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The Mathematical Connection Ability of Elementary School Students in the 4.0 Industrial Revolution Era

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The background of this research is the change into the 4.0 industrial revolution era which resulted in changing the learning ability of elementary school students. The purpose of this study is to determine the connection ability of elementary school students in the era of the 4.0 industrial revolution. This is a descriptive qualitative study. The results show a weak mathematical connection ability of elementary school students in the 4.0 industrial revolution era. The implication of this research is that it provides a foundation for teachers or other researchers in developing an effort to improve the mathematical connection ability of elementary school students.

Keywords: mathematical connection ability, elementary school students, 4.0 industrial revolution

INTRODUCTION

The 4.0 industrial revolution defines the transition and change from the analog to the digital era. The digital era is also called the technology era (Lasi, 2014). The 4.0 industrial revolution is a revolution demanding the use of technology in everyday life (Li, 2017). This has an impact on all fields of life, including education (Ciolacu, 2012) .

Education in the industrial revolution era is also called education 4.0 (Hussin, 2018). 4.0 education is an era of innovation education (Paravizo, 2018). 4.0 education has its challenge, namely, in the innovation of technology-based learning systems. This is what changes the goal and challenge of 3.0 education. 4.0 education is expected to produce graduates who can compete globally by using technology to improve the quality of competitiveness (Harto, 2018). Therefore, 4.0 education must be able to change the learning process in the classroom, thus, it can produce graduates who can compete globally. The process and effort to produce these types of graduates can begin at the elementary school level.

Elementary school is the first formal education institution in Indonesia. The basic school learning system uses the 2013 curriculum which utilises a thematic approach in the learning process. A thematic approach is an approach that combines several subjects into one under the specified theme (Liu, 2010). Thematic learning can make students active, creative and innovative in the learning process (Chumdari, 2019). This is included in the objective of the 2013 curriculum. The 2013 curriculum has goals aligned with the objectives of 4.0 education, namely to produce graduates who have the personal abilities of faith, creativity, productiveness, that are affective and innovative and can contribute to the world, nation, state and civilisation (Sufairoh, 2017). This proves that the 2013 curriculum in Indonesia already has goals aligned with 4.0 education, namely to develop students who are capable and have high competitiveness at the global level. This also proves that the Indonesian Government has prepared elementary school students to become qualified graduates through the established learning system.

Efforts to produce graduates are expected to begin in elementary school learning, such as mathematics learning. For high classes, mathematics learning in elementary schools is carried out separately but still in one theme, set by the Government. This separation occurs because of the differences in the characteristics of mathematics with other subjects.

Mathematics learning is compulsory learning taught in elementary schools. This is because mathematics learning is closely related to students' daily lives (Baki, 2019; Kenedi, 2018; Mansur, 2017). Mathematics learning becomes applicative learning, thus the effort to achieve the goals is maximised. The purposes of the mathematics learning for elementary school students are to understand and apply concepts (intra and inter-mathematics) in problem-solving, to use reasoning well, to solve problems, to communicate problems and have an attitude of appreciating the usefulness of mathematics in life. It can be seen that learning mathematics in elementary school has a useful purpose in everyday life, especially in the 4.0

industrial revolution. Therefore, mathematics learning must be taught maximally to achieve the set learning objectives.

Mathematics learning is not memorising learning. Rather, it is a learning that must be understood by elementary school students. Learning mathematics does not only require understanding a concept but is also related to problem-solving, reasoning, communication and connection. Mathematical learning relates between concepts; both between concepts in and out of mathematics). The relationship between concepts is called a mathematical connection.

The mathematical connection is a learning process that connects concepts in mathematics with concepts inside and outside of mathematics (Eli, 2013). Businkas stated that mathematical connection is a relationship between ideas or processes used to connect topics in mathematics; a process for understanding the links between mathematical ideas; is an association formed from several mathematical ideas; and is a process of the relationship between the ideas of mathematical entities (Mhlolo, 2012). From the opinion above, it can be concluded that mathematical connection is a process that connects mathematics with ideas, and concepts both in and out of mathematics.

NCTM stated that mathematical connection can link mathematical ideas, thus their understanding of ideas can be more durable and be able to comprehend mathematics as a whole (Wood, 2008). This is because mathematical connection skills can link previous knowledge with the knowledge that will be obtained, which is useful for building relationships between ideas, concepts, and mathematical representations. The mathematical connection can improve the ability to proceed with mathematics, increase the ability to connect mathematics with other sciences and increase the ability of mathematical connections related to everyday life (Jaijan, 2012). Following this goal, the mathematical connection needs to be developed in the process of learning mathematics in elementary school students.

However, the implementation of this mathematical connection ability has not been fully implemented properly by elementary school teachers.

This mathematical connection is in line with the demands of the 4.0 industrial revolution, which requires changes in the fields of parallelism, visualisation, and connections. This era has been running for some time. Hence, the purpose of this study is to determine the mathematical connection ability of elementary school students in the 4.0 industrial revolution era.

METHOD

This is a qualitative descriptive study that aims to describe, collect, analyse, and conclude the findings following the research objectives. This research is conducted in the Solok Regency Elementary School by implementing the 2013 curriculum for four years and having categorised it as a digital classes school. The subjects of this study are 120 elementary school students. The object of this research is the mathematical connection ability of elementary school students in the era of the 4.0 industrial revolution. The methods used are tests, interviews, and observations.

The test method is a series of questions or exercises and other tools are used to measure skills, intelligence knowledge, abilities or talents possessed by individuals or groups (Rahman, 2017). The test used in this study is a written test in the form of a description question to measure the students' mathematical connection skills in the elementary school setting. The test material is related to the measurement material for elementary school students.

The observation method is a technique of collecting data by observing ongoing activities (Kawulich, 2012). Observation can be done in a participatory or non-participatory manner. In participatory observation, the observer participates in the ongoing activity whereas, in the non-participatory observation, the observer does not participate in the activity, he only plays a role in observing the activity. In this study, observation is conducted to find out the reality in the field regarding the mathematical connection ability of elementary school students.

The interview method is a conversation with a specific purpose. The conversation is conducted by two parties, namely the interviewer asking the question and the interviewee answering the question (Jamshed, 2014). In this study, an interview is conducted with elementary school students. This question relates to the mathematical connection ability of elementary school students to the measurement material.

The data analysis technique uses triangulation. Data triangulation is a combining data collection technique from various data collection techniques (tests, interviews, and observations) and existing data sources to draw conclusions whose results are the same (Saminanto,2015). The steps in analysing data are (Bengtsson, 2016):

A. *Data Reduction*

The data obtained from the field is quite large and it needs to be carefully noted in detail. As stated earlier, the longer researchers are in the field, the more the data can be complex or complicated. For this reason, it is necessary to immediately analyse the data through data reduction. Reducing data means summarising, choosing the main things, focussing on the important things, and looking for pattern themes. Thus, the data that has been reduced will provide a clearer picture, and make it easier for researchers to carry out further data collection, and look for it if needed.

B. *Data Presentation*

Data presentation is a systematic process of compiling information to obtain conclusions as research findings. The presentation of data is intended to make it easier for researchers to see the overall picture or certain parts of the study. In this study, organised data is presented in narrative form. In this study, researchers present data in the form of detailed descriptions of the informants based on their opinions on data collected from the results of tests, interviews, and observations.

C. Conclusion Drawing

Withdrawing these conclusions is carried out after the data analysis and before, during and after the research is conducted. Also, this conclusion must be based on the data analysis.

To simplify the research, the research steps are arranged as follows: designing research, determining location, preparing research instruments, validating and revising instruments, testing data analysis, making conclusions, and presenting research data.

RESULT AND DISCUSSION

This study uses tests, interviews, and observations. Test and interview instruments are prepared and then validated by an expert as a determinant of the instrument feasibility, then it will be used to measure the mathematical connection ability of the elementary school students. The test and interview instruments are developed based on the material studied by elementary school students regarding measurement. It is intended that the instruments used are more directed and measurable. This measurement material is developed using mathematical connection indicators. The mathematical connection indicators utilise the relationship between ideas in mathematics, understanding how ideas in mathematics are interconnected and underlying one another to produce a coherent in a whole, and applying mathematics to everyday life.

Tests given to students consist of three questions that represent mathematical connection indicators. Meanwhile, the interview also contains questions that measure the connection ability of the elementary school students with the three predetermined indicators. To facilitate reading the results of this study, researchers will present the results of the study based on the mathematical connection indicators.

D. Use The Relationship Between Ideas In Mathematics

To measure students' ability to use the relationship between ideas in mathematics, students are given tests and interviews. The test given is in the form of the following questions:

> *Every Monday, 03 Tikalak Elementary School holds a flag ceremony. The schoolyard is used for a rectangular ceremony. The length of the school is 25 metres long and 15 metres wide. What is the schoolyard area?*

The problem above is used to measure the connection ability of the elementary school students with indicators utilising the relationship between ideas in mathematics.

The findings prove that as much as 7.50 per cent of students obtain enough grades for the ability to take advantage of the relationship between ideas in mathematics, 74.17 per cent of students get a low category, and 18.33 per cent of students are in the very low categories. This percentage can be seen in the Figure 1 below.
From the Figure above, it can be concluded that the average student's ability to utilise the relationship between ideas in mathematics under the category is sufficient. This is based on the results of interviews between researchers and several children as follows:

Conversation 1

Researcher: *Student, if you have a square garden with a side length of 20 metres, and around the park, a garden lamp is installed with a distance of 5 meters. How many lights can you install?*

Student: *Mmm, 4 lights sir.*

Conversation 2

Researcher: *Student, if you have a square garden with a side length of 20 metres, and around the park, a*

garden lamp is installed with a distance of 5 meters. How many lights can you install?

Student: *Don't know sir.*

Conversation 3

Researcher: *Student, if you have a square garden with a side length of 20 metres, and around the park, a garden lamp is installed with a distance of 5 metres. How many lights can you install?*

Student: *Maybe 10, sir.*

From the three conversations, it can be observed that the students' answers are all wrong. This proves that the students have not been able to use ideas in mathematics perfectly.

From the tests and interviews conducted, the students' ability to utilise the relationship between ideas in mathematics is still low. The ability to use ideas in mathematics is important in the process of mathematical connection. Concepts in mathematics cannot stand alone. The concept in mathematics has a relationship with one another, like the concept of multiplication. In the multiplication concept, there is the concept of addition completed repeatedly. Whereas, in the concept of addition, there is the concept of counting. This fact proves that mathematics learning requires a connection in connecting one concept with another concept (Siregar, 21). In mathematical connections, there is a process of connecting topics in mathematics (Rohendi, 2013). This mathematical connection facilitates students in building representation and understanding of building knowledge (Saminanto, 2015).

This connection connects one another. Thus, if students are not able to understand a concept in mathematics, it will affect the ability of students to understand other mathematical concepts.

E. *Understand How Ideas In Mathematics Relate To And Underlie One Another To Produce A Coherent Whole*

To measure the ability to understand how ideas in mathematics relate to and underlie one another to produce a coherent whole, students are given tests and interviews. The test given is in the form of the following questions:

Leri wants to go to Ani's house for a group study. Leri has never gone to Ani's house. Therefore Ani gives directions to Leri. From Leri's house, Leri has to head southeast along 450 metres until she meets the post office. From the post office, Leri is heading east along 350 metres to meet a three-way junction. From the three-way junction, Leri must head 200-metres north and meet the Kenedi Mini Market. Ani's house is opposite the Mini Market. How many kilometres of the road will be taken by Leri to Ani's house based on Ani's instructions and make Ani's house plan based on these instructions?

The question above is to measure the ability to understand how ideas in mathematics relate to and underlie one another to produce a coherent whole. The findings reveal that 6.67 per cent of students obtain enough grades to understand how mathematical ideas relate to and underlie one another to produce a coherent whole, 77.50 per cent of students get a low category and, 15.83 per cent of students are in the very low categories. This percentage can be viewed in Figure 2 below:

From Figure 2 above, it can be concluded that the average ability of students to understand how ideas in mathematics relate to and underlie one another to produce a coherent unit is under the enough category. The results of the interviews between the researchers with several children are as follows:

Conversation 1

Researcher: Student, consider if you experimented with chicken eggs and duck eggs. The two eggs have almost the same shape. But when the eggs are dropped to the ground, the eggs that first reach the ground are duck eggs. To find out the cause you try to observe the shape and weight. What tools are needed to determine the weight of the two eggs?

Student: The scale sir.

Conversation 2

Researcher: Student, consider if you experimented with chicken eggs and duck eggs. The two eggs have almost the same shape. But when the eggs are dropped to the ground, the eggs that first reach the ground are duck eggs. To find out the cause you try to observe the shape and weight. What tools are needed to determine the weight of the two eggs?

Student: The scale sir.

Conversation 3

Researcher: Student, consider if you experimented with chicken eggs and duck eggs. The two eggs have almost the same shape. But when the eggs are dropped to the ground, the eggs that first reach the ground are duck eggs. To find out the cause you try to observe the shape and weight. What tools are needed to determine the weight of the two eggs?

Student: We don't know sir.

From the three conversations, it can be observed that the students' answers are incorrect and unclear. This proves that students have not been able to understand how ideas in mathematics relate to and underlie one another to produce a coherent whole. From the tests and interviews, it shows that the students' ability to understand how ideas in mathematics are interrelated and underlie each other to produce a coherent whole remains low.

Mathematics is not only connected with internal mathematics but is also related to other disciplines (Blum,2007). Mathematics is the parent of all knowledge connected to other sciences. Mathematics can relate to natural sciences such as physics, chemistry, and biology. Mathematics is also related to social science. This proves that mathematics is connected to all sciences. Mathematics is a science that links with concepts other than mathematical concepts (Haji, 2017; Hendriana, 2014; Kenedi, 2018). This related concept becomes the foundation for elementary school students in making it easier to understand other science concepts. The ability of elementary school students to develop mathematical concepts associated with science outside mathematics, will make it easier for students to understand the science.

F. *Apply Mathematics in Everyday Life*

To measure students' ability in applying mathematics in everyday life, the tests given in the form of the following questions:

Wendi will make 5 rectangular frames of wire. The length of each rectangle is 5cm and 3cm. How many cms of wire length is needed?

The question above is used to measure the connection ability of elementary school students with the indicators of applying mathematics in everyday life. The findings revealed that as many as 10 per cent of students obtained enough grades for the ability to apply mathematics in their daily lives, 63.33 per cent of students received low category scores, and 26.67 per cent of students had a very low category score. This percentage can be viewed in Figure 3 below.

From Figure 3 above, it can be concluded that the average student's ability to apply mathematics in daily life is under the enough category. This is following the results of interviews between researchers with several children as follows:

Conversation 1

Researcher: Student, consider if you have a square garden with an area of 100 metres. What is the metre length of the sides of the garden?

Student: 10 metres, sir.

Conversation 2

Researcher: Student, consider if you have a square garden with an area of 100 metres. What is the metre length of the sides of the garden?

Student: 20 metres, sir.

Conversation 3

Researcher: Student, consider if you have a square garden with an area of 100 metres. What is the metre length of the sides of the garden?

Student: 25 metres, sir.

From the three conversations, it can be observed that the average answer is not correct. This proves that students have not been able to apply mathematics in everyday life.

From the tests and interviews conducted, it shows that the students' ability to apply mathematics in daily life remains low.

Overall, the mathematical connection ability of the elementary school students in the industrial revolution era is still in the low category. This is supported by observations completed by the researchers. Based on these observations, it is found that in the mathematics learning process, the teachers only focus on understanding the mathematics concepts. The teacher teaches mathematics by giving formulas and examples of questions in the learning process. This is a supporting fact so that the connection ability of elementary school students is untrained. The mathematical connection is an effort to assist students in solving everyday problems (Menanti, 2018). Mathematics is an applicative science that links the concepts of science with real-life concepts (Setiawan, 2017). Mathematics can solve problems in everyday life because the problems can be solved with mathematics. Mathematics is a science that can facilitate students in understanding problems in life (Kenedi, 2019). The ability of students to connect mathematics with the problems of everyday life is very much needed in the era of the 4.0 industrial revolution.

Besides, based on the observations in the elementary school, there was no attempt by the teachers to develop the mathematical connection skills of the elementary school students. The teacher only teaches mathematics by teaching formulas and giving examples of questions. Based on the tests, interviews, and observation of the three indicators, it can be seen that the mathematical connection ability of the elementary school students in the industrial revolution era is still in the low category. Mathematical connection is a part of mathematics that connects mathematical concepts with concepts in everyday life. Therefore, mathematical connections need to be developed because they are very necessary for the lives of students (Arthuri, 2017). In the learning process, students who have good mathematical connection skills will have good learning processes (Rohendi, 2013). A good learning process will be able to facilitate elementary school students in understanding concepts related to mathematics. Besides, mathematical connection capabilities can improve problem-solving skills (Stylianou, 2013; Latif, 2017). Hence, it can be concluded that mathematical connections need to be developed in elementary school students.

CONCLUSION

This study concludes that the connection ability of elementary school students in the era of the 4.0 industrial revolution is still low. This requires teachers to be careful in choosing the right learning method used to train students' connection skills. Thus, students can more quickly connect between mathematical concepts with empirical examples in real life.

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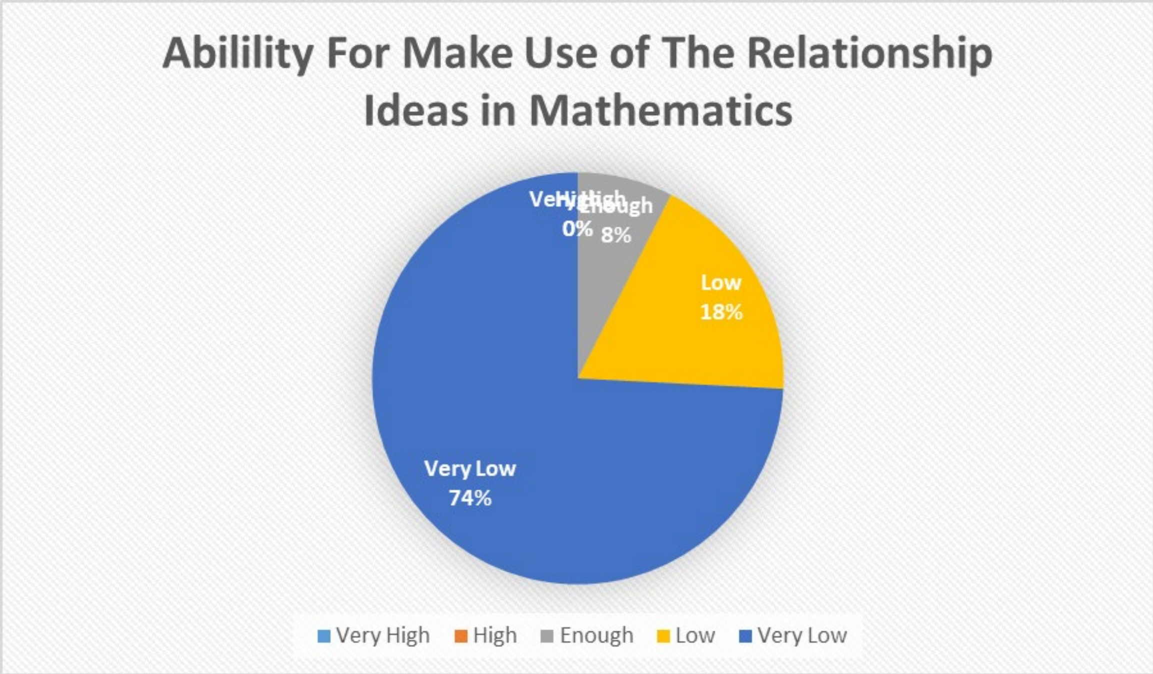

Figure 1. Abilility For Make Use of The Relationship Ideas in Mathematics

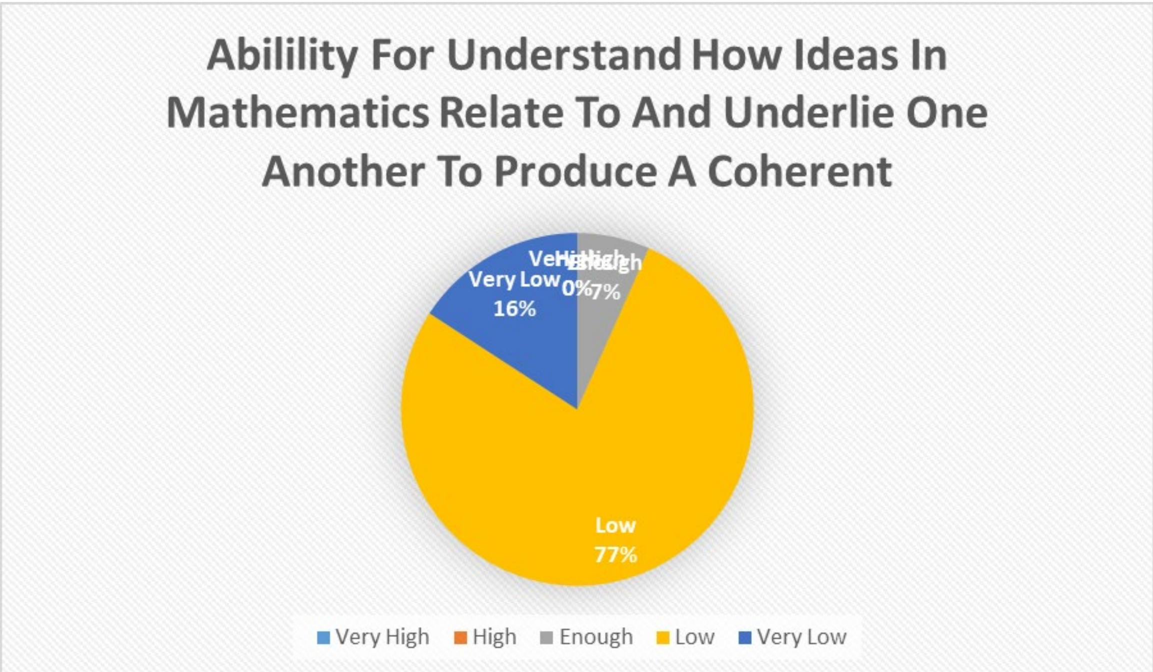

Figure 2. Abilility For Understand How Ideas In Mathematics Relate To And Underlie One Another To Produce A Coherent.

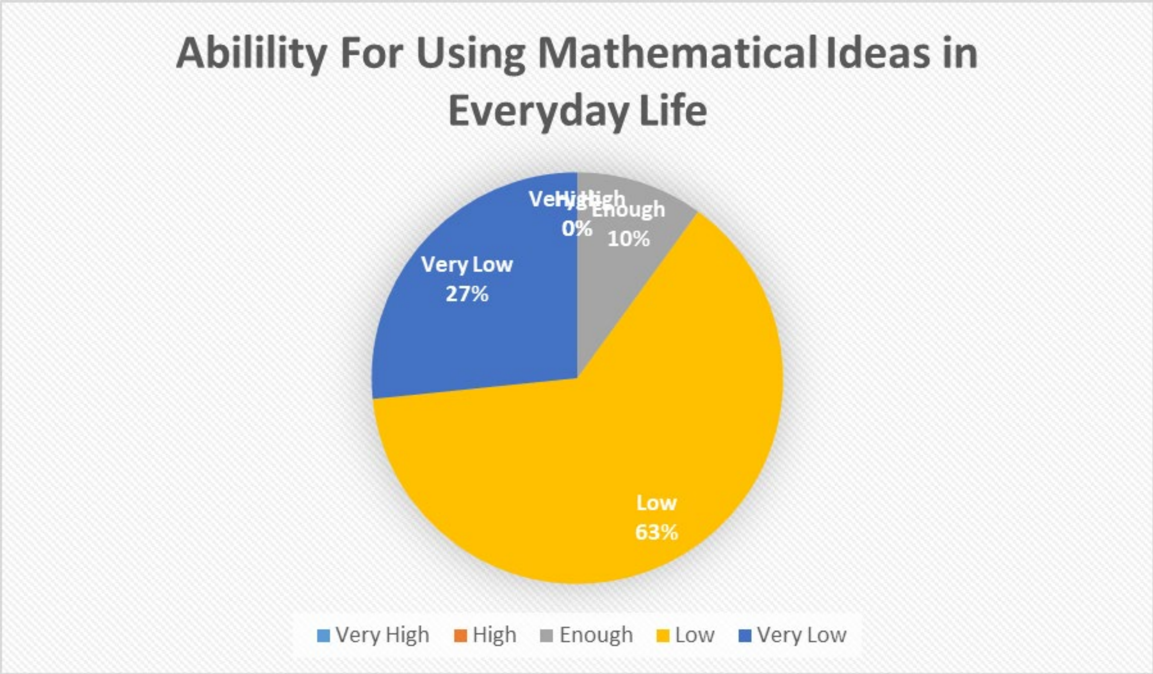

Figure 3. Abilility For Using Mathematical Ideas in Everyday Life.

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