

Single subject research: use of interactive video in children with developmental disabilities with dyscalculia to introduce natural numbers

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Dyscalculia is one of the barriers to learning for students with some special mental retardation needs. Students with intellectual disabilities may also have dyscalculia. In that sense, in learning mathematics, it is necessary to use various learning media. Related to this condition, the present study aims to determine the effect of the use of instructional video media to introduce natural numbers to students who experience mental retardation with dyscalculia. This type of research is an experimental research design with a single subject. This single-subject research uses the A - B method. The research subjects were chosen based on a purposive sampling technique because the researchers had to find subjects with mental retardation as well as dyscalculia characteristics with these characteristics one elementary special school in Yogyakarta was found. Data collection techniques involved using the method of observation, interviews to determine the characteristics of the subject, tests to determine the ability of subjects to recognize natural numbers. The results of this study indicate that interactive media positively influences the ability to recognize natural numbers in mentally retarded children with dyscalculia. This can be seen from the average score obtained by the subjects before being given an intervention that is 30 and increased to 54 after being given an intervention.

Introduction

Mathematics has an important role in life, in addition to functioning as a tool for problem-solving, logical thinking, and reasoning, it also functions as a tool for communication between individuals (National of Council Teacher of Mathematics, 2000b; Stylianou et al., 2015; Widodo et al., 2019, 2020). However, learning mathematics becomes a very difficult

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activity for mentally retarded children (Chodura et al., 2015; Dowker & Sigley, 2010; Nuari et al., 2019; Scherer et al., 2017). This is because mentally retarded children experience inhibition of intelligence function, disability in social behavior or adaptation, and barriers to social behavior or adaptation that occur during the ages of development i.e. up to the age of 18 years (Baştürk, 2016; Dekker et al., 2016; El-Keshky & Emam, 2015; Emam & Kazem, 2015; Harvey & Miller, 2017; Martin et al., 2017). Children with intellectual disabilities are generally children with special needs because they have an intellectual quotient below the average or intellectual quotient below 84 (Hegde & Bhaskar, 2015; Kumar et al., 2009; Suchyadi et al., 2018; Teixeira et al., 2015; Van Schooneveld et al., 2016). So it is very natural that students with this category have difficulty learning mathematics. But if this lack of reasonableness is allowed to continue, students with special needs become unable to think logically, and mathematical communication weakens. The effect of students with this category is very dependent on the presence of others.

Also, students with dyscalculia experience learning difficulties (Kucian & von Aster, 2015; Price & Ansari, 2013; Shalev & Gross-Tsur, 2001). Not only in mathematics, but also in learning languages, those students with dyscalculia characteristics have difficulty (Bugden & Ansari, 2016; Skagerlund & Träff, 2016; Torres-Carrión et al., 2018). In fact, dyscalculia is one of the barriers to learning in retarded children (Backenson et al., 2015; Bakare et al., 2010; Bran & Bouleanu, 2017; Sridevi et al., 2015). Children with intellectual disabilities who experience dyscalculia have difficulty in mathematics, so one can imagine how difficult it is to learn mathematics for students with intellectual disabilities. The current study was conducted in class X Senior High School (special school) Bhakti Kencana 1 Berbah, Yogyakarta, Indonesia, with students who are still having difficulty in solving multiplication and division of natural numbers, they have not been able to link multiplication or division arithmetic operations with other arithmetic operations, these students are not careful in counting or are not focused when working on problems (Nuari & Prahmana, 2018).

Even though studying mathematics for mentally retarded children and dyscalculia is challenging (Furlong et al., 2015; Montague & Jitendra, 2012; Walcott & Romain, 2019) mentally retarded children with dyscalculia are expected to have the ability to count (Pontius, 1983; Ramaa, 2014) so that they can navigate their daily lives more independently and do not depend on others (Purnami et al., 2020). For someone who has barriers to the function of intelligence, and barriers to social behavior, including barriers to learning functions such as dyscalculia to have good numeracy skills they must first be introduced to natural numbers. This means that the original number is the number that students learn at the earliest at the primary school (Kartini, 2018). If students with these obstacles are familiar with the natural numbers, learning number operations including other types of numbers will be relatively easy.

To help mentally retarded students with dyscalculia conditions, learning media is needed in learning mathematics, especially in number recognition material (Maroofi et al., 2018; Nuari et al., 2019; Nuari & Prahmana, 2018; Pradani et al., 2015; Yunisa & Fatmawati, 2018). The learning media used are intended so that the message conveyed by the teacher can be conveyed easily to them (Hakim et al., 2019; Saputro, 2016; Widodo et al., 2018; Trisniawati et al., 2019)). For the media to be effectively used by the teacher, the selection of media should be adjusted to the characteristics of students such as student conditions (Widodo, 2018), like the student characteristics referred to in this study which are students with mental retardation and discourse. Research conducted in Iran using the media using the Misha and Kusha educational software given to 100 students with mental disorders is proven to be effectively used to reduce learning disabilities (Maroofi et al., 2018). In Indonesia, ladder snake media is used to improve students' counting skills in dialysis students (Pradani et al., 2015), and there is the use of the

number stick media to introduce numbers 1 to 10 to mentally retarded students (Yunisa & Fatmawati, 2018).

In connection with these conditions, the purpose of this study was to determine the increase in the ability of mentally retarded students with dyscalculia to recognize natural numbers using learning media. The learning media used in the research is different from the media conducted by Maroofi et al (2018) using the educational software Misha and Kusha, Pradani et al (2015) with the media of snakes and ladders, and Yunisa & Fatmawati (2018) with stick numbers. In this study, to improve the ability of mentally retarded students with dyscalculia media in the form of instructional videos were referred to. The video aims to convey a learning message to introduce natural numbers (numbers from 0 to 9) to students with intellectual and mental disability needs. The introduction of numbers is chosen because basic numbers must be known by anyone, hence if students already know these numbers, writing the next number will be easier (Gray, 1986; Weil, 2006). The learning video used is a combination of text, images, audio, and also animation so that it can attract students who watch it (Alksne, 2016; Saputri et al., 2018; Wang, 2014; Yeh, 2018). Based on this, the purpose of this study was to determine the increase in the ability of students with mental disabilities and in recognizing native numbers using video.

Method

Model Research

The research method used in this study is quantitative experiments with a single subject. Single Subject Research is a research with a single subject (Byiers et al., 2012; Freeman & Eagle, 2011; Gast, 2009; Sunanto et al., 2005; Zhan & Ottenbacher, 2001). Experimental research is a research method used to look for the effects of certain treatments that are controlled (Creswell, 2012). The Single Subject Research design used is the A-B design consisting of the baseline phase and the intervention phase as can be seen in Figure 1 (Byiers et al., 2012; Gast, 2009; Lovaas, 2003; Zhan & Ottenbacher, 2001).

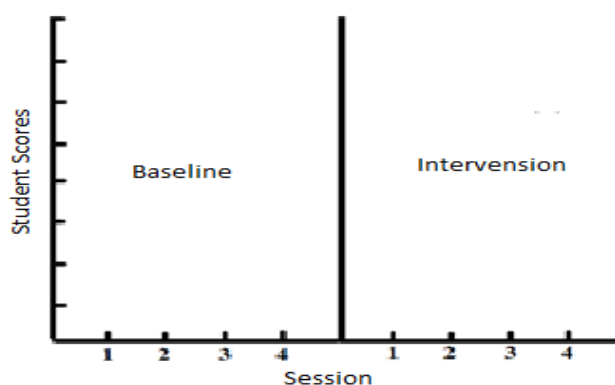


Figure 1. Research Design of Single Subject Research

The measurement of A-B design is done in a certain period for example weekly, per day, hourly, and the comparison is not done between individuals but to the same subject under different conditions (Freeman & Eagle, 2011; Sunanto et al., 2005). In condition A is a baseline condition, meaning that the condition of the research subjects is not given a learning intervention using video. In other words, learning is carried out, as usual, namely learning that is carried out face-to-face with students without using any learning media. In this study, the

baseline phase aims to determine the subject's ability to recognize natural numbers. If the subject is already emotionally close to the researcher, the research phase is continued at the next stage, which is the intervention phase. The intervention condition or condition B is the condition of the subject given the research intervention. Research subjects in the intervention phase were given learning treatment using video. This phase is different from the previous phase which did not use the intervention in the form of instructional videos. Often this intervention phase is called the experiment stage, although this experiment is given to one research subject as this type of research is a single subject.

Participants

The research subjects were selected using a purposive technique, meaning that the research subjects had to be adjusted to the characteristics of the study, the purpose of the study, and the subjectivity of the researchers to select subjects without leaving the researchers' code of ethics. The research subject used was a student with special needs, mental retardation, and dyscalculia. Furthermore, according to the research code of ethics, this subject is referred to as NB. He was a 13 year old fifth grade elementary school student with difficulty recognizing numbers. In addition, he is a mental retardation child with dyscalculia. This can be seen from the results of psychological examinations carried out by schools involving psychologists, showing that the subject is a mentally retarded child who has a level of intelligence that is classified as capable of educating with an IQ of 86. This is by the purpose of this study, which is to say to determine the increase in the ability of students with mental retardation and dyscalculia to recognize natural numbers, since this study requires subjects with mental retardation and dyscalculia.

Data Collection

In this study, for the learning process between researchers and NB to run well during the baseline and intervention phases, researchers needed a learning plan scenario in the form of a Hypothetical Learning Trajectory. Hypothetical Learning Trajectory (HLT) is a description of the learning process when students experience the learning process from the beginning until the learning objectives are achieved (Andrews-Larson et al., 2017; Simon & Tzur, 2004). HLT refers to the teacher's plan based on the anticipation of student learning that might be achieved in the learning process based on the expected mathematics learning objectives of students, the knowledge and estimated level of understanding of students, and the choice of mathematical activities in sequence (Simon, 2017). The HLT is used as a guide in the research implementation process. The preparation of a hypothetical learning trajectory aims to anticipate the possibility of student learning and development to achieve learning objectives based on the knowledge already possessed by students and the estimated student understanding of the material. This is because the preparation of HLT is based on the analysis of learning barriers experienced by students.

Data collection techniques in this study were carried out using interviews, observations, and tests. Interviews were conducted to determine the characteristics and abilities of subjects according to parents. This is done so that researchers can prepare specific strategies to deal with research subjects who have mental retardation. This strategy is needed by researchers to build closeness between researchers and research subjects. The researcher chose the subject's parents as the source to know the habits because they are the people who are close to the research subject and know the habits of the research subject the most. Observations in this study were used to observe and record all the behavior of research subject both during the baseline phase and the intervention phase. Observations were made by describing the indicators the researcher

wanted to achieve. The observation indicators were (1) the subject was enthusiastic during the lesson, (2) the subject understood the instructions and material presented by the researcher, and (3) the subject was able to work on the questions given. The observation sheet used is adjusted to the format shown in Figure 2.

Research Phase	Date	Indicator	Description
		The subject was enthusiastic during the lesson	
		The subject understood the instructions and material presented by the researcher	
		The subject was able to work on the questions given	

Figure 2. Observation Sheet

The next data collection technique is a test used to measure the ability of research subjects to recognize numbers. This test is done verbally or in written format which is done in 2 ways. *First*, the subjects were given a prepared number card. After the subject is given a number card, the subject is asked to name the numeric name written on the card. For example, the researcher gives a card written with the number "6", the research subject is expected to say "six" to answer the question given by the researcher. *Second*, the research subjects were asked to write down and show the numbers mentioned by the researcher. For example, the researcher says the number "six", the research subject is expected to write the number "6" on existing paper or books or the subject points to the "6" card. In these two ways, there are 30 questions that are used to determine the ability of the research subject to recognize numbers, which make up 10 questions related to pointing numbers, 10 questions related to writing numbers, and 10 questions related to mentioning numbers.

Data analysis

After all the data needed for the research has been obtained by the researcher, the next step is to analyze the data. Researchers use Microsoft Excel to help calculate the data to be analyzed, while tables and figures are done manually. In this study, the data analysis used was a condition analysis and an analysis between conditions. Condition analysis is an analysis performed at baseline conditions or conditions of intervention (James, 2016; Sunanto et al., 2005). The components used to perform this condition analysis include (1) the duration of the condition; (2) trend direction; (3) the level of stability that can be determined by calculating the amount of data in the range of 50% above and below the average; (4) the rate of change, which can be calculated by finding the difference between the first data and the last data; (5) trace data, and (6) range, to put it in another way the distance between the first data and the last date, can be calculated by looking for the product with the highest score on the condition with stability criteria (0.15) (Freeman & Eagle, 2011; Gast, 2009; Sunanto et al., 2005). Meanwhile, the analysis between conditions was carried out to see the difference between the baseline phase and the intervention phase (James, 2016; Sunanto et al., 2005). The components used to perform this condition analysis include (1) the changed variables; (2) changes in direction and effects, (3) changes in stability and effects, (4) changes in data levels, which can be seen by finding differences between the last data at baseline conditions and the first data on intervention conditions, and (5) overlapping data, which can be seen by determining the percentage between

the same data in the two conditions with the same data on the conditions (Freeman & Eagle, 2011; Gast, 2009; Sunanto et al., 2005).

Result and discussion

Result

The results of the measurement of the ability to recognize natural numbers on the subjects during the baseline phase until the intervention are presented as in table 1. Table 1 is obtained from the results of the ability to recognize numbers consisting of the ability to name numbers, the ability to show numbers, and the ability to write numbers 0 - 9. The baseline phase is the phase of learning the introduction of natural numbers without using learning videos to the subjects. The intervention phase is the introduction of natural numbers using video learning to subjects.

Table 1. Accumulated Score Ability to Recognize Numbers

Session	Score	
	Baseline	Intervention
1	30	-
2	30	-
3	30	-
4	-	53,33
5	-	56,67
6	-	60
7	-	56,67
8	-	60
Average	30	54

From Table 1 it is found that the mean in the baseline phase, the phase in which NB subject with mental retardation and dyscalculia conditions before using the learning video reaches 30. Because in the baseline phase for each session, NB was only able to answer the 9 questions given so the score obtained was $\frac{9}{30} \times 100 = 30$. In the intervention phase, the NB subject in the 4th session was able to answer the 16 questions given and the score obtained was $\frac{16}{30} \times 100 = 53.33$. NB in the 5th and 7th sessions were able to answer the 17 questions given therefore the score obtained was $\frac{17}{30} \times 100 = 56.67$. In the 6th and 8th sessions, the NB subject was able to answer the 18 questions given hence the score obtained was $\frac{18}{30} \times 100 = 60.00$. The average in the intervention phase, the phase where for NB subject with mental retardation and dyscalculia conditions video learning was used reaches 54. The ability to recognize native numbers of NB subject experienced positive changes with a difference of 24. Based on the data in table 1, this can be presented in graphical form as shown in Figure 3.

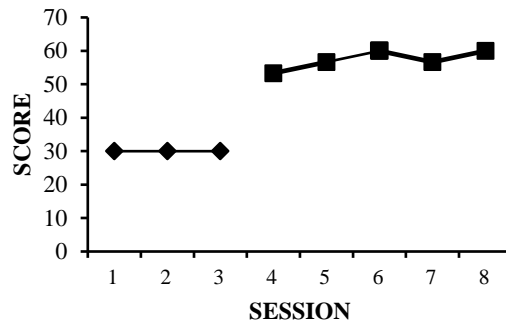


Figure 3. Visual Baseline Analysis and Interventions

Changes in the direction of the graph between the baseline conditions and the intervention show the meaning of the change in target behavior caused by the intervention. Based on Figure 1, the change in direction of the graph when the baseline conditions are straight up to trend compared to the intervention conditions. The change in the direction of the graph between the baseline conditions and the intervention shows that interactive media influences the ability to recognize numbers in mentally retarded children.

Analysis under condition

The condition length indicates the session for each condition. From table 1, it appears that the baseline A phase consisted of 3 sessions. The baseline phase generally aims to obtain an overview of research subjects related to the initial ability to recognize natural numbers. the intervention phase B consists of 5 sessions. This intervention phase aims to see the effect of the video used in mathematics learning on the introduction of natural numbers.

The estimation of direction trends is to see the development of behavior from session to session in each phase (Blankenship et al., 2016; Erlani et al., 2018; Setyawan, 2015). In this study, estimating the direction tendency was carried out by using the split-middle method. The results of the direction tendency estimation are shown in Figure 4.

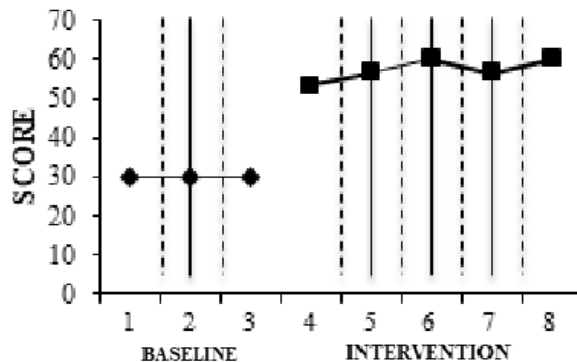


Figure 4. Estimation of Direction Trend

In the baseline phase A to determine the stability trend with the 15% criterion, the calculation is

Highest Score	×	Stability criteria	Stability range
30	×	0.15	4.5
Determine the mean level			
Baseline data	30 + 30 + 30	= 90	



Mean level $90 : 3 = 30$
 Determine the Upper Limit
 Mean level + Half of the stability range
 $30 + 2.25 = 32.25$
 Determine the Lower Limit
 Mean level - Half of the stability range
 $30 - 2.25 = 27.75$
 Determine the percentage in the Stability Range
 Many data points exist in a range : The number of data points : Percentage of stability
 $3 : 3 = 100\%$

If the percentage of stability of 85% - 90% is said to be stable (Sunanto et al., 2005), when it is below, it is said to be unstable (variable), because the calculation result for the baseline phase is 100%, then a stable result is obtained.

In the intervention phase B to determine the tendency for stability with a 15% criterion, the calculation is

Highest Score \times Stability criteria = Stability range
 $60 \times 0.15 = 9$
 Determine the mean level
 Baseline data $53.33 + 56.67 + 60 + 56.67 + 60 = 286.67$
 Mean level $286.67 : 5 = 57.33$
 Determine the Upper Limit
 Mean level + Half of the stability range
 $57.33 + 4.5 = 61.83$
 Determine the Lower Limit
 Mean level - Half of the stability range
 $57.33 - 4.5 = 52.83$
 Determine the percentage in the Stability Range
 Many data points exist in a range : The number of data points : Percentage of stability
 $5 : 5 = 100\%$

If the percentage of stability of 85% - 90% is said to be stable, when below, it is unstable (variable), because the calculation result for the intervention phase is 100%, then a stable result is obtained.

Table 2. Trends in trace data

Condition	A	B
Trends in Data Traces	=	/ +

To determine the data-trace in each phase is the same as determining the direction tendency. Table 2 is the trend of the data footprint in the baseline phase and the intervention phase. Baseline phase A, the direction of the trend is written straight (=) which means there is no decrease, and the intervention phase B, the direction of the trend is written (+), which means there is an increase.



the level of change is determined by calculating the difference between the first and last data in each phase. Then, give a sign (+) if it improves, sign (-) if it gets worse, and (=) if there is no change. The level of change in conditions can be seen in table 3.


Table 3. Level of Change

Condition	A	B
Level of Change	$30 - 30 = 0$ (=)	$60 - 53,33 = 6,67$ (+)

Inter Condition Analysis

Variables that are changed from baseline conditions (A) to interventions (B) are the ability to recognize natural numbers. Changes in direction tendencies obtained from each phase on the ability of students to recognize natural numbers accordingly can be seen in table 4.

Table 4. Change in Direction

Comparison of Conditions	B/A
Change in direction	

Changes in data levels are obtained by determining the data points in the baseline conditions (A) in the last session (30) and the first session in the intervention conditions (B) namely (53.33), calculating the difference ($30 - 53.33$) then obtained (-23.33). Changes in levels from the baseline phase and the intervention phase can be seen in table 5.

Table 5. Changes in Data Levels

Comparison of Conditions	B/A
Level of change	$(30 - 53,33) = (-23,33)$

To determine the percentage of overlap in the baseline conditions and interventions the following were performed: (1) reviewing the lower and upper boundaries of the baseline conditions, (2) calculating a lot of data points on the intervention conditions that are in the range of baseline conditions ie 0, (3) acquisition of numbers at step (2) divided by data points in the intervention condition then multiplied by 100%, then $(0 : 5) \times 100\% = 0\%$. The smaller the overlap percentage, the better the effect of the intervention on the target behavior.

Discussion

Mathematics has an important role in life, in addition to functioning as a tool to solve problems, think logically, and rationally, and it also functions as a tool to facilitate relationships between individuals and as a tool for communication (National of Council Teacher of Mathematics, 2000b, 2000a; Stylianou et al., 2015; Widodo et al., 2019, 2020). However, learning mathematics becomes a difficult activity for mentally retarded children who experience dyscalculia. Developmental children have the characteristics of being slow in learning new things and have difficulty in focusing attention so they are less able when they have to learn like normal children. Besides that, dyscalculia is one form of learning disabilities in mentally retarded children. So students with mental retardation tend to have additional learning barriers such as dyscalculia. Therefore, interactive media are needed that can foster motivation and make it easier for mentally retarded children and intellectuals to deliver mathematics learning material.



NB subject who is a child with mental retardation also had dyscalculia. Psychological examination results shows that NB is a mentally retarded child who has an intelligence level that is classified as being able to be educated with an IQ of 86. NB is a fifth-grade elementary school student aged 13 years with difficulty in recognizing numbers. Thinking that knowing numbers is the initial stage of learning mathematics. It can be ascertained that NB has difficulty in learning mathematics.

In this study, the selection of numbers 0 - 9 are based on the Hindu-Arabic number system that is used today and is a number system used internationally. The process of recognizing numbers from 0 to 9 includes the introduction of numeric names, recognition of numeric forms, recognition of numeric names based on their shapes, and recognition of numeric forms based on their names. The results showed that the video was used by mentally retarded children with dyscalculia in activities to recognize numbers. This is supported by previous research which states that interactive learning media can be used to help students with special needs such as students with intellectual and mental disability. Although the results of previous studies show a positive effect in favor of using interactive media in learning, the learning media used in the present study are different. For instance, a research conducted by Marofi et al. (2018) in Iran using the Misha and Kusha educational software. Besides, there is research conducted by Pradani et al. (2015) using snakes and ladders, or research conducted by Yunisa & Fatmawati (2018) with the number stick media to introduce numbers to students with special needs. This research uses interactive video media to introduce numbers to mentally retarded students with dyscalculia obstacles.

The test results in the baseline phase are used to determine the subject's initial ability to recognize numbers. On the ability test to mention the names of numbers, subjects can name 3 names of numbers, namely 1, 2, and 3. On the ability tests to show numbers, subjects can show 3 numbers, namely 1, 2, and 3 whereas on the ability to write numbers tests, subjects can write 3 numbers, i.e. 1, 2, and 3.

In the intervention phase, for each session the researchers introduced numbers using interactive media in the form of videos. Video as part of learning constitute a medium used to convey messages to students. This is in line with the opinion which states that learning media such as videos, comics, and power points are useful for conveying learning messages to students (Aryuntini et al., 2019; Fantin, 2011; Widodo et al., 2018). Through this video, subject were guided to remember names, numeric shapes, numeric names based on their shapes, and numeric shapes based on their names using video media. Besides, the researcher also invited the subject to play a number guessing game. Learning to guess numbers repeatedly will improve the ability to remember numbers.

The results of this study are parallel to the previous research which states that through guessing numbers using Android-based games can improve children's ability to recognize numbers 1-10 (Saputra et al., 2012). Besides, these results are also in line with the results of multimedia research used by teachers as alternative learning for children of preschool-age accommodating their needs (Fathimah & Ishartiwi, 2018; Putri & Suparno, 2020). The difference between this study and other research lies in the learning media used. By using instructional videos, mentally retarded students with dyscalculia can focus on the material provided by the researcher. As stated by Walcott & Romain (2019) for mentally retarded students with dyscalculia, being able to focus during learning is essential. This is done so that his desire to learn is very strong.

Conclusion

Based on the results of research and discussion, it can be concluded that interactive media influences the ability to recognize numbers in mentally retarded children who experience dyscalculia. The influence of interactive media can be seen by the change in data from the baseline phase to the intervention phase. In the ability test to recognize baseline phase numbers, subject was able to recognize 3 numbers, namely numbers 1, 2, and 3, and obtained scores with an average of 30. While in the intervention phase, subject was able to recognize 6 numbers namely 0, 1, 2, 3, 7, and 8; and experienced a change in the average score to 54. From these data, it can be seen that the ability to recognize the number experienced a change of 24. From these data, it can be seen that there is a positive influence of interactive media on the ability to recognize numbers in mentally retarded children with dyscalculia.

Recommendation

In connection with the results of this study, it can be recommended that the use of interactive learning videos can be used as an alternative to learning media for mentally retarded students with dyscalculia. Besides, it is necessary to consider using similar media to improve the ability of mentally retarded students with dyscalculia in other numbers

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