Hands-on Activity, which is all the activities and the direct experience of students with an object (living beings and inanimate objects), students practice a thing thoroughly (Haury & Rillero, 1994; Sudarto & Sasongko 2020). The hands-on activity method can change passive to active learning because students participate in the learning process so that students with mental disability and cerebral palsy are expected to be more motivated and more creative in the implementation of the learning process. Besides the use of tools and concrete objects or can be seen highly recommended for students with mental disability to solve mathematical problems (Prendergast, et al.,2017).

3. Research Methodology

In this research, we consider the design of research and development that involves the following steps (Borg & Gall, 1979):

1. Collecting information: literature reviews and classroom observation. The studies are used to support the development of the Hands-on Activity model to improve mathematical understanding in reading, writing and arithmetic.
2. Planning: defining required skills, goals, priorities on learning, and preliminary testing. In this step, we also need to discuss with experts who research on this field.
3. Developing a prototype product: in this step, besides we make a model of learning media based on hands-on activity, some subject materials (e.g., books, curriculum, etc.) and evaluation strategies should be prepared. In this case we focus on developing learning media for learning basic mathematics, such as summation.
4. The preliminary trials involving respondents with a limited number. In this case the data analysis is based on questionnaires, interviews, and observation. pre-trials in question are put through a trial limited in Special Schools in Bandung by involving teachers and students of the primary school in order to implement the proposed model of learning media based on hands-on activity for students with mental disability to improve mathematical understanding in reading, writing, and arithmetic.

Furthermore, we conducted the experiments on two special/extraordinary schools (SLB) in Bandung, as follows: SLB C Cpg-Bdg (i.e., involving 6 students) and SLBD YPAC-Bdg (i.e. involving 4 students). For doing the experiments well, we and teacher's classroom have collaborated to deliver the model.

4. Results and Discussions

Based on preliminary studies for analyzing the needs of the learning media based on hands-on activity, we obtained the following facts:

1. In general, the schools of SLB DYPAC-Bdg and SLB C Cpg-Bdg learn mathematics without the use of media learning based on hands-on activity.
2. Students really have trouble on understanding some mathematics concepts, especially students with cerebral palsy.
3. In general, children are less interested in learning mathematics, especially students with cerebral palsy, due to limitations in disorder movement motoric.
4. Teachers in these schools do not have special skills in the fields of mathematics and methods for teaching the concepts.

Based on the facts revealed in the above findings, we developed a model of learning media based on hands-on activity for children with special needs (i.e., mental disability and cerebral palsy) in improving mathematical understanding on reading, writing, and calculating. In this case, we invented a mathematical model in the form of motion pictures props and moving marbles boards, as illustrated in Figure 1 and 2. The first media as illustrated in Figure 1 was made of the thick wood, while the second one on Figure 2 was made of Acrylic.



Figure 1. The motion pictures props board



Figure 2. The moving marbles board

In general speaking, the first media illustrated in Figure 1 can be used by shifting the apples on the left toward the right in accordance with the position numbers that have been listed. The workings of instructional media are divided into three phases:

1. Students may simply shift the apples from left to right to train the counting and muscles/motorics.
2. If the students have been able to count numbers by shifting the apples, in this step the students were given the challenge to hang the apples as instructed teachers to the third row.
3. If the student has been able to enumerate the two previous methods, then in the third stage, these students will learn addition and subtraction using this media.

The second media can be used to calculate addition and subtraction on basic math. Basically, a student needs to put marbles on two holes according to the instructions. Then, we open the filter so that we can calculate all marbles together. To determine the sum on the tube unit, we count the marbles at the top of the bulkhead, while the dozens can be calculated by the following two possibilities:

1. If the seal is not opened, then count the marbles at the top of the bulkhead.
2. If the seal is opened, there are two possibilities again
 - a. If the seal on the tube marbles exceeds dozens, calculate the marbles above the bulkhead
 - b. If the marbles do not exceed the bulkhead on the results of dozens of tubes, calculate the marbles between slashes to the extent that existing bulkhead on it

Moreover, to find the sum in the hundreds, there are two possibilities:

1. If the sum on the tube dozens of less than 10, then count the marbles above the bulkhead.
2. If the sum on the tube dozens of more than 9, then calculate the marbles above the bulkhead plus 1 marbles underneath.

So, in short we can state here that the learning media can be used to calculate until the hundred numbers.

Both props mentioned above are expected to help improving the mathematics understanding in reading, writing, and calculating for children with mental disability and cerebral palsy. This is because the two props are made with regard to the condition of children. It refers to the ease of use, especially for children who have motor disability. Mathematics is a lesson with abstract concepts, so mathematics learning must be linked to concrete things. Learning hand-on activity in mathematics for student mental disability mental highly recommended. the use of concrete tools and objects or can be seen is highly

recommended for students with mental disability to solve mathematical problems (Nuari et.al, 2019).

According to the implementation on two schools: SLB C Cpg-Bdg (i.e., involving 6 students) and SLB D YPAC-Bdg (i.e., involving 4 students), two proposed boards have been used as alternative learning methods for helping students in mathematics understanding. The learning processes on classroom can be seen in Figure 3 and 4. These learning processes basically follow the work instructions explained previously.



Figure 3. An Example of Learning Processes on Students with Cerebral Palsy in SLB D YPAC-Bdg



Figure 4. An Example of Learning Processes on Students with Mental disability in SLB C-CPG-Bdg

There are some specific findings revealed in line with the objectives in this research, primarily associated with the way the learning media using hands-on activity for mental disability to improve mathematical understanding in reading, writing and calculating, as follows:

1. In SLB D YPAC-Bdg:

The experiments were done in elementary school, fifth grade, with her class teacher, while we become the teacher model. There are four students, namely *N*, *R*, *A*, and *Y*. Some records are revealed from activities on studying the basic math, as follows:

- a) *N* cannot write the numbers of 3, 8, and 10, but she was able to show the numbers of 1, 2, 3, ..., 10 with the help of the motion pictures props board. At first she had difficulty in summing two numbers which the results are less than 10. However, through the learning process by using the media she has been able to add $1 + 2 = 3$ and $3 + 5 = 8$, but still she has not been able to add two numbers which result greater than 10 even with the help of props. For example, she is still not able to add $8 + 2$ and $3 + 9$.
- b) *R* just as *N* initially had difficulty in summing two numbers which the results are less than 10. However, with the help of the props he has been able to add $3 + 5 = 8$, but he remains difficult to add two a number greater than 10.
- c) *A* has different abilities with his friends, he was able to write and count with the help of visual aids provided in the boards. For example, he has been able to add $3 + 4 = 7$, $9 + 4 = 13$, $7 + 8 = 15$ and $13 + 5 = 18$. If *R* and *N* have difficulty in writing down the numbers because of limited motor movement, but *A* has been able to write the numbers 3, 8, and 10 with all his limitations.
- d) *Y* knows and is able to write the numbers 1, 2, 3, ..., 10. With the aid of props, she had been able to add, e.g., $1 + 2 = 3$, $5 + 5 = 10$, and $7 + 6 = 13$. However, like the three other students, she has difficulty in writing the numbers 1 through 9 perfectly.

2. In SLB C Cpg-Bdg:

The experiments have been done in junior school (i.e., grade 2) with the class teacher, while the teacher model is a member of the research team. There are six students, namely *Ay*, *Ow*, *De*, *Ar*, *Re*, and *Ju*. Some records are revealed from learning activities on basic math, as follows:

- a) There was a student, named *Ay*, who does not have the ability to add two numbers. This is due to either not understand the law of conservation

of number, even when the learning is done with the help of real objects such as marbles.

- b) *Ju* has been able to add a number smaller than 10 without the aid of props. But he suffered when he was summing two numbers which add more than 10, for example, when given $9 + 5 = 14$. With the help of props, he can add $9 + 5 = 14$ and $10 + 6 = 16$.
- c) Four students, namely *Ow*, *De*, *Ar*, *Re* in general have been able to write as well as adding two numbers smaller than 10, and have been able to add two numbers the result is less than 30. For example, *Ow* was able to add $5 + 3 = 8$, $8 + 4 = 12$, $10 + 6 = 16$ and $12 + 10 = 22$. Similarly, *De*, *Ar*, and *Re* have been able to add up numbers $5 + 3 = 8$, $8 + 4 = 12$, $10 + 6 = 16$ and $12 + 7 = 19$.
- d) Sixth students above were still experiencing difficulties in adding two numbers that are the result of more than 30, even with the help of props board. They were apparently not able to add $24 + 16$, $32 + 28$ and $12 + 19$. In this case a challenge for researchers to develop visual aids that can help add a number for children on junior high school.
- e) Based on the findings of the above study, it was also revealed that they have not been able to recognize the value of the place. For example 12 with the number 1 and number 2 as dozens as a unit so it is natural that they cannot add $24 + 16$, $32 + 28$ and $12 + 19$.

5. Conclusions

Based on the experiments and their analysis that have been conducted, we can summarize that the proposed models of learning media based on hands-on activity for students with mental disability and cerebral palsy on the basic math have been constructed. The models are presented by two boards that are the motion pictures props and the moving marbles. These models have been implemented in two special/extraordinary schools: SLB C Cpg-Bdg and SLB D YPAC- Bdg, Indonesia. According to the analysis, these models can help the students on learning basic mathematics in the reading, writing, and arithmetic subject.

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