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Metacognition ability of grade X students in mathematical problem solving through a digital project-based learning with Edmodo

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Abstract

This study aims to determine how the description of problem-solving abilities supported by metacognition skills in digital learning Project Based Learning assisted by Edmodo. This study used a qualitative method. The population taken in this study were students of class X SMA N 1 Jekulo Kudus. This study used a true experimental design with a pretest-posttest control group design. The sampling technique used in this study was a randomized class technique. Data collection was carried out by means of written tests and interviews. Indicators of problem-solving abilities in this study include (1) identifying problems, (2) planning problems, (3) implementing problem solving in accordance with the plan, and (4) interpreting the results obtained. The results of this study indicate (1) the problem solving abilities of students who have high metacognition abilities meet the four problem solving indicators, (2) the problem solving abilities of students who have moderate metacognitive abilities meet the three problem solving indicators, (3) the problem solving abilities of students who have low metacognition ability only fulfills two problem solving indicators.

1. Introduction

In the 21st century students can innovate and develop their learning skills through technology and information media (Wijaya, Sudjimat, Nyoto, & Malang, 2016). Technology that is increasingly rapid requires an increase and development of the quality of learning at all levels of education, so that mathematics becomes one of the universal sciences that can underlie the development of modern technology. What you want to achieve in learning mathematics is to develop various kinds of complex mathematical problem solving (Wilson, Fernandez, & Hadaway, 1993). This triggers students to prepare themselves to improve critical thinking skills, creatively, and the ability to plan and solve problems. Students can develop these abilities in mathematics because mathematics has a strong and clear structure and linkages between its concepts so that it makes students skilled in rational thinking (Purwaningsih and Siswanto, 2014)

Zhu (2017) says that solving math problems is a complex cognitive activity. The main supporter of the ability of students to solve a problem is the students' understanding of a concept. Kesumawati (2008) states that learning mathematics really requires understanding concepts. Therefore, students need to know about the advantages and disadvantages of concepts that must have an awareness that they need to know about the concepts that underlie a problem and realize the advantages and disadvantages they have.

Based on the results of the TIMSS (Trends in International mathematics and science study) international survey, Indonesian students still have a low ability to solve math problems. Indonesian students need to improve their problem-solving skills, especially in answering international standard questions, so that the average math score that is still below the average can increase (Khairunnisa, 2017). This condition tells us that Indonesian students really need analytical skills, reasoning, communicate

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effectively, and solve problems, and then interpret these solutions in various ways (Wardono & Mariani, 2014).

Five abilities that students must master in learning mathematics according to the National Council of Teachers of Mathematics (NCTM, 2000), namely: mathematical communication skills, mathematical reasoning skills, mathematical problem solving abilities mathematical connections, and mathematical representation abilities. Anderson (2009) states that the skills involved in problem solving are the process of analyzing, interpreting, reasoning, predicting, evaluating and reflecting. So, problem solving ability is the ability to apply previously owned knowledge into new knowledge that involves higher-order thinking processes (Achsin, 2016). One of the things highlighted in the 2013 Curriculum is the achievement of competence. This achievement includes students being able to apply, and explain factual, conceptual, procedural, and metacognitive knowledge in science, technology, arts, culture, and the humanities. From this, one of the important abilities in the 2013 Curriculum is metacognitive abilities (Sukowati, 2016). According to Romli (2012) metacognition is a person's knowledge of cognition, or awareness of what is known and what is not known. This is in line with Anderson & Kathwohl's (2001) statement that metacgnition is knowledge about one's cognition and awareness. According to Wilson & Clarke (2001) as cited by Wilson & Clarke (2004) metacognition is the awareness of students towards their thinking processes, rechecking their thinking processes, and regulating their thinking processes. students are able to plan, control and reflect so that students are helped in gaining long-lasting understanding and learning in memory (Iskandar, 2014). Students' understanding can be increased through metacognition skills, this is because students who know their metacognitive understanding can carry out certain strategies to improve their understanding (Zubaidah, 2016).

Through learning activities students need to be given the opportunity to exploit their experiences and understandings obtained from their observations and findings. In addition, to enrich the learning experience, students also need to be given the freedom to use various technology and information equipment and media, including using the internet (Ismayani, 2016). One effort that can be done is by applying a learning model that can increase student creativity. One model that can increase student creativity is that the teacher can apply the Project Based Learning digital learning model. Digital learning referred to in this research is learning using the internet. In agreement with Holzberger, Philip, & Kunter (2013) that digital learning can be delivered through the digital internet media. At this time it is necessary to improve skills in digital literacy. According to Lin & Chen (2017: 3557) digital learning can make students feel happy learning, even though digital learning cannot completely replace traditional learning. The effectiveness of learning can be increased by utilizing information and communication technology (Husain, 2014). After the implementation of digital learning media, it is hoped that there will be a positive impact on students such as increasing interest in learning and the learning process to be more conducive so that it can improve learning outcomes. This is because the role of students becomes more active in interacting with the internet such as accessing broader information if digital learning is applied. The existence of platform media such as edmodo can support e-learning activities. Edmodo is one of the features that support learning (Mulyono, 2013). Edmodo provides facilities for providing a safe place for students and communicating, collaborating, sharing content, discussing virtual classes, online exams, delivering values, and much more (Wardono, Waluya, Kartono, Mulyono & Mariani, 2018). Teachers can take advantage of the Edmodo function in the learning process, namely substitute, companion, and complementary functions that are tailored to the needs of the class (Ainiyah, 2015). Project Based Learning is a learning model that is suitable to be applied in mathematics learning. Through Project Based Learning, students are given the opportunity to work autonomously to build their own learning, and produce valuable and realistic student work products. As suggested by Frank, Lavy, & Elata (2003: 175) through a constructivist approach students can build their own knowledge by active learning, working independently, collaborating in teams. Project learning such as Project Based Learning can produce quality learning (Scarbrough, 2004: 1584)

The disciplinary attitude of students can be grown through the Project Based Learning model (Nurfitriyanti, 2016). According to Thomas (2000) the Project Based Learning model has several advantages, namely (1) it can improve students 'academics, (2) increase students' motivation, (3) increase students 'problem-solving abilities, (4) improve students' skills. In addition, according to Orevi & Dannon (1999) the advantages of the Project Based Learning model are that it can develop data presenting skills, develop thinking skills, adjust personal learning styles, increase motivation and develop independent learning. Based on the description of the problem above, the formulation of the problem in the research is how to describe problem solving abilities supported by metacognition abilities in Edmodo-assisted Project Based Learning digital learning. The purpose of this study was to find out how the description of students' problem solving abilities supported by metacognition skills in digital learning Project Based Learning assisted by Edmodo.

2. Methods

The method used in this research is qualitative methods. Qualitative methods are used to determine the description of metacognitive abilities in solving mathematical problems in digital learning Project Based Learning assisted by edmodo. In this study, the researcher used a true experimental design with a pretest-posttest control group design. The sampling technique used in this study was a randomized class technique.

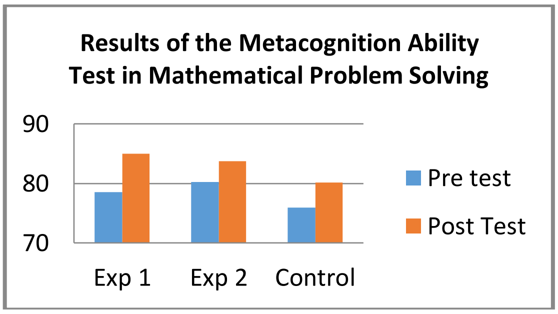
The population in this study were all students of grade X SMA Negeri 1 Jekulo Kudus even semester of the 2019/2020 school year. The samples in this study were three groups of students. They were two groups as the experimental class and one group as the control class. The samples in this study were grade X MIPA 1 and X MIPA 3 as the experimental class and grade X MIPA 2 as the control class. Experiment class 1 was given a digital treatment of Project-Based Learning assisted by Edmodo, the experimental class 2 was given a digital treatment of Project-Based Learning, and the control class group was given a treatment of the online expository model.

In this study, the considerations were made based on the observations of researchers on the self-regulation of students during the learning process and the process of taking metacognitive ability tests in mathematical problem-solving. Data collection techniques in this study included a written test and interviews. The test method was used to obtain data about the metacognition ability of students in mathematical problem-solving on trigonometry after different treatments were held. While the interview is used to determine the description of problem solving abilities. The test questions used were in the form of descriptions. The test was given once to the experimental group and the control group after being given the treatment. The results of this data processing were used to test the research hypothesis. Before the test was carried out, the questions were first tested in the trial class. The test was carried out to determine the validity of the test, which includes validity, reliability, difficulty level, and distinguishing power of each item.

After obtaining the data, then the data were analyzed qualitatively. Qualitative data is used to determine the description of problem-solving abilities supported by metacognition abilities in PjBL digital learning.

3. Result and Discussions

Before the research activities were done, the students were given pretest questions of mathematical problem-solving ability. A list of the results of the pretest and post test mathematical problem-solving ability will be presented in Picture 1.



Picture 1 . Results of the Metacognition Ability Test in Mathematical Problem Solving

3.1 Learning Implementation

Regarding the government's appeal for Work From Home and learning from home to tackle the Covid-19 outbreak, the research was conducted online on April 21 - June 2, 2020. The populations of this study were all students of grade X SMA N 1 Jekulo Kudus. The sample of this research was selected using a randomized class technique, namely class X MIPA 1 received the treatment of the digital learning model of Project-Based Learning assisted by Edmodo (experiment 1), class X MIPA 3 received the treatment of the digital learning model of Project-Based Learning (experiment 2), class X MIPA 2 received treatment of online expository learning model (control). The three classes got online learning. At the learning process, the researcher used Edmodo media for the experimental class 1, while the experimental class 2 and the control class used the google classroom media. The learning process in this study lasted for five meetings. The first meeting was used for the pre-test and the last meeting was used for the post-test. At the second meeting, the students learned about the concept of the sine rules. At the third meeting, the students learned about the concept of the cosine rules. At the fourth meeting, the students learned about the area of a triangle. At each meeting, the LKPD was used as a tool to help to find the concepts and formulas. While at the end of the meeting, the students were given project assignments that were done in groups. In this lesson, the students were given the opportunity to discuss in groups to complete a given project. The selection of the class to be used as the experimental class and the control class used random techniques has been approved by Ms. Markamah, S.Pd as a compulsory mathematics subject teacher for grade X at SMA N 1 Jekulo Kudus, so the researcher determined class X MIPA 1 students as experimental class 1 which obtained the application of digital learning of Project-Based Learning assisted by Edmodo, X MIPA 3 as the experimental class 2 which received digital Project-Based Learning, and class X MIPA 2 as the control class which received online expository learning. This sampling technique can be done if the members of the populations are considered homogeneous. The presentation of the results of this learning implementation only describes the learning outcomes in the experimental class with a digital model of Project-Based Learning assisted by Edmodo.

The researcher first determined the material and prepared the research instruments before the data collection was carried out, which included the Learning Implementation Plan (RPP), Student Worksheets (LKPD), learning videos for the control class, and metacognitive ability test questions in mathematical problem- solving. Each lesson was carried out with an allocation of two lesson hours, with one lesson hour was 45 minute lesson hour. The material details for each meeting were (1) finding the concept of the sine rules, (2) finding the concept of the cosine rules, (3) finding the area of a triangle using the sine rules. The students were given a final test (posttest) of mathematical problem-solving ability after the three classes were given treatment.

3.2 Final Data Analysis

The students in the experimental class 1, the experimental class 2, and the control class were done the post-test of their mathematical problem-solving ability on the material that has been studied, namely the sine and cosine rules. After implementing the post-test students' mathematical problem-solving ability, the data obtained from the post-test scores of mathematical problem-solving for the three classes in Table 1.

Table 1. Post-test Results of Mathematical Problem-Solving Ability

Class	N	Average	Standard Deviation	Highest Value	Lowest Value
Experimental 1	34	85	10,04	98	50
Experimental 2	34	83,76	6,68	94	58
Control	35	80,17	7,603	93	55

Based on the results of the normality test with the Komogorov-Smirnov test with the help of SPSS 21, the significance value for the experimental class 1 is sig = 0.239> 0.05, the significance value for the experimental class 2 is sig = 0.137> 0.05 and the significance for the control class is sig = 0.656> 0.05. Based on the test criteria, H_0 is accepted. This showed that the final test data (post-test) of the students' mathematical problem-solving ability in class X MIP 1, X MIPA 3, and X MIPA 2 SMA N 1 Jekulo Kudus came from a normally distributed population. Based on the output of the homogeneity test results, a significance value of sig = 0.221 is obtained. Because the sig = 0.221> 0.05, H_0 is accepted. From these conclusions, the final test data (post-test) for the three samples had the same variance (homogeneity).

3.3 Qualitative Data

The qualitative data obtained from this study are the results of the metacognition ability test in solving mathematical problems and the results of interviews with research subjects. Based on the results of the metacognition ability test in problem solving, 2 subjects were selected for each level of metacognition ability. From the results of the metacognition ability test assessment, metacognition scores were obtained.

Subjects were selected based on consideration of EA-12 and EA-17 from the high metacognition group, EA-5 and EA-20 subjects from the moderate metacognition group, and EA-26 and EA-26 subjects from the low metacognition group.

3.3.1 Description of Mathematical Problem Solving Ability Supported High Metacognition Ability

Based on the results of the analysis of the test and interview data, it was found that students who have high metacognition show good mathematical problem solving abilities because they meet four indicators of metacognition ability in solving mathematical problems. Indicators of mathematical problem solving abilities in identifying what is known and what is asked are achieved well by the EA-12 and EA-17 subjects. Both subjects can write what is known and what is asked of the problem correctly and completely with one. The indicator for the student's ability to determine the completion plan by mentioning the steps to be used to solve the problem and drawing a sketch of the problem given was achieved by both EA-12 and EA-17 subjects. Indicators of metacogenic ability in solving mathematical problems by implementing the completion plan according to the written plan can be carried out properly by the EA-12 and EA-17 subjects. The test results show that the two subjects can complete the appropriate formula, the calculation process is complete, and the results obtained are correct. This was supported during the interview, both subjects were able to explain the solutions used and were able to answer interview questions fluently. Metacognition indicators in solving by re-checking the answers to problem solving by writing the final result conclusions in full, rechecking the completion steps, rechecking the calculation results were achieved properly by EA-12 and EA-17 subjects. Both subjects examined the return of work, wrote conclusions in accordance with the results of the completion of the work correctly and correctly.

At the stage of understanding the problem and planning solutions in the planning aspect, the two subjects are able to plan solutions. The things that cause are (1) students are able to think about the relationship between what is known and what is asked, it can be seen from the completion of the answers that are completed, (2) students are able to think about what steps must be taken first to solve the problem, (3) students are able to think formulas or concepts that can help in solving problems. From this, it can be concluded that the EA-12 and EA-17 subjects used metacognition skills in solving problems. This is in line with the research conducted by Nuhayati as quoted by Safitri, Yasintasari, Putri, & Hasanah, (2020, p. 20) that students who can make good use of their metacognitive abilities are able to solve math problems well. Researcher Fauzi (2009) also revealed that students who are aware of their metacognitive abilities will think well and strategically.

3.3.2 Mathematical Problem Solving Ability Supported Moderate Metacognition Ability

Based on the results of the analysis of the test and interview data, it was found that students who have moderate metacognition show a good enough mathematical problem solving ability because they meet three indicators of metacognition ability in solving mathematical problems. Indicators of mathematical problem-solving abilities in identifying what is known and what is asked are achieved well by the EA-5 and EA-20 subjects. Both subjects can write what is known and what is asked of the problem correctly and completely with one. The indicator for the students' ability in determining the completion plan by mentioning the steps to be used to solve the problem and drawing a sketch of the problem given was achieved by both EA-5 and EA-20 subjects. The indicator of metacognition ability in solving mathematical problems by implementing the completion plan according to the written plan is not implemented properly by the EA-5 and EA-20 subjects. The test results show that the two subjects can solve with the appropriate formula, but in question number 5 the EA-5 subject is not careful in the calculation process so the results obtained are not accurate. This was supported during the interview, both subjects were able to explain the solutions used and were able to answer interview questions fluently. Metacognition indicators in solving by re-checking the answers to problem solving by writing the final result conclusions in full, rechecking the completion steps, rechecking the calculation results were achieved properly by EA-12 and EA-17 subjects. The two subjects reexamined the work, writing conclusions according to the results of the completion correctly and correctly. From this, it can be concluded that the EA-5 and EA-20 subjects used metacognition skills in solving problems.

3.3.3 Mathematical Problem Solving Ability Supported by Low Metacognition Ability

Based on the results of the analysis of the test and interview data, it was found that students who have low metacognition show sufficient mathematical problem solving ability because they meet three indicators of metacognition ability in solving mathematical problems. Indicators of mathematical problem solving abilities in identifying what is known and what is asked are achieved well by the EA-26 and EA-32 subjects. Both subjects can write what is known and what is asked of the problem correctly and completely with one. However, the indicator for the students' ability in determining the completion plan by mentioning the steps that will be used to solve the problem and drawing a sketch of the problem given has not been achieved properly by the EA-26 and EA-32 subjects. Subjects EA-26 and EA-32 did not write a detailed plan of the steps to be used to solve the problem. The indicator of metacognition ability in solving mathematical problems by implementing the completion plan according to the written plan can be implemented quite well by the EA-12 and EA-17 subjects. The test results show that the two subjects simply complete the appropriate formula, the calculation process is quite complete even though the EA-26 subject numbers 1, 2, 3, and 4 get incorrect results. This was supported during the interview, one of the subjects, namely EA-26, was unable to explain the solutions used so that he was not fluent in answering interview questions. Metacognition indicators in solving by re-checking the answers to problem solving by writing the conclusions of the final results, checking the completion steps again, checking the calculation results were not achieved well by EA-26 and EA-32 subjects. The two subjects did not re-examine the work so that the conclusions written were incorrect. At the stage of understanding the problem and planning solutions in the planning aspect, the two subjects were unable to plan a solution. The things that cause are (1) students are quite able to think about the relationship between what is known and what is asked, it can be seen from the completion of the answers that are completed, (2) students do not think about what steps to take first to solve the problem, this is shown by the two subjects not writing a plan that will be used to solve the problem (3) students do not think about formulas or concepts that can help them solve problems. From this, it can be concluded that the EA-12 and EA-17 subjects did not use metacognition skills in solving problems. This is in line with the research conducted by Nuhayati as quoted by Safitri, Yasintasari, Putri, & Hasanah, (2020, p. 20) that students who can make good use of their metacognitive abilities are able to solve math problems well. Researcher Fauzi (2009) also revealed that students who are aware of their metacognitive abilities will think well and strategically.

Table 2. Recapitulation of the Results of Analysis of Metacognition Ability in Student Mathematical Problem Solving in Digital Learning Projecy Based Learning Using Edmodo

Aspect	**Indicator**	**Level**					
		High		**Modete**		**Low**	
		EA -12	**EA-17**	**EA-5**	**EA-20**	**EA-26**	**EA-32**
Planning	Understand to Problem	D	D	D	D	D	M
Monitoring	Plan for Completion	D	D	DE	DE	ND	TM
	Carry out the plan	D	D		D	DE	D
Evaluating	Proofread Again	D	D	D	D	ND	ND

Such as : D (Doing), DE (Doing Enough), ND (Not Doing).

4. Conclusion

Based on the results of the research and discussion that has been carried out by the researcher, the following conclusions, Description of mathematical problem solving abilities supported by students' metacognition abilities in Edmodo-assisted Project Based Learning digital learning, as follows. (a) Students who have high metacognition abilities are able to solve problems and meet the four indicators of metacognitive abilities in solving mathematical problems. Students are able to understand problems, students know what to do first to solve problems, students are able to design strategies that will be used to solve problems. In doing calculations, students are able to carry out according to plan completely, thoroughly and correctly so that students are able to conclude the results that have been obtained. (b) Students who have moderate metacognition abilities are able to solve problems and meet 3 indicators of metacognitive abilities in solving mathematical problems. Students are able to understand problems, students know what to do first to solve problems, students are able to design strategies that will be used to solve problems. In doing calculations, students are able to complete according to the plan. However, the results obtained were not accurate enough that the results obtained were not accurate and students were able to conclude the results that had been obtained. (c) Students who have low metacognition abilities are able to solve problems and meet 2 indicators of metacognitive abilities in solving mathematical problems. Students are able to understand problems, but students are less able to write strategies / plans that will be used to solve problems. This can be seen from some students who are not able to answer questions completely and accurately. Still there are students who are not fluent in doing calculations. Even though there were several questions that were completed completely, the student was not careful enough so that the results obtained were not accurate. However, students are able to conclude the results that have been obtained.

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