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Developing collaborative mathematics learning model for students with intellectual disability

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Abstract. This research aims to develop a learning model that can accommodate mathematics learning in basic counting concept for students with intellectual disabilities. Mentally disabled students are students who have below average intellectual intelligence. The teacher needs to modify learning methods to suits the need of the students. The research method used here was an exploratory mixed-method research design. This research developed a school-based collaborative learning model in learning mathematics to improve numeracy skills for mentally disabled students. The construct of a collaborative learning model was developed from data from a qualitative case study on the problems of mathematics learning found in the field. The pre-experiment increases quantitative data about the effectiveness of school-based collaborative learning models. The results presented that there was an increase in mathematics learning outcomes for mentally disabled students in the learning of basic counting. In the first session, the students get 50% of the overall test, and in the next session, there was a very significant increase to 80% of the overall test. The recommendations from this study obtained data that collaborative learning models can improve the mathematical abilities of mentally disabled students.

1. Introduction

Mathematics is a science that advances human thinking and underlies the development of science and technology. Students could develop their ability to think logically, analytically, systematically, critically, and creatively by learning mathematics [1, 2]. These abilities are important because they help human learn to organize, analyze, and synthesize information to make it easier for a human to solve problems in their life. A human can also create various modern information and communication technologies because of the development of mathematics. Thus, mastering the basic concepts of mathematics at an early age is important for mastering and creating technology in the future.

Teacher, as an education practitioner, plays an important role in promoting an effective mathematics learning process. The principles of effective mathematics teaching include the following criteria. First, effective mathematics teaching requires an understanding of what students know and need to learn, and then challenging and supporting them to learn well. Second, effective teaching requires knowing and understanding mathematics, students as learners, and pedagogical strategies. Third, effective teaching requires a challenging and supportive classroom learning environment. Forth, effective teaching requires continually seeking improvement [1].



And then, the teacher needs to present learning such that the mentally disabled students are actively involved and motivated in the learning process. Teachers need to also understand mathematics concepts, their students' condition, and suitable learning strategies. Some efforts need to be done such as providing a challenging learning environment and improving the learning quality sustainably.

Problem-solving is one of the important topics in mathematics learning. This idea based on the belief that problem-solving is the basic principle in mathematics learning. Problem-solving is the foundation of all mathematics activity. Therefore, problem-solving should play a prominent role in the elementary school mathematics curriculum [3]. Problem-solving in mathematics learning is important for mentally disabled students because it helps them develop skills, practice, and active work, and systematical thinking. Working on problem offers good practice in calculation skills. But the important mathematics goal of problem-solving is to help students thinking systematically about probability and to organize and to record their thinking without waiting until the students could do mathematics operation fluently [4].

Problem-solving in mathematical activities provides opportunities for mentally disabled students to actively organize their thoughts so that they do not become learners who are highly dependent on the teacher's explanation [5]. Some steps and strategies can help mentally disabled students in solving a mathematical problem. The steps are understanding the problem, making plans, implementing plans, and looking back [6]. While strategies that can be used by mentally disabled students in problem-solving include creating tables, drawings or diagrams, make models, find and use patterns, trial and error, and write mathematics sentences [7].

Based on observations at Sekolah Khusus (SKH) Negeri 01 Kota Serang, a special public school in Serang, Indonesia, we found that the mentally disabled students still lacked social attitudes. Many students like to work alone, were easily discouraged in learning, had low self-esteem, tended to be closed, and lacked confidence. They did not share knowledge or help their friends who have difficulty in carrying out tasks, either. Also, there were still mentally disabled students who were too selective to make friends, preferred to be alone, lacked empathy, and lacked tolerance. SKH Negeri 01 Kota Serang is a school with quite a lot of study groups and with very heterogeneous mentally disabled students (regarding religion, ethnicity, culture, economic ability, gender, and academic ability). Therefore, social attitudes need to be instilled and cultivated to all mentally disabled students. The application of collaborative learning models helps mentally disabled students to improve knowledge and skills, improve understanding and problem-solving skills, train mentally disabled students in social interaction, and develop various social attitudes [8].

Collaborative learning is a learning model that involves the active participation of four mentally disabled students (two mentally disabled students and two female mentally disabled students) with diverse abilities who are members of a group to exchange ideas and learn to build meaning and increase learning — understanding problem-solving or completing a task so that there are no mentally disabled students who are alone or left behind. Collaborative learning is when students work effectively together on project or task. Thus, learning with friends will be more effective than learning alone because mentally disabled students can be more actively involved. Collaborative learning is a relationship of mutual learning, namely learning that departs from the question of mentally disabled students who do not understand "How to do this part?". Moreover, the mentally disabled students who understand and who do not understand could take the benefits on reciprocal relationships [8]. So, in collaborative learning, mentally disabled students can learn from each other to improve their understanding.

Collaborative learning emphasizes social bonding that can develop the knowledge and understanding of mentally disabled students [9]. This idea is consistent with the opinion of that collaborative learning is a learning model by establishing social relationships that have mutual sympathy which in turn can lead to the development and intellectual growth of mentally disabled students. The collaborative learning model has several advantages, namely: (1) becoming the essence of learning, (2) realizing the learning rights of every mentally disabled student, (3) improving the academic abilities of mentally disabled students, and (4) ensuring mentally disabled students with high academic abilities [10].

Collaborative learning is the essence of learning because learning requires teachers and peers to collaborate. Collaborative learning can realize the learning rights of every mentally disabled student because group learning becomes the most powerful means to stimulate learning for mentally disabled

students because it can develop various skills, namely: (1) Cognitive skills such as the ability to analyze, evaluate and synthesize information; (2) Critical thinking and problem solving skills; (3) Numeracy, literacy and visual communication skills; (4) Skills in interpersonal understanding, with the capacity to communicate effectively and to work both independently and cooperatively; and (5) Commitment to continuous learning [11].

These various skills are important in learning at school and later become provision for mentally disabled students in preparing themselves for the world of work. This study aims to: (1) Describe the influence of collaborative learning model on mathematical problem solving skills of class III mentally disabled students SKH Negeri 01 Kota Serang, (2) Describe the effect of collaborative learning model on social attitudes of mentally disabled students in class III SKH Negeri 01 Kota Serang, and (3) Describe the effect of collaborative learning model on mathematical problem-solving abilities and social attitudes of mentally disabled students in class III SKH Negeri 01 Kota Serang.

SSR design is an integral part of analytic behaviour. SSR refers to research strategies developed to document changes in individual subject behaviour. Through an accurate selection of the use of the same group design patterns. This pattern makes it possible to show a functional relationship between the treatments of behaviour changes.

2. Method

The method used in this study is an experimental method because this research was conducted with the intent to see the consequences of treatment [12]. The experiment is an activity to examine an event or symptom that appears in certain conditions suggests that the experimental method is a method that deliberately strives for the emergence of variables. In this case, the experimental method is a method that aims to obtain the data needed by looking at the results of the presence or absence of treatment (treatment). This experimental research has a single subject, so using the Single Subject method. Single Subject Research (SSR) is experimental research conducted to find out how much the influence of a treatment (intervention) is given to one subject repeatedly at a certain time [13, 14].

The design procedure used is A-B-A where one of the developments of the basic design of A-B. This ABA design shows at baseline (A1) conditions, treatment conditions or interventions (B), and the second baseline (A2) is intended as a control for the intervention phase so that it is possible to conclude the functional relationship between independent variables and dependent variables [12].

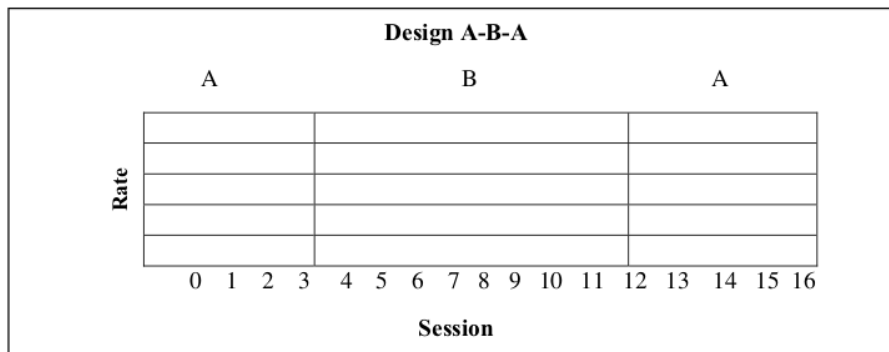


Figure 1. A-B-A design chart

In Figure 1, A-1 (Baseline 1) is the initial condition of the ability to count the research subjects before obtaining intervention. B (Intervention) is the condition of the ability to count research subjects during repeated interventions. At this stage, the subject is given treatment by using the collaborative learning

method repeatedly with a set time the same as the baseline stage for 35 minutes of the meeting. A-2 (baseline 2) is the repetition of the baseline condition as an evaluation of how the intervention gave affects the subject.

3. Results and Discussion

3.1 Baseline Data (A-1)

In this study, there are two variables, namely independent variables and dependent variables. The independent variable in this study is the collaborative method, while the dependent variable is the ability to calculate mentally retarded students. The ability to calculate sums for mild mentally disabled children in SKH can be seen in Table 1.

Table 1. Calculation ability in Baseline Data-1

Session	Number of items	Correct answer	Percentage (%)
1	20	5	25
2	20	6	30
3	20	6	30
4	20	7	35
Average			28.75

Baseline data-1 (A-1) from Table 1 is obtained by observations of researchers on the response to the subject's numeracy ability when Baseline-1 lasts four sessions per 35 minutes then the average numeracy understanding of children is 28.75%.

3.2 Intervention Data (B)

Intervention data on the ability to calculate the number of children with mild mental retardation in the SKH can be seen in Table 2.

Table 2. Ability to calculate in the intervention

Session	Number of items	Correct answer	Percentage (%)
1	20	10	50
2	20	13	65
3	20	15	75
4	20	15	75
5	20	16	80
6	20	14	70
7	20	16	80
8	20	17	85
Average			72.5

In Table 2, the percentage of calculating ability can be obtained with the results during the treatment which lasted eight sessions per 35 minutes then the average numeracy understanding of children was 72.5%. From this data, there is an increase of 43.75% from Baseline-1.

3.3 Baseline Data -2

Baseline-2 of the calculation ability data of the children with mild disabilities in SKH can be seen in Table 3.

Table 3. Ability to calculate in Baseline Data-2

Session	Number of items	Correct answer	Percentage (%)
1	20	10	50
2	20	11	55
3	20	9	45
4	20	12	60
Average			52.5

From Table 3 it is clear that the percentage obtained at baseline-2 for four sessions per 35 minutes reached 52.2%.

Table 4. Development of the ability to count (A-B-A Design)

Session	Number of items	Correct answer	Percentage (%)
1	20	5	25
2	20	6	30
3	20	6	30
4	20	7	35
5	20	10	50
6	20	13	65
7	20	15	75
8	20	15	75
9	20	16	80
10	20	14	70
11	20	16	80
12	20	17	85
13	20	10	50
14	20	11	55
15	20	9	45
16	20	12	60

Table 4 shows that the percentage of the development of the ability to do the sum of counting subjects from A-1 to B, from B to A-2 and from A-1 to A-2 can be seen in the direction of the graph line that has increased from A-1 to A-2. Thus there has been an increase in counting arithmetic from A-1 to B and from A-1 to A-2.

Based on the results of the analysis, data processing and A-B-A graphic design that have been described previously it turns out that the use of collaborative method effectively increases numeracy skills, especially addition. By using the collaborative method, it is seen that students are very enthusiastic and more interested. The collaborative method has a positive effect on numeracy ability, although increasing numeracy skills that are influenced by the collaborative method do not require a long time to achieve developmental changes and increase positively. This is evidenced by the percentage score count in the intervention phase (B) is higher than the Baseline-1 phase, so that there is an increase in the percentage of counting at the time of intervention and at Baseline-2, this means that the ability to count has increased.

3.4 Discussion

The increase in numeracy ability is used by the use of collaborative method as an attractive method for the subject, because this method emphasizes the provision of wider learning opportunities and a conducive atmosphere for students to obtain, and develop knowledge, attitudes, values, and skills social skills. This learning method is quite fun for students and teachers as actively used to repeat the material previously given. However, even new material can still be taught with this strategy with notes; students are

given the task of learning the topics that will be taught first so that when they enter the class, they already have the provision of knowledge [15].

Overall scores obtained from the four sessions in the Baseline-1 phase for operating skills counted to 20 where the percentage shows the baseline session is 25%, the second baseline is 30%, the third baseline is 30%, and the fourth baseline is 35%. Whereas scores obtained from eight scores obtained from eight sessions in the intervention phase the figures showed intervention 1 was 50%, intervention two was 65%, intervention three was 75%, intervention four was 75%, intervention five was 80%, the sixth intervention was 70%, the seventh intervention was 80%, the eighth intervention was 85%. While the score obtained in the Baseline-2 phase is the first session is 50%, the second session is 55%, the third session is 45%, and the fourth session is 60%. From the results of data processing based on the scores obtained in each phase, namely the Baseline (A-1), Treatment (B), and Baseline (A-2) phases, it appears that there are differences.

4. Conclusion

Mathematics learning will go in the right direction and succeed if we know the characteristics of mathematics. Therefore, our task as teachers is to be able to determine precisely the methods, approaches, strategies and learning models that can be applied in teaching a particular material so that learning can run effectively and efficiently.

Based on the analysis of the overall data obtained in the field, both through the percentage score of addition to 20 operating abilities in intellectual disability children using collaborative methods at the baseline-1 stage, the intervention stage and after the intervention, the researchers concluded that this study indicated that the application of surgery summation using the collaborative method is quite effective and can be understood by children. This is evidenced by an increase in the percentage from the A-1 baseline to baseline-2. Thus the collaborative method can improve the addition of numeracy skills. The recommendations from this study obtained data that collaborative learning models can improve the mathematical abilities of mentally disabled students.

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