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MATHEMATICAL CONNECTION OF ELEMENTARY SCHOOL STUDENTS TO SOLVE MATHEMATICAL PROBLEMS

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Abstract

This study aims to determine the mathematical connection ability of elementary school students in solving mathematical problems. This research uses the qualitative approach with descriptive method. We used observation, interview, and test to collect data. This study shows that 6.67% of the samples scored between 60 and 69 in the fair category. A total of 98 students or 81.67% scored between 45 and 59 who belonged to the below average category, and 14 students or 11.67% scored between 0 and 44 which were classified as a poor category. This result proves that the mathematical connection ability of elementary school students in solving mathematics problems is still low.

Keywords: Ability, Elementary school, Mathematical connection, Mathematical problems.

Abstrak

Penelitian ini bertujuan untuk mengetahui kemampuan koneksi matematis siswa sekolah dasar dalam memecahkan masalah matematika. Penelitian ini menggunakan pendekatan deskriptif kualitatif. Metode pengumpulan data dalam penelitian ini adalah observasi, wawancara, dan tes. Penelitian ini menunjukkan bahwa sebanyak 8 orang siswa atau 6,67% dari sampel penelitian mempunyai nilai di antara 60 dan 69 yang termasuk kategori cukup. Sebanyak 98 siswa atau 81,67% mempunyai nilai di antara 45 dan 59 yang termasuk kategori kurang. Sedangkan 14 siswa atau 11,67% mempunyai nilai di antara 0 dan 44 yang termasuk kategori sangat kurang. Hal ini membuktikan bahwa kemampuan koneksi matematika siswa sekolah dasar dalam memecahkan masalah matematika masih rendah.

Kata kunci: Kemampuan, Koneksi matematis, Masalah matematika, Sekolah dasar.

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Mathematics is a compulsory subject in elementary school. Mathematics learning in primary schools has a useful purpose for the life of a country. The Indonesian Ministry of National Education (MONE) argues that mathematics learning can equip students with logical, analytical, systematic, and creative thinking skills (BSNP, 2006). Moreover, the MONE states that the purpose of mathematics learning in elementary school is to enable students to understand the concept of mathematics. Students are expected to explain the relationship among one concept with the others, to use the right concept to solve problems, to make sense of patterns and traits, to manipulate mathematics in making reports, and to explain mathematical ideas (BSNP, 2006).

Based on the purpose of mathematics learning in elementary school, we can conclude that mathematics learning is very important for elementary school students since it is closely related to the daily life (Hamidah & Chotimah, 2015). The elementary school mathematics learning can equip elementary school students to think logically, analytically, systematically, critically and can cooperate with others. Therefore, it is necessary to qualified mathematics learning such that the students could not only memorize or use the existing formula but also connect the material learned at school with the

real life or vice versa. Mathematics learning should avoid the use of traditional learning methods that lead to convergent thinking in which students only remember mathematical theorems and rules to solve problems. What often happens in mathematics learning is students are given the closed problem to be solved (Maharani, Sukestiyarno, & Waluya, 2017).

Mathematics is a subject that links concepts (Nurhasanah, Kusumah, & Sabandar, 2017). Students' ability to understand the concept is the ability to not only know or remember some concepts learned but also able to express again in other forms that are easy to understand, provide interpretation of data, and able to apply the concept with its cognitive structure (Ulia, 2015; Istihapsari, 2017). Concepts in learning mathematics are interconnected with each other. When the students learn a concept, then they need to learn the other ones. This state is called a mathematical connection, the ability of students in connecting a concept with the other concepts.

The mathematical connection is the ability to associate students' mathematical knowledge with other mathematical skills and real life (Bahr & DeGarcia, 2008). Mathematical connections are part of a network of interconnected knowledge with other knowledge composed of critical concepts to understand and develop relationships between mathematical ideas, concepts, and procedures. The ability of students to connect mathematically is one of the essential things that must be achieved by students in the learning process because if students know the relationship between the concepts, they will quickly understand the mathematics itself and open opportunities for students to develop their mathematical skills.

The National Council of Teachers of Mathematics states that there are five standards of mathematics learning, namely communication, reasoning and proof, representation, connections, problem-solving (Rickard, 2005). Thus, mathematical connections need to be taken into consideration in the mathematics learning process especially in elementary schools. In mathematics learning, the mathematical connection should be developed since elementary school age. The mathematical connection ability emerges when the students can connect between one material to the others. Students can communicate the concepts that they learn because they have mastered the prerequisite materials related to daily life. If the students can connect the material which they learn from the previous subject or with other subjects, then the learning of mathematics becomes more meaningful (Linto, 2012).

The mathematical connection is vital to be developed in the students because it will help students in understanding a concept and can improve their understanding of other science by connecting the concept of mathematical concepts with other concepts (Hendriana, 2014). Also, the ability of the mathematical connection needs to be widely developed as it can increase students' cognitive by remembering a concept, understanding and applying the concept in daily life, without which students will find it challenging to learn mathematical concepts (Siregar & Surya, 2017). Thus, the mathematical connection should be developed since elementary school age.

However, many argue that the mathematical connections of elementary school students are still low. Hermawan & Prabawanto (2015) found that the mathematical connection ability of elementary school students is still low with a score of 10.87 from a maximum value of 24.00. It is caused by the assumption of elementary school students that learning mathematics as problematic and unpleasant learning and also this is caused by teachers who carry out the learning process using the lecture method (Hermawan & Prabawanto, 2015). Also, the ability of mathematical connections of elementary school students using conventional methods is still in the low category; this proves that students' mathematical communication skills need to be improved (Putri, Rahayu, Saptini, & Misnarti, 2016). The research proves that the mathematical connections of elementary school students in Indonesia are still low.

The lack of mathematical connections of elementary school students influences the ability to solve mathematics problems in primary schools. The process of solving the problem requires an effort to establish a connection between the stages of problem-solving (Tasni & Susanti, 2017). Based on this idea, the mathematical connections of students cannot be separated from the attempt to solve mathematical problems. The process of solving mathematical problems is the activity of students who can build mathematical connections of students; this happens because in solving the problems of mathematics students must have the ability to find the linkage of concepts or theorems used to solve a problem (Siregar & Surya, 2017). Our analysis of the above opinion results that the ability of mathematical connections has a relationship in solving mathematical problems related to everyday life. Mathematical connections can improve thinking skills in solving mathematics problems.

To know the conditions in the field about the ability of mathematical connections in primary school, we conducted interviews with elementary school teachers in X Koto Singkarak District. A teacher said that he did not know about the connections of the five basic skills in mathematics learning, especially regarding mathematical connections. The teacher only knows the problem solving while the other skills the teacher does not know. The teacher only gave mathematics problems when there are basic competencies related to problem-solving. Many teachers implement the learning process by using the direct method. This phenomenon is due to lack of media for the learning process of mathematics. We also interviewed a teacher from a different school who claim that the term of mathematical connection is not familiar, only the term problem-solving is familiar to the common teacher. Teachers rarely provide material related to solving mathematics problems. Teachers occasionally use demonstration methods as an effort to improve the quality of mathematics learning. Teachers also stated that the low learning outcomes of students.

The results of our analysis of the interview are the lack of information by teachers on basic skills in learning mathematics in primary schools, while in improving the quality of mathematics learning should master the skill of the skill. Teachers do not know the benefits of mathematical connections, while the benefits of mathematical connection ability one of them can improve the learning of mathematics, both cognitive, affective, and psychomotor. Also, the teacher lack strategies

for improving the quality of mathematics learning in primary schools, especially in improving mathematical connections. Teachers do not connect the learning materials into the student's life. There is no effort to create a learning process that uses mathematical connection skills in solving mathematical problems. Based on the problems, we are interested in analyzing the mathematical connection ability of elementary students in X Koto Singkarak District of Solok regency in problem-solving.

METHOD

This research uses a qualitative approach. The method used was descriptive research using observation, interview, and test. Descriptive method is a method of research by collecting actual data. After the data collected, the data are prepared, processed, and analyzed to be able to provide an overview of existing problems. The population in this research is the third-grade students of public elementary schools in X Koto Singkarak District, Indonesia, in the 2017/2018 academic year. The school is grouped into five clusters by region. Each region is taken one elementary school to represent the region. Sampling on this research is using cluster sampling technique.

This research is qualitative, so the analysis used is a descriptive and interpretative analysis done since data collection is done. Analysis of test results is used to determine and obtain the level of mathematical connection ability of students in solving mathematical problems. To simplify the research, we undertook the research steps: (1) designing the research; (2) determining the location and subject to be studied; (3) contacting the research site; (4) preparing the research instruments; (5) validating instruments and revising them; (6) collecting data by using observation and test, (7) analyzing the data obtained and summing up the results of research and presenting the data.

RESULT AND DISCUSSION

The first step in this research is designing the research include determining methodology used is using the qualitative approach with observation, interview, and test. After designing the research, the next step is to determine the sample and location of the subject under study. Samples were collected using cluster sampling technique representing each cluster in elementary schools located in X Koto Singkarak district, namely SDN 03 Tikalak, SDN 10 Saning Bakar, SDN 13 Sumani, SDN 04 Tanjung Alai, and SDN 15 Kacang.

The next step is to design the research instrument. The design of the problem to measure the ability of mathematical connections is tailored to the learning materials that are taught in the third grade of elementary school. The item was designed to measure success in achieving learning objectives. This statement is in line with the opinion of Adedoyin (2010) that teachers' questions are of significant values for many instructional purposes, eliciting student reflection and challenging students' understanding deeper and engagement in the classroom.

The problem is matched to the mathematical connection indicator that students should be able

to recognize and utilize the relationship between ideas in mathematics. Students also need to understand how ideas in mathematics interconnect and underlie each other to produce a coherent unity, and apply mathematics in daily life and adjusted to the scope of subjects on elementary school education units namely numbers, geometry and measurement. Churchill states that there are two ways to propose an item. First, determine the question that must be determined its validity and second is to scale the item by way of reviewing the literature (Rahi, 2017). Therefore, the designed instrument is tailored to the literature review and validated by an expert mathematician of elementary school and an expert in the oral language of elementary school to be corrected whether the question is worth to be used in measuring the mathematical connection ability in solving mathematical problems. To see the validation results from mathematics expert, we can see Table 1.

Table 1. Comments Expert of Mathematics of Elementary School

Comment	Revision
The problems designed to represent the learning materials have been in line with the mathematical connection indicators. However, there were some questions such as the number x and x not used because it is not relevant to the indicator mathematics connection, namely understanding how ideas in mathematics interconnected and underlie one another to produce a coherent unity.	We follow the expert's advice not to include problems Number 3 and Number 7 because they were not relevant to the second indicator. Deleting these two problems do not affect other problems because some other problems already represented the second indicator.

Meanwhile, we also addressed the validation to the language expert. It is important to make sure that the message in the problem could be delivered properly to the students. The result of validation can be seen in Table 2.

Table 2. Comments Expert Language of Elementary School

Comment	Revision
So that the problem of 2, 4 and six the language is more simplified because the problem used less concrete terminology	Simplify the sentence of the problem

The next step was giving the question to the school that has been selected. The school has 120 students. We administered some tests in 60 minutes to the students. In the test, two questions represent two questions represent one indicator of mathematical connection. Furthermore, the data is processed and analyzed based on the assessment rubric.

The first problem is adapted to the mathematical connection indicator that students should be able to recognize and utilize the relationship between ideas in mathematics. The problem is written in Problem 1.

Today Andy and family will be recreation. Andy's mother brought eight packets of sweets to consume during the trip. Each candy wrap contains nine candy bars., Brother Andy brought 15 candies. How many candies are brought by Andy's family?

In Problem 1, the student is asked to be able to recognize and utilize the relationship between ideas in learning mathematics. Problem 1 requires some mathematical concepts and links between the concepts to answer the question. Students are required to be able to understand and recognize problems, to try to relate those problems to some known mathematical concepts. Problem 1 requires knowledge of students in recognizing a problem. After that, students are required to associate the multiplication concept and addition. Based on the analysis result, from 120 student samples, only 21 students or 17,5% get score 3, 74 students or 61,67% student get score 2, and 21 students or 17,5% get score 1, four students or 3.34% earned score 0.

From the results, we can conclude that elementary school students are still low in recognizing and utilizing the relationship between ideas in learning mathematics. NCTM states that when students can connect mathematical ideas, students' understanding becomes more profound and more enduring, (Rismawati & Irawan, 2016). In addition to learning by knowing relationships mathematically, students will better understand mathematics and also give them greater mathematical power (Romli, 2016). Therefore, this problem is expected in elementary school students can use ideas and concepts in mathematics to solve problems.

The next question represents mathematical communication indicators in solving mathematical problems of understanding how ideas in mathematics interconnect and underlie each other to produce a coherent unity. The problem is written in Problem 2.

David experimented on the growth of green beans. On the first day of green beans grown along 1 centimeter, David's second day measured to 3 centimeters, on the third day to 5 centimeters. What is the estimated growth on the fourth day?

In Problem 2, the students are asked to be able to connect with other concepts that result in a coherent unity. Problem 2 contains the meaning that the learning of mathematics is associated with science learning so that it becomes a whole and coherent matter so that students can associate the concept of mathematics in other learning without separating a mathematical concept with other concepts. In this problem, no students get scores 3. There are 23 students, or 19.17% of students get a score of 2, 15 students or 12.5% of students get a score of 1, and 82 students or 68.34% of students get a score of 0. The question proves that the weakness of elementary school students in connecting mathematical material into another fundamental science as a coherent unity.

Mathematics is the source of other sciences, that is to say, the many sciences that discovery and

development depend on mathematics so that mathematics courses are useful for learners as the virgin for application in other fields (Sholihah, 2015). Besides, mathematics as the science of logic about form, structure, quantity, and concepts related to each other. Concepts in mathematics related to concepts outside mathematics. Many theories and other branches of science are found through the concept of mathematics. Thus, learning mathematics is related to other learning. Therefore, if the students could connect one concept in mathematics with the concept beyond mathematics, then they could connect mathematics well. However, based on the results of research that elementary school students are still weak in connecting the concept in mathematics and outside mathematics in a comprehensive way.

Problem 3 represents the indicators of recognizing and applying mathematics in daily life. The problem is:

> *My family and I leave at 7.30 from Solok to Pekan Baru. After walking three and a half hours, we rest for lunch for 30 minutes in Bukittinggi. Then we continue the trip for 3 hours. At what time did we get to Pekanbaru?*

In Problem 3, students are asked to be able to recognize mathematical problems and apply them in everyday life. In Problem 3, students are required to understand the immediate problems in their life and can solve the problem in the mathematical model. In this problem, as many as 34 students or 28.34% of students get a score of 3, as many as 56 students or 46.67%. Problem 3 illustrated that the ability of students in solving math problems in everyday life is still low. Mathematics learning is closely related to daily life. Mathematics is one of the essential lessons mastered by elementary school students because of its many uses in everyday life. Mathematics was not only arithmetic but also contribute to life value which was necessary for people life (Soeprianto, 2009).

Problem 3 can prove that the application of primary school students' mathematics learning is still low. Whereas helping students learn to make connections between various forms of mathematical knowledge, as well as between mathematics and real-life experience, is increasingly recognized as integral to effective mathematics learning and teaching with students able to apply the learning mathematics in everyday life. Mathematics is one of the disciplines that can improve thinking ability and contribute to daily problem solving and in the world of work and provide support in the development of science and technology (Susanto, 2013).

After the analysis of the grading problem as a whole, there were eight students or about 6.67% of the sample scored between 60 to 69 which belongs to the fair category. A total of 98 students or 81.67% scored between 45 and 59 who belonged to the below average category, and 14 students or 11.67% scored between 0 and 44 who were classified as a poor category. These results prove that the highest student presentation is in a low category. Thus, the mathematical connection ability of elementary school students in solving math problems is still low.

We conducted interviews with elementary school students. We questioned a mathematical case like " *Wilda bought a book for Rp. 7,500.00. He pays by using a sheet of five thousand and two thousand two. How much change will Wilda accept* ?". When we asked that question, elementary school students answered with hesitation, " *maybe the answer is Rp. 1000,00 sir* ". Our analysis of the answers is that students are still unable and accustomed to associate ideas in mathematics learning in primary schools.

We conducted interviews with other students, giving the following questions "*Deni experiments on ping pong balls and golf balls. Both balls have almost the same shape. However, when the ball is dropped to the ground, the first ball to the ground is a golf ball. To determine the cause of Deni try to observe from the shape and weight. What tool does Deni need to know the weight of both balls?*". The question was answered by the student "*using a scales maybe, sir*." Our analysis of the student's answer is that the students are still unable to understand the problem and have not been able to link the learning of mathematics with other learning.

The next sample interview is with different students. We asked "*if Garden Mr Alfi be a square shape with an area of 100 meters. How long the length of the side of the garden*?". Then the students start thinking and start looking for papers to do the calculations. After a long time the students answered "*25 sirs*", then we asked again. "*25 what*?". Students answer "*25 sirs*". Our analysis of the process is that students have been able to recognize and apply mathematics in their daily life but still unable to answer correctly.

From the analysis we showed that elementary school students are still weak in relating ideas in mathematics learning in primary schools, understanding how ideas in mathematics interconnect and underlie each other to produce a coherent unity as well recognize and apply mathematics in everyday life.

Based on the observation we have done to the SDN 03 Tikalak when the teacher performs the learning process, the teacher only taught mathematics by explaining the material on the blackboard after which the students were asked to do the exercises. When we did observations in SDN 10 Saniang Baka, we also found the same problem that was the teacher explains the material by providing training to students. We also do observations in SDN 13 Sumani found the teacher explains the concept of mathematics by using learning media but the teacher only limited to explain the media without any attempt to associate the learning with mathematical concepts and concepts outside mathematics. In SDN 04 Tanjung Alai also found that teacher did not attempt to improve the ability of mathematical connections of their students, to embed mathematics concept but still used conventional methods. Observations that we did in the SDN 15 Kacang find things that were not much different than teachers teach using the lecture method and still provide practice to testing the understanding of the concept.

Mathematical connections in solving mathematical problems need to be developed since elementary school age. The ability of mathematical connections is important because it has the same

properties with the systematic and structured science that contains concepts related to each other (Hendriana, Slamet, & Sumarmo, 2014). Besides, mathematical connections also help students in seeing the relationships of math with everyday life. Mathematical connections can make students understand a concept and assist students in improving the understanding of mathematical concepts. Also, mathematical connections help students in providing mathematical models that connect between concepts, data, and situations (Agustini, Suryadi, & Jupri, 2017).

However, what happened in the field is the mathematical connection ability of students in solving math problems is still low. The low ability of mathematical connection causes a lack of meaning and interest of students to learn mathematics. It can be seen from great fear and the lack of attention of students in learning mathematics (Kartikasari & Widjajanti, 2017). The low mathematical connections of elementary school students in solving mathematical problems will have an impact on the learning process and outcomes.

CONCLUSION

In this research, the mathematical connection ability of elementary school students in solving mathematical problems is measured through the problems made based on mathematical connection indicator which is adjusted with the learning material in class III. These indicators include recognizing and exploiting the relationship between ideas in mathematics, understanding how ideas in mathematics interconnect and underlie each other to produce a coherent unity, and recognize and apply mathematics in everyday life. From the results of the study, we conclude that the mathematical connection ability of elementary school students is categorized as low.

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