Diagnosis of learning difficulties in mathematics for students resolving problems related to material in the pythagorean theorem for 8th grade students in SMP 1 Todanan and SMP Muhammadiyah 9 Todanan, academic year 2018/2019

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Abstract. This study was aimed at diagnosing the difficulties encountered by students of mathematics when problem solving Pythagorean Theorem materials, and at describing the type, location and factors of difficulty experienced by students in solving diagnostic questions of Pythagorean Theorem materials. The research used descriptive research with a qualitative approach. The research subjects were taken randomly. The most dominant type of difficulty experienced by all students in SMP Muhammadiyah 9 Todanan and in SMP 1 Todanan in completing the mathematical diagnostic test questions was in finding solutions to problems and checking answers. While the location of the difficulties experienced by students of both schools in completing the mathematical diagnostic test questions was in writing clues, problems, formulae and finding solutions to problems, they also experienced difficulties in reviewing answers and drawing conclusions. The factors that caused students difficulty in solving these test questions were as follows: Students were unable to solve the root of the results, they often forgot formulae and ways of answering the questions given. Students were not careful when solving problems and were in a rush to do so.

1. Introduction

Every institution has its constraints or problems in achieving its goals. Likewise with educational institutions, namely schools. Schools also meet with various kinds of obstacles in achieving their goals, both in educational goals in general and school goals in particular. One such obstacle experienced by schools is student learning difficulties. Learning difficulties are very disturbing factors for students when it comes to achieving school and educational goals. If students as educational subjects have difficulty participating in learning activities, then the school, as a place for students to learn, cannot carry out its role properly. This will greatly affect the process of achieving the planned educational goals. Learning difficulties experienced by students must be overcome immediately so that the obstacles or problems do not further complicate students’ learning experiences. There are various types and causes of learning difficulties experienced by students. Burton in Entang [1] divided the factors causing learning difficulties into two groups, namely the internal factors, which stem from within the students and external factors which originate from outside the learners.
One of the learning difficulties experienced by students is in mathematics. Adam & Hamm [2] said that mathematics is the science of number and their operations, interrelations, combinations, abstractions, and space configurations. The study of abstract structure is central to math. Also, structure, measurement, estimations, generalization, and probability play a role in math-based inquiry. Chambers [3] said that Mathematics is a study of pattern, relationship, and rich interconnected ideas (the purist view). It is also a tool for solving problems in a wide range of context (the utilitarian view). Mathematical language is a wonderful way of communicating ideas, which work across international boundaries, and is not subject to individual interpretations of meaning.

Lerner [4] define that mathematics is a symbolic language that enables human beings to think about, record, and communicate ideas concerning the elements and relationship of quantity. Piaget (Ginsburg & Opper) [5] said that the signified (what the symbol or word stand for, or their meaning) is not the real object, but rather the child’s understanding or intellectual construction of the real object. Lawrence (Chambers) [6] said that mathematics is a study of patterns abstracted from the world around us, so anything we learn in mathematics has literally thousands of applications, in arts, sciences, finance, health and leisure. Skemp [7] said that mathematics concepts are among the most abstract.

NCTM [8] define that the need to understand and be able to used mathematics in everyday life and in the workplace has never been greater and will continue to increase. For example: mathematics for life, mathematics as a part of cultural heritage, mathematics for the workplace, and mathematics for the scientific and technical community. Bell [9] add that that the sole function of mathematics is to serve science. Mathematics has a light and wisdom of its owm, and it will richly reward any human being to catch a glimpse of what mathematics means to it self.

Based on the explanation, the researcher will discuss further in this study with the title Diagnosis of Learning Difficulties in Mathematics for Students Resolving Problems Related to Material in the Pythagorean Theorem for 8th Grade Students in SMP 1 Todanan and SMP Muhammadiyah 9 Todanan, Academic Year 2018/2019. The purpose of this study was to find out what these learning difficulties are and what causes them when learning mathematics, especially in Pythagorean Theorem material. The benefits of this research are: 1) an effort for students to resolve or overcome the learning difficulties they experience; 2) as a reference for teachers to find the right method in learning; 3) as a reference for other researchers in conducting relevant research.

2. Method
The method used in this study is the method of observation, tests and interviews. The observations used in this study were direct observations, made by researchers, of the steps taken by teachers and students during the learning process, in order to gather initial information about difficulties students encountered when solving math problems and how teachers use material and guide students in solving Pythagorean Theorem questions. The test questions used in this study were Pythagorean Theorem material questions that had been modified by the researcher and given in the form of diagnostic tests, which could later be analyzed to highlight the difficulties faced by students when solving Pythagorean Theorem material matter questions. In depth interviews were conducted on the research subject units of 6 students from each school who had received test scores below the Minimum Completeness Criteria or obtained the highest difficulty score.

The study was conducted during the period 4-26 February 2018. The research was conducted at SMP 1 Todanan and SMP Muhammadiyah 9 Todanan. The research subjects were chosen randomly. The samples of this study were students of classes VIII E and VIII G in SMP 1 Todanan and students in grades VIII A and VIII B at SMP Muhammadiyah 9 Todanan who were enrolled in the Even Semester of the Academic Year 2018/2019, a total of 103 people consisting of 62 students of SMP 1 Todanan and 41 students of SMP Muhammadiyah 9 Todanan. Data analysis techniques used in this research were: data reduction, display data, and data conclusion. Data reduction consists of summarizing, selecting the main points and collecting data from the whole data and from the results of in-depth interviews with 12 students to reinforce understanding of the type, location, and factors that cause students to experience difficulties completing the diagnostic test of Pythagorean Theorem material. Display data is a deeper
3. Result and Discussion

3.1. Observation of Results of Learning Process
Based on the results of observations of the learning process in SMP 1 Todanan, the percentage of learning achievement was 10 (58.83%) out of 17 observation items, where there were 2 (66.7%) students' readiness in the learning process, 2 (66.67%) this method was used by teachers to explain the Pythagorean Theorem to students, 5 (83.33%) the implementation of the teacher's role in the learning process, and 1 (16.67%) the implementation of active student participation in the learning process. While in SMP Muhammadiyah 9 Todanan, the percentage of learning accomplishment was 9 (31.1%) from 17 observation items, where there were 2 (66.7%) implementation of students' readiness in the learning process, 1 (33.33%) implementation of the methods used by the teacher in learning, 5 (83.33%) the implementation of the teacher's role in the process learning, and 1 (16.67%) implementation of student inclusive activity in the learning process.

Based on the explanation above, it can be concluded that the implementation of the learning process in SMP 1 Todanan and SMP Muhammadiyah 9 Todanan had not been maximized. This was indicated by the acquisition of percentage of performance on all items that only reached 58.83% and 31.11% (<75%). Thus, students' readiness, learning methods, a teacher's role, and student activity in the learning process can be used as preliminary information relating to the difficulty factors facing students in completing diagnostic test questions on the Pythagorean Theorem material.

3.2. Description of Student Difficulties in Solving Diagnostic Test Questions
The results of the description of students' difficulties in completing each item of the diagnostic test obtained the following percentages: 1) item 1 relates to competence in calculating the length of a right triangle side if both other sides are known to have an absorption of 83.25%; 2) item 2 relates to competence in calculating the length of a right triangle side if the other two sides are known to have an absorption of 68.45%; 3) item 3 relates to Pythagoras's triple competence with an absorption capacity of 64.81%; 4) item 4 is related to competence in calculating the length of a right triangle side if the other two sides are known to have an absorption capacity of 76.94%; 5) item 5 related to competence of triangle types having an absorption of 46.60%; 6) item 6 related to competence around a triangle, which has 40.78% absorption; 7) item 7 is related to competence in solving contextual problems that exist in daily life using the Pythagorean Theorem, having an absorptive capacity of 55.34%; 8) item 8 relates to competence in solving contextual problems that exist in daily life using the Pythagorean Theorem, having an absorption capacity of 34.95%. The most dominant type of difficulty experienced by all students at SMP 1 Todanan and SMP Muhammadiyah 9 Todanan in completing mathematical diagnostic test questions on the Pythagorean Theorem material is difficulty in finding solutions to problems and in checking answers.

3.3. Location of Student Learning Difficulties
In general, the location of student difficulties summarized in the type of difficulty in items 1 to 8 is as follows:

3.3.1. Difficulty in Understanding and Analyzing Problems
Problem : Joko made a small rectangular table. When the table was finished, the lengths of two adjacent edges turned out to be 36 cm and 18 cm and the diagonal of the table was 43 cm. Was the surface of the table rectangular?
The student’s answer :
From figure 1. above, when it came to understanding and analyzing problems, the difficulties that students encountered were: 1) students are unable to determine what is known. This is indicated by a mistake made by most students in determining what is known by writing information related to the principles used in solving problems; 2) students are still wrong in determining what is asked. This is indicated by the mistakes made by students in determining what is asked, by writing the wrong symbol; 3) students do not specify or do not write what is known and what is asked because of not knowing what is meant in the problem and forgetting to write it down.

3.3.2. Difficulties in Designing and Planning a Completion Strategy

Problem: The area of an isosceles right triangle ABC is 18 cm². Determine the circumference of the triangle. (Should this be ‘periphery’? I thought circumference only referred to a circle or a sphere.)

The student’s answer:

From figure 2. above, when designing and planning a completion strategy, the difficulties that students encountered were: 1) students are unable to determine the formula to be used. This is because students feel confused in determining which formula to use to solve the problem. Also, some students do not remember the correct formula to solve the problem; 2) students feel confused when trying to determine the strategy and systematic solution for solving problems. Data obtained from the problem are directly utilised by using the existing formula without regard for the correct completion steps.
3.3.3. Difficulties in Finding Solutions to Problems
Problem: A painter puts up a ladder to reach the bottom of a second floor window of a building 8 m from the ground. The base of the ladder is 6 m from the base of the building. While the painter was stirring the paint, a cat collided with the bottom of the ladder so that the ladder shifted 1 m further away from the base of the building. Determine how many meters the top of the ladder shifts from its original position.
The student’s answer:

Figure 3. Student difficulties in completing item 8

From figure 3. above, when it comes to finding solutions to problems, the difficulties that students encounter are: 1) students are unable to find solutions or answers to problems given; 2) students are wrong in finding solutions or answers to problems given.

3.3.4. Difficulty in Checking Answers
Problem: Look at the picture below. Based on the picture, what are the lengths of sides AC and AD?

Figure 4. The length of the sides of a right triangle if the other two sides are known
The student’s answer:

Figure 5. Student difficulties in completing item 4
From figure 5. above, when re-checking the answers to problems, the difficulties that students encountered were: 1) difficulty re-checking the strategies used; 2) difficulty reaching conclusions.

3.4. Results of In-depth Interviews with Research Subjects
The twelve research subjects who received a test score below the Minimum Completeness Criterion or obtained the highest difficulty score were interviewed in-depth to obtain detailed information about the difficulties students encountered in understanding and analyzing problems, designing solutions to problems, finding solutions to problems and checking answers. In general, of the twelve students interviewed, it was assumed that questions numbered 1 to 8 presented a variety of obstacles and were difficult to solve. This was indicated by the inability of students to understand and analyze problems, design solutions to strategies, find solutions to problems and check answers. Based on the results of the interview, the difficulties faced by students in understanding and analyzing problems lay in the difficulty of determining what was known and required, because they were unable to comprehend and/or mistaken in their understanding of the information in the problem. Students had a tendency to write down any principle in working on a problem as what is known, which leads to mistakes in determining what is known.

3.5. Factors That Cause Learning Difficulties
The difficulty factor related to understanding and analyzing problems can be seen from students' mistakes in understanding the information contained in the problem so that students were wrong in determining what was known and what was asked. Students appeared confused when researchers asked them again to determine what was known and what had been asked, because students did not understand the purpose of the information in the problem. Factors of student difficulty in determining the completion strategy can be seen from the tendency of students to forget or not know the formulae and how to solve the problems given. The same applied to the difficulty factor of students in finding solutions to problems, which can be seen from the tendency of students to forget or not know the formulae and how to solve the problems given correctly. Erroneous factors related to carelessness, misinterpretation of text symbols, or the results of misunderstandings are reasons for mistakes made by students based on studies from Hansen, Drews & Dudgeon [10]. While the factor of students who quickly give up in solving math problems is in accordance with the emotional factors proposed by Cooney, Davis & Henderson [11] because in learning mathematics often feelings of fear, worry, odd feelings, depression, and so on. Besides that, Nathan et al [12] also stated the same thing that students felt hopeless and lost asking when solving mathematical problems.

The factors of students' difficulty in completing diagnostic test questions related to the Pythagorean Theorem material are not only seen from the ability of students to solve mathematical problems, but also from the implementation of the mathematics learning process which is one source of learning difficulties raised by Kennedy, Tipps & Johnson [13]. The difficulty factor that comes from the mathematics learning process is seen from the factors of students' readiness, the teacher's method, the teacher's role, and student activity during the learning process. Based on observations, the readiness factor of students in answering questions raised by teachers and students' readiness in learning material is still lacking, this can be seen when the teacher asks about material that has been studied previously, only a few students are able to answer. This student readiness factor corresponds to the pedagosis factor proposed by Cooney, Davis & Henderson [11] that students' 'readiness in learning mathematics is closely related to students' readiness in using concepts and principles to solve problems, in this case the concepts and principles contained in material that students will learn. Student readiness factors are also in accordance with Djamarah's [14] study related to student factors where lack of learning activities and poor student learning habits are the causes of student difficulties so that it affects the readiness of students in the learning process. Habibullah [15] in addition, there are other various factors that influence students' difficulties in completing the mathematics problem solving process in the form of words.
problem. As for the factors of difficulty, among others, students’ sense in lack of time, carelessness, anxiety, giving up easily, and being hasty in doing the given problem.

3.6. Strategies for Overcoming Difficulties in Solving Diagnostic Test Questions

Based on the description of the diagnosis results of learning difficulties and difficulties in solving diagnostic test questions related to the Pythagorean Theorem material, the learning difficulties and difficulties in completing diagnostic test questions related to the Pythagorean Theorem material include the lack of student understanding in understanding concepts, lack of students' ability to choose information on the problems, errors in the problem solving procedure, errors in counting, and students are not used to solving complex problems. The results of this study are consistent with research conducted by Wijaya, Van Den Heuvel-Panhuizen, Doorman, & Robitzsch (2014) [16] and Retnawati, Kartowagiran, Arlinwibowo & Sulistyaningsih (2017) [17].

Another problem solving difficulty is difficulty in counting. Many students find the answers where students are not careful in carrying out the operations of addition and subtraction of integers, the results of departure, and the results of roots. Then many students are not accustomed to solving complex problems. According to Brucker & Grossnikle long and complex problems make students not interested in solving these mathematical problems, because students first lose motivation to solve these problems (Phonapichat, Wongwanich, & Sujiva) [18].

4. Conclusion

Based on the results of research and discussion, various conclusions can be reached:

1. The most dominant types of difficulty experienced by all students in SMP Muhammadiyah 9 Todanan and in SMP 1 Todanan in completing mathematical diagnostic test questions on the Pythagorean Theorem material were difficulty in finding solutions to problems and difficulty in checking answers.

2. In general, the location of student difficulties summarized in the type of difficulty in items 1 to 8 was as follows: 1) difficulty understanding and analyzing problems; 2) difficulties in designing and planning a completion strategy; 3) difficulties in finding solutions to problems; 4) difficulty in checking answers.

3. Overall factors that caused the students of SMP Muhammadiyah 9 Todanan and SMP 1 Todanan to have difficulty in completing mathematical diagnostic test questions on the Pythagorean Theorem material were found to be: Students were unable to finish root results, students often forgot formulae and ways of solving given problems, students were not careful when solving problems, students were too hasty in their rush to solve problems, students gave up quickly when trying to solve problems, students felt that the time given for solving problems was insufficient, students' readiness in learning was still lacking.

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