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Mental Retardation Student' Arithmetic Problem-Solving Ability of Through Computational Thinking-Oriented Approach

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Abstract. Mental retardation students experience intellectual development far below the average mental and adaptive behavioral barriers that make it challenging to solve arithmetic problems, especially multiplication operations. Even though they have limitations, they can develop through an appropriate learning approach for solving multiplication problems. This study aims to analyze the achievement and improvement of students' multiplication problem-solving abilities by applying a computational thinking-oriented approach. This research was included in a quasi-experimental study using a non-equivalent group control design. The experimental group subjects were five students with mild mental retardation from SLB Dharma Rena Ring Putra. In comparison, the control group subjects were three students from SLBN 2 Bantul. The research instruments were test questions using multiplication problems and intervention guidelines. The results showed that learning with a computational thinking-oriented approach was quite effective. The average value of N-Gain for the experimental is 63.06%, there is higher than conventional learning, with the average N-Gain for its control class being 39.63%. Further research can be carried out by developing teaching materials based on the computational thinking-oriented approach to complement learning so that it is very effective applied to mental retardation students.

INTRODUCTION

Teaching mathematics for mild mental retardation students has experienced a shift in focus from basic skills instruction to computational and problem solving [1]. Furthermore, teachers use several techniques combined with certain cognitive strategies according to student characteristics. According to the American Association on Mental Retardation, mental retardation is someone who has significant limitations in both intellectual function and conceptual, social and practical adaptive skills so that he must manifest before the end of the developmental period defined as the first 18 years of life [2]. According to the American Psychiatric Association [3], mental retardation groups are classified according to intellectual disability and level of intelligence. For the mild mental retardation group (able to learn), children can still develop social and communication skills during the preschool period, have minimal sensorimotor disorders, and have intellectual abilities that are still equivalent to normal children aged 9-13 years.

A diagnosis of mental retardation was associated with significant limitations in two or more areas of adaptive skills before the age of 18. Adaptive skills are skills that are needed for everyday life be it communication skills, life and social skills, work skills, and functional academic skills (reading, writing, and arithmetic) [4, 5]. related with one of the adaptive skills, mentally retarded students have limitations in arithmetic skills as functional academic skills, be it in basic operations of addition, subtraction, multiplication, and division of integers [6]. These skills are a major element of the elementary school mathematics curriculum and have a fundamental role in solving more complex mathematical problems ([7, 8]). Mastery of a basic arithmetic operation can be achieved if students understand the concept of operations and relationships between operations [9].

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In fact, there are still many students who are afraid to learn mathematics because it is considered difficult and complex [10]. No exception for mentally retarded students who have obstacles in measurement or calculation, and estimation [11]. With low IQ scores and poor memory, many mentally retarded students experience an inability to solve problems related to arithmetic calculations that require appropriate cognitive abilities ([8, 12]). According to Andriyani and Monif [13], one material of arithmetic calculation that has the potential to be memorized by students is the multiplication operation. Children are often confused with interpreting the mathematics terms such as types of arithmetic operations due to difficulties in language or lack of understanding of the language structure in the arithmetic problems presented [14].

The results of preliminary research at SLB Dharma Rena Ring Putra and SLBN 2 Bantul, found that grade VII students with mental retardation still did not understand the concept of multiplication operations and often had difficulty calculating the multiplication of two numbers. Students also still have difficulty solving contextual problems related to the concept of multiplication, especially the multiplication abstraction related to modeling problems. Meanwhile, teachers still use the conventional method to teach multiplication. Therefore, we need a learning approach that can help students to achieve good problem-solving abilities that accordance with the obstacles and limitations of mentally retarded students.

One approach that can be used to stimulate the problem-solving ability of mentally retarded students is a learning approach that is oriented towards computational thinking skills. Computational thinking oriented approach is a way of solving problems that involves the use of abstraction and decomposition to solve complex problems [15]. For mentally retarded students, the meaning of complex in a mathematical problem is that it contains several tricky elements to be understood and is related to other elements. In fact, mental retardation students have the characteristics of having difficulty remembering complete information, solving problems, or learning difficulties so that it takes a long time [16]. With the computational thinking approach, problems that are difficult to break down into smaller and more familiar problems can solved so that the information memorized by mentally retarded students becomes simpler. Furthermore, in the computational thinking approach is used a set of rules for finding solutions (algorithms), abstractions, or generalization to get solutions based on the same or similar problems. Based on the facts above, an effort is needed to improve the quality of multiplication learning that is adjusted to the limitations and constraints of mental retardation students. This effort is carried out by implementing learning with the computational thinking-oriented approach to improve the problem-solving abilities of mental retardation students.

METHODS

This research was included in quasi-experimental research using a non-equivalent group control design which he illustrates as stated by Lestari & Yudhanegara in Figure 1 [17].

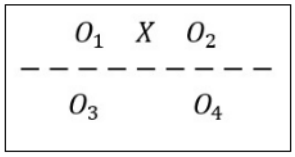


FIGURE 1. Research Design

Description:
$O1$ = The pre-test was given before the experimental group given treatment
$O2$ = The post-test was given before the experimental group given treatment
$O3$ = The pre-test was given before the control group given treatment
$O4$ = The post-test was given before the control group given treatment
X = Treatment which is learning activities using a computational thinking approach

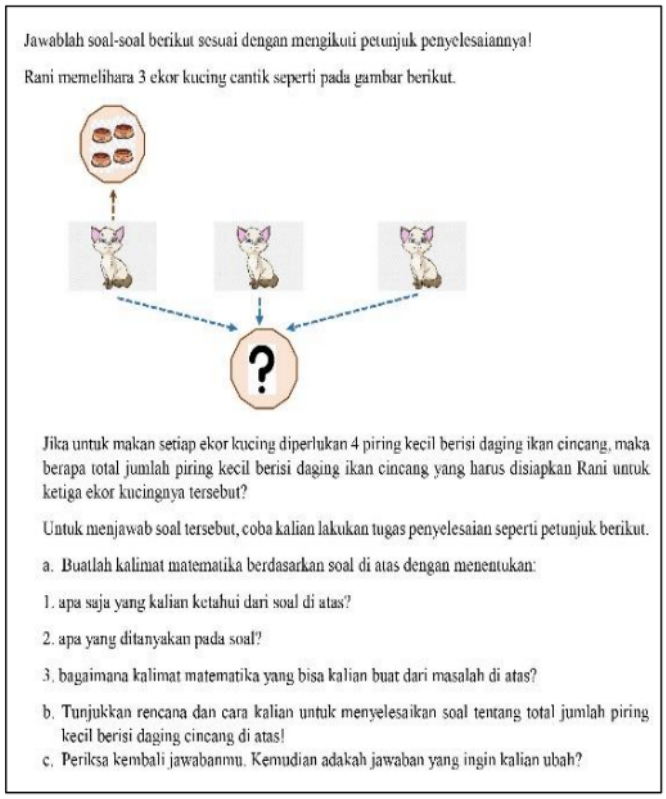
The control and experimental groups were not chosen randomly because it was challenging to get a control class as a comparison. The subjects of this study were students with mild mental retardation in two special schools in Yogyakarta. The experimental group subjects were five students from SLB Dharma Rena Ring Putra, who would be given learning using a computational thinking approach. In contrast, the control group subjects were three students from SLBN 2 Bantul, who were not given learning with a computational thinking approach but learning by lecturing.

The instruments used to collect data were test questions in the form of multiplication problems and interview guidelines. Data analysis was performed using a statistical independent t-test [18] and descriptions of semi-structured

interviews. To find out the effectiveness of learning with a computational thinking approach to improve students' problem-solving abilities, the researcher used the calculation of the percentage of the N-gain value, the category of which was adapted from the Hake [19] category, namely: <40% (ineffective), 40%-50% (less effective), 56%-75% (quite effective), and >76% (effective).

RESULTS AND DISCUSSION

Researchers carried out learning during three meetings in the two special schools, namely SLB Dharma Rena Ring Putra and SLBN 2 Bantul, in which each school was given a different learning approach according to the lesson plan. A computational thinking approach is given to study concepts and solve multiplication problems based on finding the results of initial research which are still difficult for mentally retarded students in the experimental group. Learning begins by giving two multiplication problems that students often encounter in everyday life. The two problems can be seen sequentially in Figure 2 and Figure 3.



Jawablah soal-soal berikut sesuai dengan mengikuti petunjuk penyelesaiannya!

Rani memelihara 3 ekor kucing cantik seperti pada gambar berikut.

Jika untuk makan setiap ekor kucing diperlukan 4 piring kecil berisi daging ikan cincang, maka berapa total jumlah piring kecil berisi daging ikan cincang yang harus disiapkan Rani untuk ketiga ekor kucingnya tersebut?

Untuk menjawab soal tersebut, coba kalian lakukan tugas penyelesaian seperti petunjuk berikut.

a. Buatlah kalimat matematika berdasarkan soal di atas dengan menentukan:

1. apa saja yang kalian ketahui dari soal di atas?
2. apa yang ditanyakan pada soal?
3. bagaimana kalimat matematika yang bisa kalian buat dari masalah di atas?

b. Tunjukkan rencana dan cara kalian untuk menyelesaikan soal tentang total jumlah piring kecil berisi daging cincang di atas!

c. Periksa kembali jawabanmu. Kemudian adakah jawaban yang ingin kalian ubah?

TRANSLATION

Answer the following questions by following the instructions for the solution!

Rani raises three beautiful cats as in the following picture.

If it takes four small plates of minced fish to eat of each cat, how many minced fish does Rani have to prepare for the three cats?

To answer this question, try to do the complete task as follows:

a. Make a mathematical sentence based on the problem above by determining:
   1. What do you know from the questions above?
   2. What is asked in the question?
   3. What mathematical sentences can you make from the problem above?

b. Show your plans and ways to solve the problem about the total number of small plates of minced fish above!

c. Recheck your answer. Then, is there an answer you would like to change?

FIGURE 2. Multiplication of the first problem

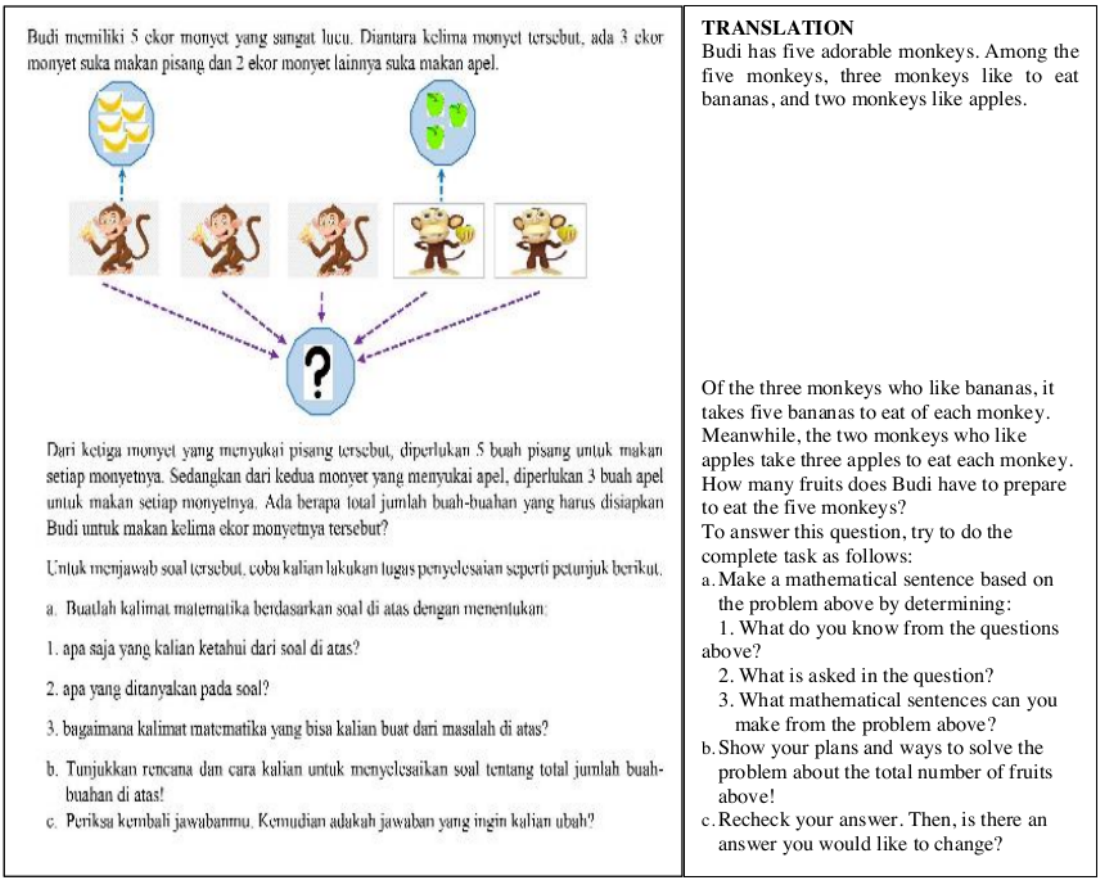
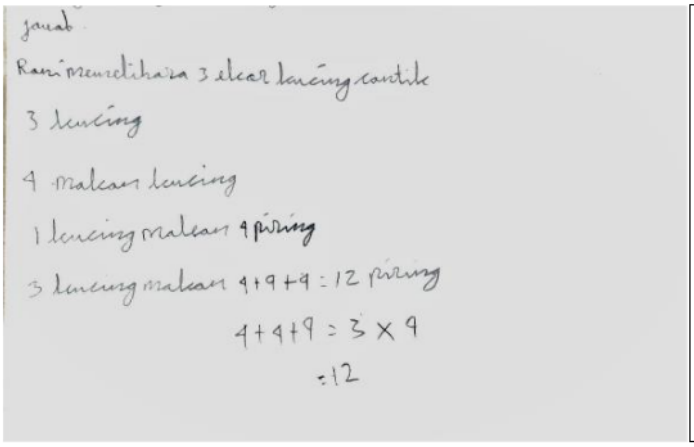


FIGURE 3. Multiplication of the second problem

Students are asked to read the given multiplication problem carefully. If there are difficulties in understanding the meaning of the questions, students can ask the teacher. After reading the two questions given, students are asked to work on the questions. To solve these two problems, the teacher guides students to identify general principles contained in the questions. This activity is carried out to construct students' abstraction which is one of the cores of the computational thinking approach. But in the second, more complex problem, the teacher also guides students to divide the problem into smaller parts to be managed and solved more easily. In this phase, the teacher applies the core of decomposition to the computational thinking approach. Then students are asked to observe the image to be associated with data patterns which will later be used in making predictions and data presentations. These activities are used to construct students' pattern (generalization) abilities which are also another core in the computational thinking approach. Next, the teacher guides students to develop step-by-step problem-solving ways using existing information to solve both problems. Examples of student' answer in solving problems using the cores of the computational thinking approach can be seen in Figure 4 and Figure 5.



TRANSLATION
Answer
Rani raises three beautiful cats

Three cats

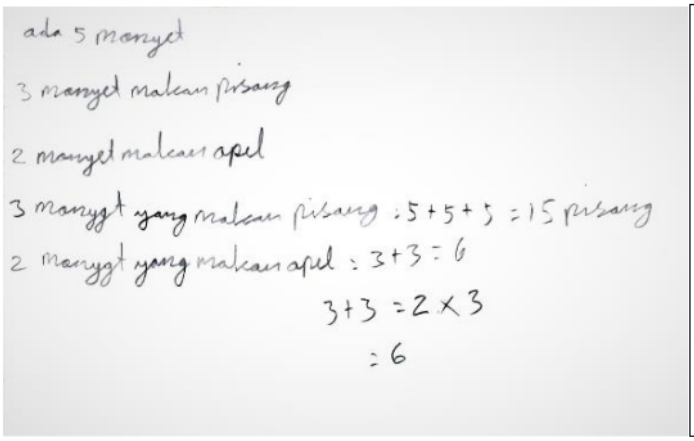
Four eat cat

One cat eats four plates

Three cats eat 4+4+4 =1 2 plates

4+4+4 = 3 × 4
=12

FIGURE 4. Students' answers in solving of first problem using the cores of the computational thinking approach



TRANSLATION
There are five monkeys

Three monkeys eat bananas

Two monkeys eat the apple

Three monkeys eating bananas = 5+5+5 = 15

Two monkeys eating apples = 3+3 = 6

3+3 = 2 × 3

= 6

FIGURE 5. Students' answers in solving of second problem using the cores of the computational thinking approach

In Figures 4 and Figure 5, it can be seen that the student identifies what information she knows in the problems based on the object types and many of the objects contained in the problems. The student's answer in Figure 5 shows that the student describes the data for each object type and much of objects on a more complex problem in a more detailed way. Then the teacher guides the student in representing each of these data into an arrangement of pictures provided by the teacher so that the student can find general principles that produce certain patterns as shown by the white dotted line in Figure 6 (a) - (b).

(a) (b)

FIGURE 6. Figures of student's multiplication representation in the arrangement of pictures

In Figures 6 (a), the student was able to organize data and interpret data visually well. That means the student can understand the problems given well, such as the achievement of the cognitive process of interpretation in understanding presented by Anderson Krathwohld [20]. Figures 6 (b) show that the student uses similarity of patterns and regularities in a list of written information she knows, as shown in Figure 4 and Figure 5 so that she can be used in making predictions and mathematical models. Furthermore, the teacher guides the student to write down a mathematical model and steps to solve the problem as shown in Figure 4 and Figure 5. In this case, the student has succeeded in carrying out the abstraction that they use to define the model, generalize examples and suggest a sequence of problem-solving steps according to the input as presented by Wing [21].

Students' sequence of problem-solving steps contains their algorithmic thinking ability to obtain a solution with a clear definition of the steps. This is in line with what was stated by Csizmadia [22]. Students can use the cores of abstraction and decomposition to solve complex problems [23]. Furthermore, according to Csizmadia [22], the decomposed problems can be easier to understand, solve, and evaluate separately. This makes mentally disabled students with intellectual weaknesses more easily solve complex problems and understand new situations. To find out whether the computational thinking approach can improve the problem-solving abilities of mental retardation students, then hypothesis testing is done using independent t-test and N-gain value. Before carrying out the independent t-test, it is necessary to check the normality assumptions of the distribution of the two classes using the Shapiro-Wilk technique [24]. Based on the results of normality testing using the Shapiro-Wilk technique, the signification (Sig.) value is obtained for the experimental class it is 0.679 and the control class is 0.463. Because of the Sig. value the two classes > 0.05, it can be concluded that the problem-solving ability for the experimental class and the control class is normally distributed.

Meanwhile, checking homogeneity assumption is done by using Levene's test [25]. Based on the test output, it is known that the Sig. Levene's test for equality variances is 0.644 > 0.05, which means that the data variance between the two classes is homogeneous or the same. Because it has met the requirements for normality and homogeneity, then testing the similarity of average problem-solving abilities of mental retardation students between the control and experimental classes. Based on the independent t-test sample' output, it is known that the Sig. Value (2-tailed) of 0.000 <0.05, so it can be concluded that there is a significant difference between the average problem-solving ability of students the experimental class and the control class. After knowing the differences in problem-solving abilities between the control and experimental classes, the effectiveness of learning with a computational thinking approach will be checked on the multiplication problem-solving abilities of mentally disabled students using the N-gain value test as in Table 1.

TABLE 1. Description Output of N-Gain Test

N-Gain Value of Components	Experiment Class	Control Class
Mean	63.06	39.63
Std. Deviation	4.67	4.34
Minimum	56.76	36.67
Maximun	68.97	54.71

Based on the test output with SPSS, it is known that the average value of N-Gain for the experimental class is 63.06%, including in the quite effective category. With a minimum N-gain value of 56.76% and a maximum of 68.97%. Meanwhile, the average N-gain value for the control class is 39.63%, including in the ineffective category. With a maximum N-gain value of 54.71% and a minimum of 36.67%. Thus, learning with a computational thinking method can be said to be more effective for improving the multiplication problem-solving abilities of men retardation students than conventional learning. The effectiveness of the method chosen by the teacher affects the quality of learning in the classroom both in terms of optimistic expectations for student success as well as appropriate learning management and design [26]. Seeing the importance of choosing learning methods in the success of student learning, a teacher needs to consider the selection of learning methods that are adapted to their cognitive development. Because a cognitive of student shows the idea of what students know in their mental activity [27].

It is important to note that students with disabilities will need modifications to meet their learning needs. But in general, all students benefit from a meaningful mathematics learning experience. According to Clements [28], students who do not have broad learning opportunities or limitations will require a more extended study time than normal children, while students who have vast opportunities will benefit from strategies and teaching materials. In the learning activities of mentally retarded students, the active role of parents, support, and practical guidance of teachers is needed through a learning approach adapted to the peculiarities of the development of mental retardation [29]. Therefore, a computational thinking-oriented approach can be a suitable alternative in learning mathematics for mental retardation students whose learning needs tend to lea through games. The tendency to learn through games integrated with a computational thinking-oriented approach is in line with the research results of Kosmas research, etc. [30]. Their result shows that students who study in secondary schools in five different countries as Greece, Cyprus, England, Italy, and Poland, have an interest and need for games to apply computational thinking, which is one of the problem-solving strategies.

CONCLUSIONS

Based on the results of research data analysis and discussion, it can be seen that there is a significant difference between the avera multiplication problem-solving ability for students who are given computational thinking approach learning and conventional learning. The difference in problem-solving abilities is caused by the provision of learning with a computational thinking approach, which effectively influences the problem-solving abilities of mentally disabled students compared to nventional learning. The implementation of learning with a computational thinking approach contains the cores of abstraction, decomposition, algorithmic thinking, and pattern (generalization).

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