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Number recognition development with number card: Single subject research

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ABSTRACT

Mentally retarded is a mental disorder with an intelligence quotient (IQ) between 55-70, besides those mentally retarded children are only able to think concretely. For this reason, learning mathematics for mentally retarded students requires learning media that can bridge abstract mathematical material with the abilities of mentally retarded children who are only able to think concretely. The objective of this study was to improve the recognition of 1-20 numbers using number cards for students with mild mental retardation. The research used is single subject research method with basic design non reversal. Study subjects were selected based on a purposive sampling technique, as the researcher had to look for subjects with mild mental retardation. Data collection techniques use documentation to find out subjects with mild mental retardation characteristics, and tests to determine the subject's ability to recognize numbers 1-20. The results of this study indicate that the number card media can improve the ability of mild mentally retarded students to recognize numbers 1-20. This can be seen from the average in the baseline phase of 39 with a percentage of the ability to recognize numbers of 33.3%, and in the intervention phase of 74.44 with a percentage of the ability to recognize numbers of 88.89%.

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1. INTRODUCTION

Mentally retarded children or often referred to as mentally retarded children are children with special needs who have mental intelligence below normal, making it impossible to take part in learning in public schools [1]–[4]. Based on intelligence abilities, mentally retarded students with an intelligence quotient (IQ) between 55-70 are included in mild mental retardation [5]–[8]. Students with special needs usually find it difficult to understand the basics of mathematics [9]–[11]. This is because children with developmental age disabilities, that is, up to the age of 18, experience obstacles in the functioning of intelligence, disabilities in social behavior, and barriers to social behavior [12]–[17]. Also, the cognitive development of students with mild mental disabilities stops at the concrete operational stage so that they will have difficulty dealing with abstract mathematical concepts [18], [19].

Normally, a piece of knowledge can be settled on each individual through a process of assimilation, accommodation, or equilibration [20], [21]. With these three thought processes, knowledge in this case called a schema or schemata will stay in one's mind. Likewise, for mentally retarded children, the process of knowledge formation is also through an assimilation process if the old schema with the new schema matches, but if there is a mismatch between the old schema and the new schema, the mentally retarded child will

undergo an accommodation process or schema adjustment so that there is equilibration between the old schema and the new schema [22], [23]. The difference between normal children and mentally retarded children lies in the stages of thinking. Mentally retarded students are only able to think based on physical manipulation of the objects they encounter, but when physical objects are removed, mentally retarded students experience high disequilibrium [5], [18], [19]. Because mentally retarded students have not been able to use scientific reasoning or logical reasoning, and have not been able to deal with complex problems [24]. In other words, mentally retarded students are only able to think concretely, but to think formally or abstractly they are very difficult [25].

Mentally retarded students are considered normal if they have difficulty learning mathematics. Because the ability of mentally retarded students has intelligence below normal and the ability to think of mentally retarded students stops at the concrete thinking phase [1]–[3], [26]. If this is allowed to continue, mentally retarded students become unable to think logically, mathematical communication becomes very weak and very dependent on the existence of other people.

Whereas mathematics is very important for the development and communication of children in the future [27]. Basic numeracy skills help kids in terms of achievement and just become competent adults [28]. Wider recognition of this fact will lead to greater equality in literacy [29], [30]. However, the development of a strong base in early mathematical skills is crucial for children with subsequent success, as well as financial results, healthcare and career [29]. Longitudinal studies suggest that poor math performance can have serious long-term consequences, affecting later academic performance, employment, crime, mental health, and future income. In many countries, low mathematics is closely related to social, cultural, and economic disadvantages.

For that mathematical knowledge needs to be given to mental retardation students. This is in line with previous research which states that learning mathematics for mentally retarded students is important [31], [32], so that they have basic numeracy skills [33], [34], and they can be independent in navigating everyday life [35]. In addition, by studying mathematics, students with intellectual disabilities have a greater chance to successfully navigate life in the future when compared to not studying mathematics. So that mentally retarded children can be more independent in navigating life, both in social, economic, cultural, health, educational, and work aspects without having to depend on others.

One of the most basic mathematical skills that need to be given to mentally retarded students is the ability to recognize numbers [33], [36], [37]. The introduction of numbers is first given to mentally retarded students before being given the concept of operations on numbers, this aims to provide them with a mathematical foundation or basis [38]. By providing a strong mathematical foundation or prefix, the ability of mentally retarded children can be ensured to be better and it becomes easier to learn further mathematical material such as the concept of counting operations on numbers. The introduction of numbers to mentally retarded students can be started with the introduction of numbers 1-3 [39], numbers 1-5 [40], [41], numbers 1-10 [42]. This is in line with the opinion which states that studying natural numbers, is a number that is learned at the beginning to make it easier to learn mathematical operations and subsequent numbers [43]. The results of preliminary observations made at a special school in Yogyakarta showed that there were fourth-grade students who had not been able to memorize number symbols well and how to put them into written form. This condition is because mentally retarded students grow very slowly in learning new things when compared to normal students. Even though recognizing number symbols is one of the competencies that must be mastered by students at the previous level, especially numbers 1-20. Also, by recognizing natural numbers, students with mental retardation will find it easier to learn natural number arithmetic operations and get to know other numbers [43].

For this reason, so that the ability to recognize numbers for mentally retarded students can increase, learning media is needed [44]–[47]. This aims to make abstract mathematical concepts easily accessible to mentally retarded students who are at a concrete level. Also, learning messages such as number recognition can be conveyed by the teacher easily [48], [49]. For example, Iran's media research using the Misha and Kush educational software, which was provided to 100 students with intellectual disabilities, successfully reduced learning disabilities [50]. In Indonesia, snake and ladder media is used to improve students' numeracy skills in students [51] or using stick numbers to introduce numbers 1-10 to mentally retarded students [52]. This suggests that the choice of media must be adjusted to the characteristics of students [53], such as the condition of students with mental retardation or mental retardation.

This research is important to do, considering the problem of mentally retarded children who have not been able to develop using abstract thinking patterns, in other words, the cognitive development of mentally retarded children stops at concrete cognitive development. Those who are only able to think concretely, and the problematics of abstract mathematical concepts need a bridge such as learning media so that abstract mathematical concepts can be reached by the minds of mentally retarded children who are only able to think concretely. In addition, one way to support mentally retarded children to be able to live

independently without being dependent on others is to study mathematics [3]. For mentally retarded students, number recognition is one of the basic mathematical concepts that must be mastered before he learns the material of number operations. Therefore, the purpose of this research is to improve the numbers recognition skills by using number card media for mentally retarded students. Number recognition skills used in this study are numbers 1-20. Also, what is meant by numerical ability is the ability to memorize and remember the number 1-20 symbols.

2. RESEARCH METHOD

2.1. Research design

The research methodology used in this research is a quantitative experiment on a single topic or is often called single-subject research [54]–[56]. Experimental testing is a research method used to determine the effects of certain controlled treatments [57], [58]. The single-subject design was chosen because the characteristics of this study were carried out on special subjects [59], namely subjects with the mild mental retardation category. In general, there are two stages in this research, namely the baseline and intervention [56], [60]. The steps of this study are summarized in Figure 1.

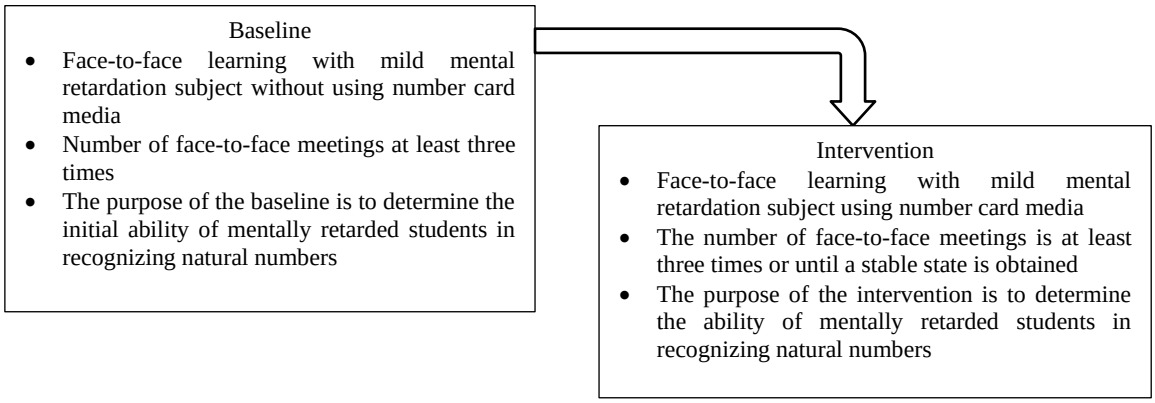

Figure 1. Single subject research research design

Condition A is the baseline phase, which means that the condition of the research facility does not require training interventions with the number card media. This phase aims to determine the subject's ability to recognize numbers 1-20 without card number media. Condition B is an intervention phase which is a condition of the subject who is given research intervention, namely learning using number cards. The intervention phase is often referred to as the experimental phase, although this experiment is assigned to one subject because that type of research is one subject.

2.2. Subject of the research

The research subjects were selected using the purposive sampling technique. This sampling is a method of sampling data sources in some respects. The aim of this study was to determine the increase in the ability of students with mild mental retardation to recognize numbers 1-20, so that the subject used in this study is mild mental retardation. To determine whether a child has mental retardation or not, the researcher collaborated with a category C special school teacher in Yogyakarta. In Indonesia, category C special schools are special schools for mentally retarded children. There are three other considerations used in sampling in this study, first, the students who were used in this study did not experience double tuna. This means that the research subjects only experienced mental retardation without being accompanied by other retardations such as dyscalculia and deafness. Second, the subjects used in this study must be (relatively) easy to communicate with researchers, to make it easier for researchers to communicate orally and in writing. Third, because the baseline phase and the intervention phase were carried out outside school hours (done at students' homes), the subjects used in the study, apart from obtaining permission from the special education teacher, also had to obtain approval from the parents of the subjects used in the study. In addition, according to the code of research ethics, this subject is marked with a T.

2.3. Learning design

For gaining knowledge for the duration of the baseline and intervention levels to run well, gaining knowledge of the situation is first created. The gaining knowledge of the situation is an outline of the gaining knowledge of procedure while college students enjoy the gaining knowledge of procedure from the start till the gaining knowledge of targets is executed. This situation refers back to the teacher's plan primarily based totally at the anticipation of scholar gaining knowledge of that is probably executed withinside the gaining knowledge of procedure primarily based totally at the anticipated arithmetic gaining knowledge of targets of the scholar, the understanding and anticipated degree of knowledge of the scholar, and the selection of mathematical sports in sequence. The instruction of gaining knowledge of eventualities objectives to assume the opportunity of scholar gaining knowledge of improvement to attain gaining knowledge of targets primarily based totally at the understanding already possessed via way of means of college students and the anticipated college students' knowledge of the material.

2.4. Data collection

The data collection methods in this study were conducted through interviews, observations, and tests. The interview was conducted in order to define the characteristics and skills of the subject in accordance with the opinion of parents and teachers. This is to enable researchers to develop specific strategies when working with research facilities in order to facilitate the establishment of closeness between researchers and subjects. Parents and teachers were chosen because they knew the subject's habits in daily life best. During both the baseline and intervention phases, observation is employed to monitor and record all of the test subjects' behavior. The researcher made the observations by narrating the indications he hoped to attain. The observation indicators are: i) The subject is enthusiastic during the lesson; ii) The subject understands the researcher's instructions and material; and iii) The subject is able to answer the questions asked. The test measures the ability of mentally handicapped students to recognize numbers of 1 to 20. The ability to recognize numbers 1-20 is given in writing and adjusted to indicators: i) Students can write numbers 1 to 20 in sequence; ii) Students can say numbers 1 to 20 either randomly or sequentially; iii) Students are able to count and write down correctly the number of objects/pictures that have been provided; and iv) Be able to match pairs of numbers with pictures.

2.5. Data analysis techniques

To find out whether the learning media in the form of numbers has a positive effect on the ability to recognize numbers for mentally retarded children, the analysis used is the visual inspection. This analysis technique is done by looking at the distribution of the plot on the graph for each session. Furthermore, where this data analysis technique focuses more on the location of the data plots obtained by mentally retarded students for each learning session, then determines the quartile location of the data plots. In-condition analysis is an analysis performed at baseline conditions and intervention conditions. The components used to perform the analysis in these conditions include: i) Determining the length of the condition; ii) Determining the estimation of the directional trend; iii) Determining the stability trend; iv) Determining the trend of the data trail; v) determining the level of stability and range; and vi) Determine the level of change. An analysis was performed between the conditions to observe the distinction between the baseline and intervention phases. This condition analysis was carried out using the following components: i) Determining the number of variables changed; ii) Determining changes in trend direction; iii) Determining changes in stability trends; iv) Determining the level of change; and v) Determining the overlap of baseline conditions. and intervention.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Analysis under conditions

This single subject research used an AB research design. Where condition A is the Baseline condition and B is the intervention condition. After that, the researcher needs to determine the length of the session for each condition. Figure 2 shows that the baseline phase consists of six sessions, while the intervention phase consists of nine sessions. So that this condition can be made like Table 1.

In baseline conditions with a long condition for 6 meetings, each meeting ends with a number recognition test 1-20. The scores obtained by subject T at each baseline session were 30, 52, 28, 36, 46, and 42 in a row. In the intervention conditions with the length of the conditions for 9 meetings. Every time learning number recognition uses a number card and each meeting ends with a number recognition test 1-20. The scores obtained by subject T at each intervention session were 60, 70, 74, 80, 76, 78, 76, 76, and 80 respectively.

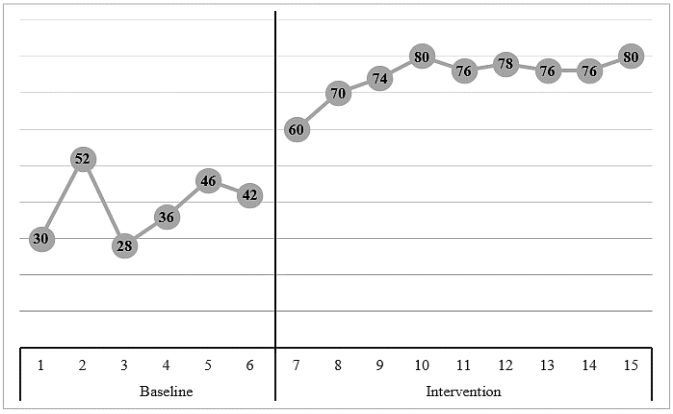

Figure 2. Graph of mentally retarded students' ability scores in recognizing numbers 1-20

Table 1. Length of condition of each phase

Condition	A/1	B/2
Length of condition	6	9

Estimating the trend towards direction is to see the development of behavior from session to session of each phase [61]. A directional trend can use an ascending line (/) if the trend in direction is relatively up or the change is increasing, a parallel line (=) if the direction is relatively fixed or there is no change, and a down line (\) if the direction is relatively downward or the change is decreasing. Estimation of the direction in this study uses the split-middle [61]–[63]. This method is carried out based on the middle value (median) of the ordinal data points. The steps to determine the direction trend using the split-middle method are: i) Divide the data into two parts at the baseline condition and in the intervention condition; ii) In the baseline condition and the intervention condition, the data that has been divided in two are then divided into two parts; iii) In the baseline and intervention conditions, determine the median position of each hemisphere; iv) In the baseline and intervention conditions, draw a parallel line with the ordinate that connects the intersection between the graph line and the right and left lines. The trend in the direction can be seen in Figure 3.

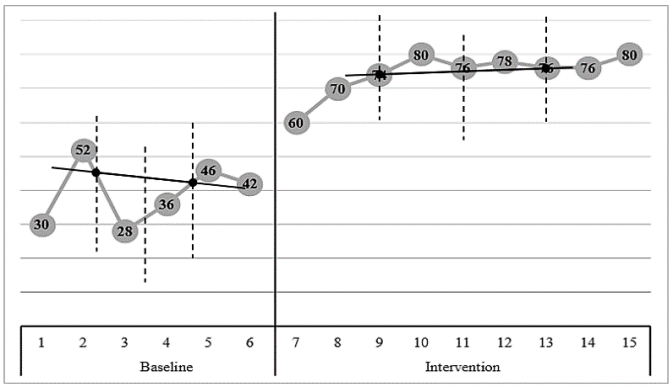

Figure 3. Graph of the direction of the trend using the split-middle method

Based on Figure 3, it can be seen that the baseline phase has a downward trend (\), this can be seen from the straight line that connects the two points in the baseline phase, which appears to be decreasing. This trend in this direction can be interpreted that in the baseline phase the subject T experienced a downward change. In the intervention phase, there is an upward trend (/), this can be seen from the straight line that connects the two points in the intervention phase upward. The trend in this direction can be interpreted that in the intervention conditions the subject T has an upward change. Based on these conditions, the direction trends in the baseline and intervention phases can be summarized as shown in Table 2.

Table 2. Table of trend

Condition	A/1	B/2
Estimation of directional trend	(-)	(+)

In single subject research, most of them use a stability tendency of 15%. Based on Figure 3, the calculation of the stability range is the highest score × stability criteria=52×0.15=7.8. Furthermore, the determines the mean level and range of stability in the baseline phase are:

Data of baseline 30+52+28+36+46+42=234, so mean level in 90:6=39
Determining the upper Limit is Mean level+half the stability range=39+3.9=42.9
Determining the lower limit is Mean level – half the stability range=39–3.9=35.1

Figure 4 shows that the percentage trend of data point stability in the baseline phase is 33.3%. This percentage value is obtained from the comparison between the number of data points in a range (2 points) and the number of data points (6 points). If the percentage of stability 85%-90% is said to be stable while the lower it is said to be unstable (variable) because the results of the calculation of the trend of data point stability for the baseline phase are 33.3%, then the results are unstable (variable). These results indicate that the ability of subject T to recognize numbers 1-20 is at a percentage of 33.3%. This condition is supported by a downward trend in the baseline phase, although the scores obtained at the first and sixth meetings have increased. For this reason, subject T needs to be given intervention so that the ability to recognize numbers 1-20 does not decrease. The intervention given in this study was to use number card media.

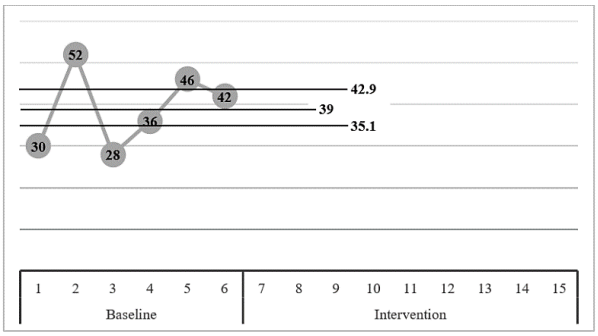

Figure 4. The trend of baseline phase stability

In addition, the trend of stability (Figure 3) in the intervention phase is the high score × stability criteria=80×0.15=12. Furthermore, determines the mean level and range of stability in the intervention phase are: i) Data of baseline 60+70+74+80+76+78+76+76+80=670, so mean is 670:9=74.44; ii) Determining the upper limit is mean+half the stability range=74.44+6=80.44; iii) Determining the lower limit is mean – half the stability range=74.44–6=68.44. From this calculation, a graph was made as shown in Figure 5.

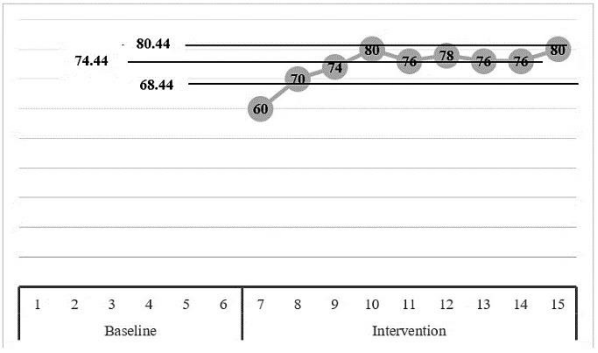

Figure 5. The trend of baseline phase stability

Based on Figure 5, the percentage trend of data point stability in the baseline phase is 88.9%. This percentage value is obtained from the comparison between the number of data points in a range (8 points) and the number of data points (9 points). If the percentage of stability 85%-90% is said to be stable while the lower it is said to be unstable (variable) because the results of the calculation of the trend of data point stability for the baseline phase are 88.9%, then the results are stable. These results indicate that the ability of subject T to recognize numbers 1-20 is at a percentage of 88.9%. This stability is supported by an upward trend in the intervention phase. Based on this condition, the intervention given to subject T using number card media in learning number 1-20 recognition has a positive or better effect.

After knowing the stability range on the subject T, the next step is to determine the trend of the data trail. To determine the trend of a data trail is the same as determining an estimate of the directional trend. Thus, the trend data trail in this study can be presented in Table 3. Furthermore, determine the level of stability and range. This determines as previously calculated, it was found that in the baseline (A) the data was variable or unstable with a score range between 28 and 52. In the intervention (B) with a score range of 60 to 80, the data was stable. The summary can be seen in Table 4.

Table 3. Trending data footprint

Condition	A/1	B/2
Trending data footprint	(-)	(+)

Table 4. Stability level and range

Condition	A/1	B/2
Stability level and range	Variable 28 – 52	Stabil 60-80

The last is to determine the level of change. The calculation is done by marking the first data (day 1) and the last data (day 6) in the baseline phase (A). Then, the difference between the two data is calculated and the direction is increasing or decreasing and is given a sign (+) if it improves, (-) gets worse, and (=) if there is no change. Likewise to calculate the level of change in the intervention phase (B). Based on Figure 1, it is found that in the baseline phase for the first day the score was 30 and the score on the last day was 42, so the difference was (+12). in the intervention phase for the first day, the score was 60 and the score on the last day was 80, so the difference was (+20). The summary of these calculations can be seen in Table 5.

Table 5. Level of change

Condition	A/1	B/2
Level of change	42–30=(+12)	8–60=(+20)

3.1.2. Analysis between conditions

In this analysis, the steps used are: i) Determining the number of variables changed; ii) Determining changes in trend direction; iii) Determining changes in stability trends; iv) Determining the level of change; and v) Determining the overlap of baseline conditions and intervention. The initial activity to analyze the number of variables changed in this study was to use number card media to improve the ability recognize number. Thus, only one variable will be changed in this study. One variable that was changed in this study was the ability to recognize numbers.

The second step is determining changes in trend direction. To determine changes in conditions, it can be seen in Table 6 related the ability recognize number. Based on Table 6, it can be seen that the ability recognize number in the baseline phase A1 trends to increase (+), as well as in the condition B1 trends to increase (+). but the effect of increasing the use of card media in these two phases is very different. this can be seen from the level of change (Table 5), that in the baseline phase the level of change is +12, while the intervention phase is +20. So, it can be concluded that the provision of learning interventions using number card media has a positive effect on the changed variables.

Table 6. Change in trend direction

Comparison of conditions	A/B	
Change in trend direction	(+)	(+)

The third step is determining changes in stability trends. To determine changes in stability trends, it can be seen from the stability trend in the baseline (A) and intervention (B) phases in the summary analysis under conditions. From the summary of the analysis under conditions, the changes in the stability trend can be seen in Table 7.

Table 7. Changes in stability trends

Comparison of Conditions	A/B
changes in stability trends	Unstable to stable (Variable to stable)

The fourth step is determining the level of change. To determine the level of change, it is done by determining the data point in the baseline condition (A) in the last session, which is 42, and the first session in the intervention condition (B), which is 60. Then calculate the difference between the two, namely (42–60), so that the difference is (18). The last step is determining the overlap of baseline and intervention conditions. To determine the overlap of data at baseline conditions (A) with the intervention (B) by: i) Looking back at the lower and upper limits in the baseline conditions; ii) Calculating the number of data points in the intervention condition (B) which is in the condition range (A). After observing it, all data points in the intervention condition are not in the baseline range, so in this section, the number is 0; iii) The results obtained are divided by the number of data points in condition (B) then multiplied by 100. Since there are many data points for the intervention conditions that are not in the baseline condition, the result of this stage is 0%. In connection with this overlap percentage, the smaller the overlap percentage, the better the effect of the intervention on target behavior.

3.2. Discussion

Media in learning is one way to increase students' enthusiasm and motivation to learn [64]. Media is something that is used as an intermediary for information from the sender to the recipient so that it can stimulate thoughts, feelings, interests, and also the attention of students in learning activities [53], [65]. Media is a tool for students to understand what is explained, including mentally retarded children who have problems in concentration and memory [66]. The use of media is the focus of treatment in this study aimed at improving the cognitive abilities of the subject, namely the ability to recognize numbers 1-20.

This research was conducted in two phases, namely the baseline phase and the intervention phase. The activities carried out in the baseline phase focused on finding initial data on the subject's ability related to the concept of numbers 1 to 20. The results obtained in the baseline phase showed that the subject's ability tended to decrease based on the calculation graph and the values obtained in six sessions had not shown a stable level. Besides, it is indicated by the average test results in the baseline phase of 39 and the percentage of the ability to recognize numbers by 33.3%. With this condition, an intervention is needed by providing learning media to mentally retarded students to recognize numbers 1-20. There is one alternative learning media that can be used to introduce numbers 1-20 to mentally retarded students which is a number card [66], [67]. Number cards are paper with numbers written following the learning objectives. The number card used in this study is shown in Figure 6.

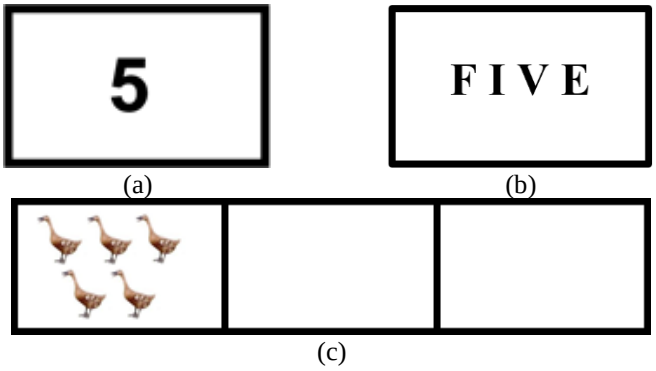

Figure 6. A number card consists of (a) a number symbol, (b) a number name, and (c) a number base card

The way to use the number card is: i) A set of number symbols and a set of number names are handed over to the students; ii) The teacher opens one base of the number card; iii) The students put the corresponding symbol and number name in the empty box on the base number card. Suppose the teacher opens the base of a number card as shown in Figure 6 (c), then students must put the number "5" and the name "FIVE" in the empty box at the base of the number card.

Based on the results of the intervention carried out, shows that the use of learning media in the form of number cards can improve the cognitive abilities of research subjects, in this case, mild mentally retarded children can recognize numbers 1-20 well. This can be seen from the tendency of the intervention phase which shows better than the baseline phase and the average result of the intervention phase is 74.44, and the percentage of mentally retarded students in the ability to recognize numbers 1-20 is 88.89% even though the learning is carried out for nine sessions.

In connection with this condition, subject T in recognizing numbers 1-20 has increased. This can be seen from: i) The increase shown by the average results in the baseline and intervention phases; ii) The trend in the direction shown in Table 7; and iii) The increase in the percentage of mentally retarded students' ability to recognize numbers 1-20 of 33.3 % to 88.89%. In connection with this condition, it can be stated that the number card media has a positive influence on the cognitive ability of subject T in recognizing numbers 1-20. The positive effect of number card media for students with mild mental retardation is because the number card media can concretize abstract numbers for mentally retarded students of mental age who stop at the concrete phase. In other words, recognizing numbers 1-20 using number card media for mild mentally retarded students has a positive effect because the learning media used is adjusted to the needs and abilities of mild mental retardation subjects.

The results of this study are consistent with previous research that using number cards can improve mentally retarded students to recognize numbers [33], [39]–[42], [68]. Although the number cards used in previous studies were number cards 1-3 [39], number cards 1-5 [41], puzzle number cards for 1-5 [40], and cards numbered 1-10 [42]. However, the form of the number cards used in this study is different from previous studies.

4. CONCLUSION

In this study, it can be concluded that the number card media can improve the ability of mild mentally retarded students to recognize numbers 1-20. The effect of the media number card can be seen in the change of data from the baseline phase to the intervention phase. In the baseline recognize number skills, the subject had a mean score of 39. In the intervention phase, the mean score changed to 74.44. These data show that the learning outcomes of extroverted students changed by 35.44. Based on the results of this study, it is proposed to use number card media as an alternative teaching method for mentally retarded students to recognize numbers 1-20. In addition, attention should be paid to the use of teaching aids to improve the skills of mentally retarded students in using other materials.

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