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Finding Students' Missing Concept About Pythagorean Theorem In Mathematics

Mika Br Sembiring[1], Rifqa Amaliah[2].

[1,2]Jurusan Matematika, Fakultas Matematika dan Ilmu Pengetahuan Alam
Universitas Negeri Medan, Jl. Willem Iskandar Psr V Medan, 20221
e-mail: alyaamalia97@gmail.com

Abstract. *The purpose of this study is to find solutions for students who have difficulty in learning mathematics especially for those who have weaknesses in solving a problem math Students in class VIII SMPS JAMBI MEDAN. Which identic students junior high school are still in the stage of play and stage of thinking that has not understood something abstract. Researchers use the method of observation. The population of this research is the eighth grader of SMPS JAMBI MEDAN consisting of 78 students. This research is done by various stages. The initial stage of this research begins by asking directly to students in the class about phythagoras python triangle material they have learn before, this is intended to know their memory of the material. The second stage we give a questioner that contains questions relating to the right triangle material and phythagoras for them to do and finish. In the process we make observations by looking at student behavior and their process of resolving questions in the questioner. The next stage is to interview students about their work processes and things they do not know about the problems we provide. The results show that most students are afraid or not eager to work on math problems that the topic of discussion has passed, because most of them no longer remember the topic and tend to forget it, only those who actually go directly (in the sense that something from their brains who constructed the subject matter with the real life they experienced themselves) who can remember the subject of the lesson again. There are some who can actually solve the problem if it is guided through the initial concept and through a problem without using the formula. Therefore a solution that can be used to help tackle it is a problem-based learning method.*

Keyword: *Students' MIssing, Pythagorean Theorem, Learning Outcomes, Secondary School*

Introduction

For a long time, many children have not been interested in or even they have been afraid of learning mathematics. Many of those who do not like mathematics, do not even want to be familiar with mathematics at all. This happens because they do not know mathematics well, some of them have argued that math is a boring subject, mathematics is about formulas and cranking out computations. On the other hand the understanding given to them is not a realistic understanding of mathematics. Many children are given various formulas to calculate or solve mathematical problems without them understanding the meaning of the formula. They are less aware of the meaning of the real mathematics. if we examine it seriously, mathematics is all around us, in everything we do.

In everyday many problems we encounter are related to mathematics. Mathematics is one of the sciences that fundamentally developed in the life of society and is needed in the development of science and technology. As stated by Hudojo (2005: 3) "Matematika berfungsi mendasari perkembangan ilmu pengetahuan dan teknologi dan merupakan pengetahuan yang esensial sebagai dasar untuk bekerja seumur hidup dalam abad globalisasi. Karena itu tingkat penguasaan matematika pada tingkat tertentu diperlukan bagi semua siswa agar kelak dalam hidupnya mendapat pekerjaan yang baik". Dr. Robert H. Lewis, Professor of Mathematics, Fordham University say that "Mathematics has been a part

of the human search for understanding, mathematical have come both from the attempt to describe the natural world and from the desire to arrive at a form of inescapable truth from careful reasoning".

Considering the regulations above, it can be concluded that the mathematics is important science for life, so that from the young must be understanding about mathematics. It is never too late to correct the inappropriate things that have been implemented in life. Especially we fix it from the young. "childhood is a special, magical time when the brain is metaphorically spongelike and when learning new skills can be both fun and effortless" (diamond and hopson, 1998, p. 4). This early learning can positively stimulate and enhance young children's potential for exploring the world in the future (copley, 2010).

In addition, if you want the child can really understand the math we must pay attention to the effectiveness of learning, People can learn more in physical environment, emotional, and social, existence of feel perfection, security, enthusiasm, and joy is more important to optimize of the study of human being. Second, People can learn effectively if you want to do it. (GaneÇ Swara Vol. 9 No.2 September 2015)

If the social environment of the child is good, it will help improve the existing mathematical understanding within the child. Based on vygostky theory, the ability of students can be increase with social assistance. Basically Vygotsky's theory suggests that development depends on interaction with people and the tools that the culture provides to help form their own view of the world. Vygotsky believed that any pedagogy creates learning processes that lead to development and this sequence results in zones of proximal development. It's the concept that a child accomplishes a task that he/she cannot do alone, with the help from a more skilled person. Vygotsky also described the ZPD as the difference between the actual development level as determined by individual problem solving and the level of potential development as determined through problem solving under adult guidance or collaboration with more knowledgeable peers. The result of this process is children become more socialized in the dominant culture and it induces cognitive development (Moll, 1994).

Theoretical Framework

Learning

Learning is one of the most supportive needs to survive, to develop and adjust to the changing environment and demands of life. The change can be the development of knowledge, attitude, skills and later expected to be able to solve the problems or demands of his life. Therefore one is said to learn when it can be assumed in itself a process that results in a change of behavior. Activities and efforts to achieve behavioral change is a learning process, whereas behavioral change is the result of learning.Slameto (2003:2) "belajar adalah suatu proses usaha yang dilakukan seseorang untuk memperoleh suatu perubahan tingkah laku yang baru secara keseluruhan, sebagai hasil pengalamannya sendiri dalam interaksi dengan lingkungannya".

According Gagne (cited in Slameto, 2003:13), "*belajar ialah suatu proses untuk memperoleh motivasi dalam pengetahuan, keterampilan, kebiasaan , dan tingkah laku*". According sudirman (2010:20): "*Belajar itu merupakan perubahan tingkah laku atau penampilan, dengan serangkaian kegiatan misalnya dengan membaca, mengamati, mendengarkan, meniru dan lain sebagainya*". From the definition of learning presented by experts above can be concluded that learning is a process of activities that change a person's behavior to be better, who have the ability. In this case Traffic in question is the skills, knowledge, attitudes, and values.

Mathematics Learning

Ways and approaches in learning mathematics is strongly influenced by the teacher's view of mathematics and students in learning. Trianto (2011) said that the essential learning is a conscious effort from a teacher to teach students (directing the interaction of students with other learning resources) in order to achieve the expected goals. In this meaning, it is clear that learning is a two-way interaction from a teacher and learner, where between them there is intense and directed communication (transfer) towards a predetermined target. In learning mathematics, teachers are required to be able to train students how to think and reason, develop problem-solving skills, develop creative activities, draw conclusions, and convey information systematically. Adam dan Hams (cited in wijaya, 2012) said that there are four perpectives about

the role of mathematics, such as: (1) way of thinking; (2) understanding pattern and relationship; (3) problem solver; and (4) communication tool".

So in learning mathematics mastery of mathematics teaching materials is not a major goal but as a tool for forming life skills. Students not only learn math materials, but also have to know how to use, and apply the science in dealing with and solving problems that exist in everyday life.

Vygotsky's Sociocultural Theory

Vygotsky is best known for being an educational psychologist with a sociocultural theory. This theory suggests that social interaction leads to continuous step-by-step changes in children's thought and behavior that can vary greatly from culture to culture (Woolfolk, 1998). Basically Vygotsky's theory suggests that development depends on interaction with people and the tools that the culture provides to help form their own view of the world. There are three ways a cultural tool can be passed from one individual to another. The first one is imitative learning, where one person tries to imitate or copy another. The second way is by instructed learning which involves remembering the instructions of the teacher and then using these instructions to self-regulate. The final way that cultural tools are passed to others is through collaborative learning, which involves a group of peers who strive to understand each other and work together to learn a specific skill (Tomasello, et al., 1993).

Kozulin (1990) indicates that Vygotsky's primary objective 'was to identify specifically human aspects of behavior and cognition' (p. 4) via genetic analysis methodology. He focused on several different domains of development: human evolution (phylogenesis), development of human cultures (sociocultural history), individual development (ontogenesis) and development which occurs during the course of a learning session or activity or very rapid change in one psychological function (microgenesis) (Wertsch, 1991). De Valenzuela (2006) asserts that while genetic analysis involves the examination of the origins and processes of development of higher mental processes within all of these domains, the most common foci of current educational research are ontogenesis and microgenesis. Vygotsky (1982) reiterates the fact that social interaction with cultural artifacts forms the most important part of learner's psychological development .Cultural tools or artifacts include all the things we use, from simple things such as a pen, spoon, or table, to the more complex things such as language, traditions, beliefs, arts, or science (Cole, 1997; Vygotsky, 1982).

Learning Model

Arend (cited in Trianto, 2011:22) stated that the term teaching model refers to a particular approach to include it's goals, syntax, environment, and management system. The learning model is an effort to create a climate and service for the abilities, potentials, interests, talents and needs of diverse students so that there is optimal interaction between the teacher and students and between students and students. Therefore, the learning model can help teachers determine what to do in the learning process.

Problem based learning is a learning model that uses real-world problems as a context for learners to learn about critical thinking and problem-solving skills. As well as to gain knowledge and essential concepts from the subject matter. According Arends (2007: 41) problem-based learning, namely: the role of teachers in problem-based learning is to offer a variety of problems to provide questions and facilitate investigation and dialogue. Most importantly, the teacher provides seaffolding-scaffolding or supporting frameworks that enhance education and intellectual growth.

Based on the description of the characteristics, it is clear that the learning with the Problem Based Learning model is started by a problem which in this case can be raised by students or teachers, then students deepen their knowledge about what they already know and what they need to know to solve the problem. Students can choose issues that are considered interesting to solve so they are encouraged to play an active role in learning.

Pythagorean Theorem

Pythagoras was a Greek mathematician and philosopher living in 569-475 BC. As a mathematician, he reveals that the square of the length of the oblique side of a right triangle is

equal to the sum of the squares of the lengths of the other sides.

If you look carefully there will be a relationship $c^2 = a^2 + b^2$, where c is the length of the oblique side, a is the length of the base, and b is the height. From the relationship it can be said that the square of the right side of the right triangle is angled with the sum of the squares of the other sides. This is the so-called *Pythagorean Theorem*.

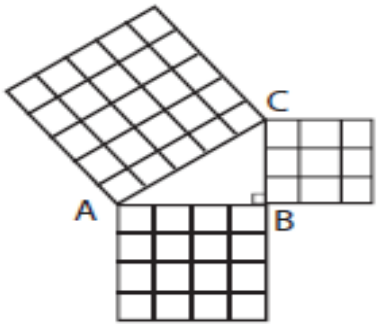


Figure 1. Triangle ABC formed by squares

Figure 1 shows a right triangle ABC with beveled side length b, the length of the base side c, and height a. According to the Pythagoras theorem, in that right triangle is valid:

$b^2 = c^2 + a^2$
or
$b = \sqrt{c^2 + a^2}$

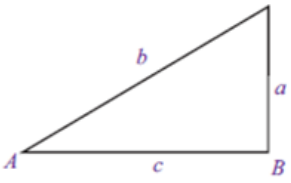


Figure 2. The Pythagorean Theorem

Now, how to determine the length of the other sides? Like the long sides of the base c or high a? Using the general formula of the Pythagorean theorem, the following calculations are obtained.

$$b^2 = c^2 + a^2 \Rightarrow c^2 = b^2 - a^2$$
$$c = \sqrt{b^2 - a^2}$$
$$b^2 = c^2 + a^2 \Rightarrow a^2 = b^2 - c^2$$
$$a = \sqrt{b^2 - c^2}$$

From the description, Pythagoras's theorem writing on each side of the right triangle can be written as follows.

$$b = \sqrt{c^2 + a^2}$$
$$c = \sqrt{b^2 - a^2}$$
$$a = \sqrt{b^2 - c^2}$$

Research Methodology

Research Location

This research was conducted in the second semester of the school year 2017-2018 at a private school located at Jl. Pertiwi No 116, Medan Tembung Indonesia. The school is located in a rural suburb, near this school there is also a densely populated housing complex on the outskirts of the railway that connects Medan-Deli Serdang. The reason researchers chose this school was its strategic location between the city center and the rural and densely populated housing on the outskirts of the railroad tracks, which we assume that students represent urban and rural areas. During the process of this research, the author involved 26 second grade students of junior high school and also involved mathematics teachers who applied the teaching and learning process in this junior high school.

Population and Samples

The population is all research subjects (Arikunto, 2006). Population is all special aspects such as characteristics, phenomena and concepts (Tiro, 2000). Based on the description of the population definition, the population of this study were all eighth grade JAMBI Private Middle School students, which consisted of three classes, and each class had 26 students.

The sample is mostly representatives of the population under study (Arikunto, 2006). Samples are a number of individuals for study in such a way that individuals represent groups that are larger than they choose (Suharsimi, 2006, p.131). The sampling technique used in this study is random sampling. Random Sampling Is a sampling technique where all individuals in the population either individually or together are given the same opportunity to be selected as members of the sample (Sugiyono, 2003: 74-78). Therefore the sample in this study was 26 JAMBI Private Middle School students who were randomly taken from 3 classes in the Middle School.

Research design

Basically, this study aims to find out the weaknesses of students in solving a problem and provide some views to help resolve these problems. The initial stage of this research begins

by asking students directly in the class about the pythagorean right triangle material that they have learned before, this is intended to find out their memories of the material. The second stage we gave a questionnaire containing questions related to the material of right triangle and pythagoras for them to do and complete. In the process we made observations by looking at students' behavior and their process of solving the questions in the questionnaire. The next step is to interview students about their work processes and things they do not know about the problems we have given.

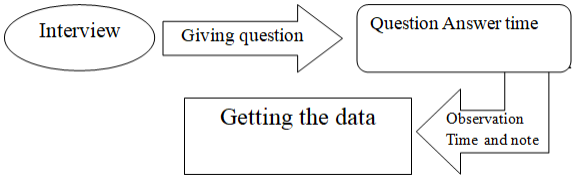


Figure 3. Research design

Data collection

To get an idea of the difficulties and weaknesses of students in working on the questionnaire. Various data sources include recording interviews, photos, student writing, and various field notes. Data from students' writing is collected to obtain information about students, as a material for analyzing weaknesses and misunderstandings of students during the questionnaire process.

In this study, interviews were also conducted for seven students before the questionnaire. During the interview, students were asked to explain what they remembered about a right triangle, how to find the side length of a right triangle if the other two sides are known.

Results

This research is part of a research project and a search for learning solutions for students in junior high school education who in fact are still in the playing stage and the stage of thinking that does not yet understand something abstract. This research is specifically designed to find solutions for students who have difficulty learning mathematics, especially for those who have weaknesses in solving a mathematical problem. The solution that will be presented is based on the data that has been obtained from students and their environment, in this case the solution we offer is a problem-based learning method.

From the data that we have obtained, almost all of the students who are the object of our research no longer remember the right triangle and pythagorean material that we presented in the questionnaire, even though the material should still be warm in their minds, because the material was studied in even semester VIII this is in accordance with the material guidelines in the curriculum for junior high school level.

Most students are lazy, not passionate or even afraid to work on math problems that they have passed the topic of discussion, because most of them no longer remember the topic and tend to forget it, only those who really jump in (in the sense that there is something from their brain construct the topic of the lesson with real life that they experienced themselves) who can remember the topic of the lesson again.

The conclusion that the students did not remember the material we got from the results of a brief interview before we gave them a question worksheet, we asked a few things about right triangles.

Researcher : Hey students, who knows here about the phytagorean theorem?

Student : What is that, Miss?

Other students : Still silent

Because many students were silent, the researchers took the initiative to awaken their memories of right triangles and pythagorean theorems by asking about waking up flat to them.

Researcher : Have you learned about plane figure?

Student : Yes, Miss ...

Researcher : Well, try the friend who knows what the flat building is, what do you say about the building?

Student : The flat building is like a square, Miss.

Researcher : Yes that's right, square is one that is plane figure. Plane figure is a two-dimensional shape of an object that does not have a thick size and does not have space, now try to look at this picture (drawing a rectangle on the board), is there space from the shape that you are drawing?

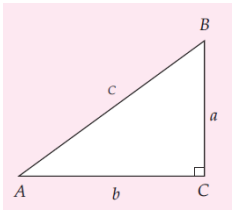
Student	: No, Miss.
Student	: Can say this shape (picture of a rectangular) as a plane figure?
Student	: You can, Miss.
Researcher	: In addition to the square and the shape that I draw on the board, what other forms include plane figure?
Student	: Triangle and kite, Miss
Researcher	: Yes that's right, hey who remembers how many shapes are triangles?
Student	: The triangle is ... the size of the lines are all the same
Researcher	: Yes, it's called an equilateral triangle
Student	: Another?
Student	: There are four sides, right triangle, equilateral triangle, isosceles triangle, arbitrary triangle, Miss.
Researcher	: Yes right, can anyone describe what right triangle is?
Students	: Still silent
Researcher	: Hey, let's see what is the difference between a right triangle and another triangle (drawing triangular shapes)?
Students	: There are 90 degree legs, Miss.
Student	: Yes, there is someone like this (making his hand into a 90 degree angle)
Researcher	: Is it correct, if a right triangle has an angle of 90 degrees, and there are two sides of the triangle perpendicular to each other. Well now, look at this right triangle, who knows how to calculate one side of a right triangle if the other two are known?
Student	: Still silent

This shows that students do not really participate in the learning atmosphere when the teacher teaches the material. Based on the data in the field we also found that there were some students who did not know the names of the sides of a right triangle and they were confused in determining which side was upright, the side and the hypotenuse of a right triangle.

This is evident from the students' answers in questioner of Problem 1.

Problem 1

What can you explain from the picture below?



a. Which one says the upright side of a triangle?
b. Which one is the side of a triangle?
c. Which one is the hypotenuse of a triangle?

Student's solution:

The sample answers the question of the side of the triangle, which is point (A-C), (C-B), (B-A), even though that point is the whole point in the right triangle shown in the questionnaire. Next he answers the upright side is point (A-B), (B-C), then he also answers that the hypotenuse of the right triangle is the point (A-B). This proves that respondents have not been able to determine the upright side, the hypotenuse, and the side of the right triangle correctly (see figure 4 below).

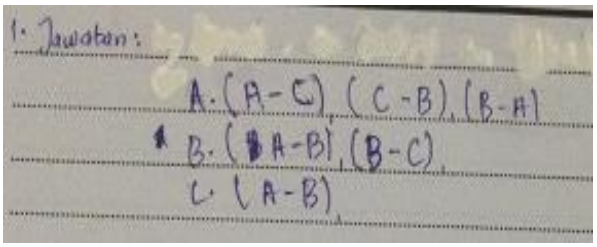


Figure 4. Student's answer of problem 1

Furthermore, there are respondents who have not been able to distinguish side names and point names in the images that we have presented. As repondent in Figure 1.1, he answers the upright side of the right triangle shown is side a to side b, then to the side of the right triangle the respondent answers the AC point, and for the side of the right triangle he answered the BA side.

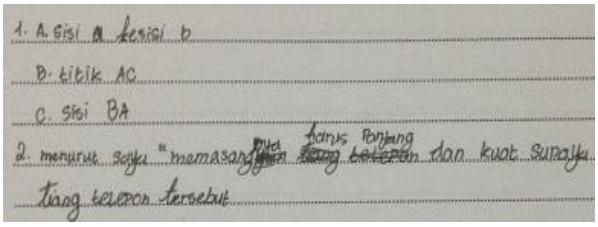


Figure 5. Student's different of problem 1

The two figures above present answers from other respondents for students who have not been able to distinguish side names and point names, up to the difference in the upright side, the hypotenuse, and the sides of a triangle.

But not a few students who have been able to determine the upright side, side, and the hypotenuse of a right triangle, as in figure 6 below.

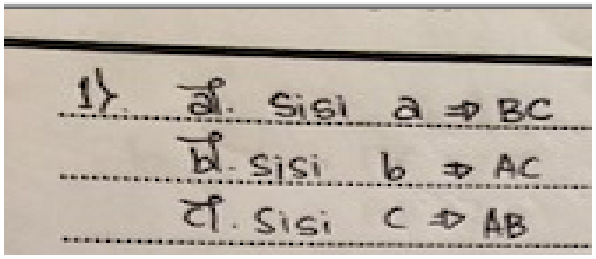


Figure 6. Student's strategy by listing

In addition, we also found their rationalization lacking the questions, such as they did not understand the meaning of the questions in question number 2.

Problem 2

The purpose of installing a lathe on a telephone pole is to support it. The lathe wire is installed on a telephone pole at 8 meters high from the ground.

Explain how you will do to determine the length of the lathe without measuring the wire directly?

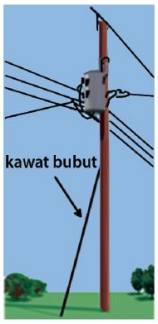


Figure 7. Telephone Pole

Student's solution:

One example os students' response to deal with this problem can be explicitly seen in Figure 8 below.

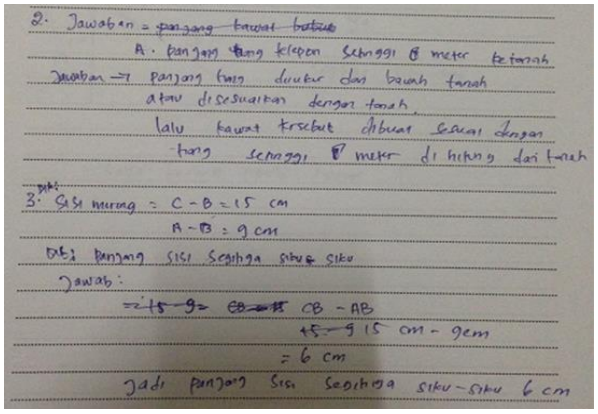


Figure 8. Student's strategy to problem 2

Although not a few respondents answered the question correctly.

Then there are also some of them who do not understand the concept, if they are told to work on a problem that uses reason, they are not able to construct their minds and reason to solve the problem. Some are almost right to solve the problem through reason, but he does not understand the next step he must do when he has finished making the steps to calculate the length of the hypotenuse of the triangle when the upright side and side side are known. This is recorded when the respondent answers problem 3.

Problem 3

A ladder rests on an 8 m high wall. If the foot of the stairs is 6 m from the wall.

a. Describe the problem above in the form of an image?
b. Determine the length of the stairs that rests on the wall?

Student's Solution:

Based on the answer for question number 3, this respondent (Figure 9) seems to think creatively according to his knowledge, he tries to get the length of the stairs if the wall height is 8m and the distance between the walls to the foot of the stairs is 6m. The ability to think realistically to the limit of calculating the length of the stairs through making the steps, if the thoughts are directed then he will be able to understand how to find the length of the stairs in the right way, which leads to the conclusion that the concept of pythagorean theorems can help find the length of the stairs. In addition there are also respondents who try and mobilize their abilities to get the right answers, as junior high school students who still have the soul to play, these respondents apply their imagination in the answer to problem 3 (see Figure 9 below).

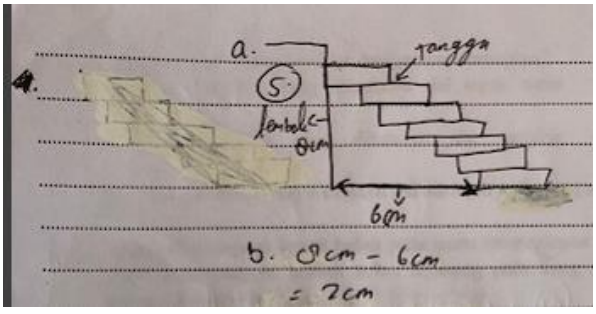


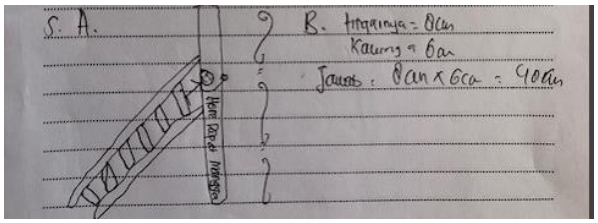
Figure 9. Student's solution to problem 3

Problem 4

The length of the hypotenuse of a right triangle is 15 cm. If the length of one side of the elbow is 9 cm, determine the length of the side of the other right triangle?

Student's solution:

Then there are some of them if given a formula, they only refer to the formula, without knowing the meaning of the formula as shown below (Figure 10). The formula used to find one side of the triangle in question 4 is a general formula for determining the area of a triangle. The student's answer can be obviously seen in Figure 10 below.



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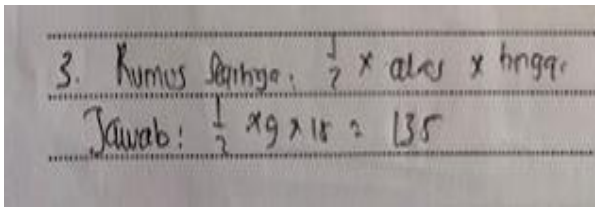

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Figure 10. Student's other solutions to problem 3

Discussion

Based on the description in the discussion, we can conclude a number of things regarding the ability of students to work on math problems.

Most students are afraid or not eager to work on math problems that they have passed the topic of discussion, because most of them no longer remember the topic and tend to forget it, only those who really jump in (in the sense that there is something from their brain that constructs the topic of the lesson with real life that they experienced themselves) who can remember the topic of the lesson back.

There are some of them do not know the names of the sides of a right triangle. In addition, they are confused to determine which side is upright, the side, and the hypotenuse of a right triangle. The students lack of rational thinking about the problem, like they do not understand the purpose of the question presented. There are some of them who do not understand the concept, in working on problems that use reason, they are not able to construct their minds and reason well to solve the problem. Some are almost right to solve the problem through reason, but he does not understand the next step he must do when he has finished making the steps to calculate the length of the hypotenuse of the triangle when the upright side and side side are known. There are several of them if given a formula only based on the formula, without knowing the meaning of the formula. There are some of them who can actually solve the problem if guided through the initial concept and through a problem without using formulas.

Conclusion

Based on the results of the research we can conclude that we can provide probem based learning methods to help them get closer to mathematics, to show them that mathematics is something that always happens in our environment so they are not afraid and quickly forget about the material that has been learned before, and their understanding is not always about formulas but also real things and their implementation in daily life.

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