Mathematical connection ability of elementary school student in number materials

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Abstract. The background of this research is the lack of information about the mathematical connection ability of elementary school students. This study aims to determine the strength of mathematical connections of elementary school students concerning the ability to solve problems in the matter of numbers. The research used the qualitative approach with descriptive method. Instruments used in research are observation and test. The results showed that in the indicator to recognise ideas in mathematics as many as 12.50% of elementary school students scored between 60 and 69 with enough category, 55.83% composed between 45 and 59 with less category, and 31.67% scored between 0 and 44 with less than one category. Indicators understand how ideas in mathematics interconnect and underlie each other as many as 10.83% get scores between 60 and 69 with enough category, 61.67% get scores between 45 and 59 with fewer category and 27.50% scored between 0 and 44 with less than one category. The indicator of applying mathematics in everyday life shows that as many as 11.67% of elementary students who scored between 60 and 69 with sufficient category, 67.50% scored between 45 and 59 with less category, and 20.83% scored between 0 and 44 with less than one category. This research shows that the mathematical connections of elementary school students in solving mathematical problems in the number matter are still low. The results of this study have implications as the basis of teachers to improve the ability of mathematical connections of the elementary school student.

1. Introduction
Mathematics learning is compulsory learning that is learned in school [1]. Mathematical education is essential to be taught in schools because learning mathematics is very close to everyday life [2]. Mathematical learning is a tool that can determine the nature and relationship between natural phenomena [3]. This statement means learning mathematics is very close to everyday life. Everything related to human activities will be related to mathematics. Therefore, learning mathematics is very important to be taught at school and college level.

This statement is in line with the objectives of mathematics learning. Mathematics learning is taught to students so that students can think logically, analytically, systematically, critically, creatively and can cooperate [4]. It aims to prepare students to face changes in circumstances in life and in the world that always develops through practice and acting by thought [5]. In mathematics learning, students will become a reliable problem solver [6]. This concept aims to enable students to be free to use mathematics in their daily lives.
While specifically the purpose of learning mathematics in elementary schools formulated by the Indonesian Ministry of National Education is that elementary school students can understand, explain and apply concepts both inside and between concepts in mathematics as an effort to solve mathematical problems; elementary school students are expected to do reasoning, manipulate, and compile evidence in explaining an idea or accurate statement; elementary school students have the ability to understand, design mathematical models, complete models and interpret solutions in solving mathematical problems; elementary school students can use symbols, tables, diagrams, or other media in communicating ideas [7]. Seeing how vital mathematics learning is, there is a need for intense efforts to teach mathematics, especially learning mathematics in elementary schools.

Mathematics learning is not only limited to learning to understand the mathematical concepts just like what mathematics teachers have done so far. The National Council of Teachers of Mathematics divides there are five mathematics learning competencies namely, communication, representation, reasoning and proof, connections and problem solving. This concept shows that mathematics learning is not just limited to teaching numbers and symbols. Mathematical must be learning that can make students be able to communicate mathematical ideas and concepts [8]. Mathematics learning must also be able to prepare students to express and understand mathematics not only limited to numbers, but students can understand mathematical concepts in the form of pictures, symbols, and words in writing [9]. Mathematics learning is expected to enable students to find out by themselves by conducting their investigations, proving and finding out their answers so that there is a process of reasoning in mathematics learning [10]. Mathematics learning is not only focused on how to teach mathematics but also how students can apply it in their daily lives [11]. Mathematical learning can make students describe relationships between concepts, data and situations, this right is called a mathematical connection [12].

The ability of mathematical connections is essential for students [13]. The ability to connect mathematically is the ability of students to connect related issues in mathematics learning. This mathematical connection is not just in one mathematics learning, but also between mathematical concepts and comparing them with ideas outside mathematics, and this concept is associated with thoughts in everyday life [14]. Connection capabilities need to be developed at every level of education [15]. No exception for elementary school students because with mathematical connections students can connect between concepts in mathematical learning and outside of mathematics learning so that this can be used by elementary school students solving problems in everyday life. Mathematics connections are essential to learning in elementary school because students can see the possibility of relationships that exist on topics in mathematics learning, students can organise ideas in learning mathematics and make students able to understand mathematics teaching in depth [16]. Mathematical connections can make students estimate and develop their minds using insights in a particular context to test a conjecture in another context [17]. We can conclude that mathematical connections can improve students’ thinking ability to connect concepts both inside and outside mathematical concepts. Seeing the purpose of this precise connection, of course, the need for this genuine connection was developed since elementary school age so that the goal of learning mathematics in elementary schools was reached to the maximum.

Teachers as educators who teach mathematics in elementary school must be able to combine mathematical communication in the process of learning mathematics. In mathematics teaching in elementary schools, there are several scopes of material namely numbers and operations, geometry and measurement, data processing, problem solving and reasoning and communication [18]. Numbers are the initial concepts that are taught in mathematics learning in elementary schools. Numbers are part of mathematics learning which consists of calculating, one-on-one correspondence, classification and sorting, the relation of the whole section, comparison of recognising and writing numbers and place values [19]. Besides a number of operations also include understanding the concept of ten numbers and place value [20]. It can be concluded that the ratio and its operation consist of counting, correlation of correspondence one with one, calcifying and sorting, the relation of the whole part and the value of the place. The teacher must be able to combine the learning of numerical material to be able to train the ability of elementary school students to connect mathematics.
Different things researchers found when making observations in several schools. The first school that researchers found that in the learning process of mathematics the classroom teacher only taught mathematics material without any given feedback. The teacher explains the mathematical concept with the lecture method while writing on the board. The teacher tells the content directly to the formula while providing examples of the problem. On the one hand, the researcher looked at the condition of the students, many of them were confused by what the teacher explained. Researchers' observations proceed to the next school. At the school, the researchers found that the teacher taught mathematics material with the lecture method as well. When the teacher processes the concept of the teacher, explains the concept without linking the concept with other concepts. The teacher explains the material without giving reinforcement to students so that when the teacher gives examples of questions and is asked by students to do so many of them are unable to answer them. When researchers observe other schools' researchers also find the same thing, the teacher explains the mathematical concepts directly to the formula and provides examples of questions without feedback on the explanation so that students feel boredom in the process of learning mathematics. The researchers' analysis of this condition is that there is a suspicion that researchers have a weak mathematical ability of students in the school. Including of the problem is weak mathematical communication skills of elementary school students.

Researchers conducted literature studies and journal studies on previous studies that found no research that examined and analysed the ability of mathematical connections of elementary school students, especially students in low grades. Several studies have been done previously by other researchers, namely looking for the influence of the application of PBL learning models using media information and communication technology on mathematical connection skills of elementary school students [21]. Subsequent research is about the application of thematic learning models in improving mathematical connection skills of elementary school students. Previous research, there was an effort to enhance the mathematical connection ability of elementary school students. The need for valid data to determine the extent of the mathematical connection capabilities of elementary school students before efforts are made to improve these mathematical connections.

Therefore, the purpose of this study is to analyse the mathematical connection ability of elementary school students in numerical numbers so that the results found can be used as a basis for developing the strength of these mathematical connections.

2. Methods

The research method uses a quantitative approach with descriptive methods. The population in this study were students of class III elementary school X Koto Singkarak sub-district. Sampling using a cluster random sampling technique. The sample consisted of 120 students. Data collection for this research is techniques using observation and tests. The research steps are designing research, determining location, preparing research instruments, instrument validation and revision, testing data analysis, concluding, and presenting research data.

3. Results and Discussion

The first step in this research is to design research. Researchers along with members of the researchers conducted a discussion to create this research. The initial phase is to analyse the background of this research. Because of this study to find out and analyse the ability of mathematical connections of elementary school students on the numerical material, the research team determined that the approach used to be a qualitative approach with descriptive methods. A qualitative approach is an approach based on the symbolic interaction of a school with other symptoms that are interpreted based on the culture concerned by searching for the meanings of the signs being studied with the aim of developing understanding, concepts that eventually become theories. While the descriptive method is a study that describes an example of a condition or relationship that exists, opinions that develop, the ongoing process, the consequences of the event or the current [22]. So this is suitable for use in this study.

The next step is to determine the location. In determining the position or sample of the study using cluster random sampling technique, this is because the area of the sub-district to be studied so that one
of the appropriate methods used is cluster random sampling technique [23]. So that four schools were chosen to be used as research sites. Furthermore, researchers collaborate with schools so that research can be carried out. After the researchers established the collaborative research, they made research instruments that were adapted to the curriculum that applies to the school. The researcher made several tools in the form of items related to numbers, and the researchers validated the experts. The ten objects which represent the three mathematical connection indicators that have been established by NTCM. Indicators of mathematical connections are recognising and utilising the relationship between ideas in mathematics, understanding how concepts in mathematics are interconnected and underlying one another to produce a coherent unity and identify and apply mathematics in everyday life [24]. Validation was carried out by two expert experts namely elementary school mathematicians and primary school Indonesian experts. The advice from experts for questions can be seen in the Table 1.

Table 1. Decisions of mathematician experts

| Comment                                                                 | Revised decision                                                                 |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Overall all questions represent mathematical connection indicators for elementary school students, but there are some improvements such as: | The whole suggestion of a mathematician is accepted. The revisions made are: |
| 1. In questions number 2 and 5, the problem is too long, so it will make grade 3 students in elementary school challenging to define questions. | 1. In questions number 2 and 5, it is more efficient to make it easier to understand for elementary school students. |
| 2. In problem number 7 which deals with solving problems in everyday life, the problems given are less related to students' real life | 2. In the matter of number 7, the problem is replaced by issues related to the daily life of the elementary school students |

Furthermore, the researchers also asked for advice from elementary school Indonesian experts to fit the language skills of elementary school students. The suggestions and revision decisions are in the Table 2.

Table 2. Judgments of linguistic experts

| Comment                                                                 | Revised decision                                                                 |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Overall all questions are feasible and easily understood by elementary school students. However, there are some suggestions like: | Overall, advice from Indonesian experts. The revisions made are: |
| 1. In issues, number 2 and 5, the language used is too long, so it will make elementary school students confused in understanding the question | 1. In questions number 2 and 5, it is more simplified so that elementary school students easily understand it. |

After experts say it is appropriate to make the instrument as an instrument that will be used as an instrument to measure students' mathematical connection abilities, the next step is to measure students' mathematical connection abilities. Valid questions were tried out to elementary school students. This study involved in five schools with a total number of students is 120 people. The questions given are six which represent mathematical connection indicators. Examples of questions representing indicators recognise and utilise the relationship between ideas in mathematics as follows:

_Ega likes to save. Ega saves the rest of his allowance. The first week, I saved Rp. 1,000.00, the second week Ega saved Rp. 1,500.00, the third week of Ega saved Rp. 500.00. On the fourth week, Ega wanted to help the Sinabung volcano eruption. Ega opened the tube and gave Rp. 1,200.00 for alms. What is the remaining money for Ega?_
The indicators recognize and utilize the relationship between ideas in mathematics, as many as 15 students or 12.50% of elementary school students who get scores between 60 and 69 with enough categories, as many as 67 students or 55.83% get scores between 45 and 59 with less class, and 38 students or 31.67% get scores between 0 and 44 with inferior categories. This data proves that as many as 87.50% of elementary school students are in the category of lacking even many of them categorised as poor. This data shows that the ability of elementary school students to recognise and utilise the relationship between ideas in mathematics is still low. The strength of students to understand and use ideas in mathematics must be developed. Bruner stated that mathematics learning would be more meaningful if students learn mathematics to be able to connect a mathematical concept with other mathematical concepts [25]. Learning by combining mathematical ideas taught explicitly will not make students understand their learning as a whole, but if students can recognise and use it, mathematics learning will be more meaningful.

Examples of questions that represent the second indicator understand how ideas in mathematics relate to each other and underlie one another to produce a coherent unity that is:

*Andi is very fond of animals. Andi’s house has Chicken, Pigeons, Chefs and Cats. Each type of animal consists of 5 heads. What is the number of each Pet Andi if it is grouped based on his place of living?*

In the indicator, understanding how ideas in mathematics are interconnected and underlies one another to produce a coherent unity of 13 students or 10.83% get a score between 60 and 69 with enough categories, as many as 74 students or 61.67% get grades between 45 and 59 with less categories and 33 students or 27.50% get scores between 0 and 44 with very poor categories. This data proves that the weak ability of students in connecting ideas in mathematics with ideas outside mathematics. This indicator is very rarely highlighted in mathematics learning in elementary schools. Learning mathematics as universal learning that underlies technological development and is essential in various disciplines [26]. The weak ability of students in connecting mathematics learning will have an impact on the learning process and daily life of students.

The need for developing mathematical learning combined with other education. The ability of students to use various representations of mathematics, their expertise in the field of technology, as well as making linkages with other disciplines, provides greater mathematical power [17]. This data means that learning mathematics cannot be separated from other sciences. If mathematics learning is taught by itself without linking a concept with other concepts, education will be meaningless. If a topic is given separately, then learning will lose a precious moment to improve student achievement in mathematics learning in general [27].

Examples of questions that represent indicators of recognising and applying mathematics in everyday life are:

*Mr Ruli raises chickens. Initially, he bought 553 chickens, and then he bought another 323 chickens. 576 chickens were the remaining female roosters. Roosters will be placed as many in 6 cages. What is the number of roosters in each coop?*

The questions that represent indicators of recognizing and applying mathematics in daily life show that as many as 14 students or 11.67% of elementary school students get scores between 60 and 69 with enough categories, as many as 81 students or 67.50% get scores between 45 and 59 with less category, and 25 people or 20.83% get a score between 0 and 44 with inferior categories. This data proves that the ability of elementary school students to recognise and apply mathematics in daily life is still weak. This data shows that students are vulnerable to implementing mathematical learning in everyday life.

Mathematics has a role in answering the problems that occur in everyday life; therefore, mathematics learning in elementary schools equips primary school students to think logically, analytically, systematically, critically, creatively and the ability to cooperate that is needed in everyday life [28]. Besides that, mathematics also has values that can motivate students and can be learned so that the values contained can be implemented in everyday life.

From the data regarding these three mathematical connection indicators, it can be concluded that the connection ability of elementary school students is still in the less category. Weaknesses in students'
mathematical connection abilities are tested from numbers. The need for efforts from teachers as educators to be able to develop this mathematical connection ability because mathematical connections contribute positively to student learning processes and outcomes [29].

4. Conclusion
The mathematical connection is a part of mathematical competency that can connect ideas in mathematics, analyse mathematical concepts with concepts outside mathematics and apply mathematical concepts in everyday life. In this study proves that the weak mathematical connection ability in the number of elementary school students.

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