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Mathematical Problem Solving Skills Reviewed from Students' Metacognition Performance in Online-Based PME Learning Model

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Abstract

This research was carried out with the aim of knowing: (1) whether students' mathematical problem solving abilities in the online-based PME learning model achieved classical learning completeness; (2) is the average mathematical problem solving ability in the online-based PME learning model better than the online-based expository learning model; (3) is there any effect of metacognition performance on students' mathematical problem solving abilities in online-based PME learning models; (4) how is the description of mathematical problem solving abilities in terms of the metacognitive performance of Vocational High Schools Perdana Semarang students on the online-based PME learning model. This research uses the mix method. This research is a Quasi Experimental Design with Pre-Test-Post-Test Control Group Design. The population of this research is all students of class XI Vocational High Schools Perdana Semarang. The results of this study indicate that: (1) students' mathematical problem solving abilities in the online based PME learning model can achieve classical learning completeness; (2) the average mathematical problem solving ability of students in the online-based PME learning model is better than the online-based expository learning model; (3) there is a positive influence on the level of metacognition performance on students' mathematical problem solving abilities in the online PME learning model; (4) students with high metacognition performance have better mathematical problem solving abilities than students with moderate and low metacognition performance levels, then students with moderate metacognition performance have better mathematical problem solving abilities than students with low metacognition performance levels.

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1. Introduction

The development of the times accompanied by the development of modern Science and Technology resulted in the need to develop quality in various fields, especially in the field of education. The ability to cooperate, analytical thinking, logical, systematic, critical, and creative are abilities that need to be developed to support the quality of education. This ability will be obtained through good mastery of mathematics in school. Mathematics is important for students to learn because our lives cannot be separated from its use (Pujiadi, 2016:5).

In accordance with Law No. 20 of 2003 article 37 concerning the National Education System, mathematics is a compulsory subject given to students with primary and secondary education levels, including vocational students. The process of learning mathematics in Vocational High Schools is slightly different from the application of learning in Senior High Schools. Vocational High School is one of the

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school levels that consists of various fields of expertise to produce graduates by prioritizing special skills to equip themselves to compete in the world of work in the future. Student learning in Vocational High Schools is mostly carried out by direct practice in the field so that the implementation of mathematics learning in Vocational Schools is more related to learning materials with real life in order to solve problems in the world of work in the future. Mathematics subjects in Vocational High Schools become the basic science for other sciences. Mathematics is used in almost all subjects in Vocational High Schools in its application and calculations, including in every area of expertise. This is the reason why mathematics is important to learn in school for vocational students.

Currently, many students still think that mathematics is a difficult subject. In the process of learning mathematics in Vocational High Schools, students find it difficult to solve the math problems given. Students are only trying to get the final answer and still can't do the right steps in solving the problem. This situation can also be seen from the low mathematics learning outcomes of students at Vocational High Schools Perdana Semarang, where the daily math test scores of students in class XI Multimedia A for the academic year 2021/2022 show that only 15 of 23 students or a percentage of around 65.2% who meet the mastery learning score, namely 70. The study results have not been significantly completed classically. On the other hand, seen from the results of the achievement of the 2019 National Examination scores of students at Vocational High Schools Perdana Semarang, it shows that the average achievement percentage who answers correctly for mathematics subjects is lower than other subjects. The following is the percentage of students' average achievement scores in National Examination subjects in 2019:

Table 1. Percentage Achievement of Student

Mark	Subjects			
	IND	ING	MAT	KMP
Percentage	70.47%	41.40%	33.09%.	39.86%

Then, of the 4 mathematics materials tested in the National Examination, the smallest percentage is found in Calculus material where there are two indicators of solving problems in the form of solving non-routine problems and solving problems in daily life related to Calculus which shows the absorption value of the percentage is less than 55%, namely 22.55% and 37.25%. This shows that students have not optimized their mathematical problem solving abilities. Reinforced from the results of an interview with one of the class XI mathematics teachers at Vocational High Schools Perdana Semarang, Mrs. Eti Siti Rofikoh, S.Pd stated that students' mathematics learning outcomes were still low usually caused because students still have difficulty in solving problems. When given student questionstend to seek the final answer without understanding the concept of the problem first, without planning the right solution strategy, and not re-checking or evaluating the results of solving the problem.

According to Davita & Pujiastuti (2020:111) interpret mathematical problem solving ability as a student's effort to find a solution to a given mathematical problem with his skills and knowledge. Problem solving ability is one of the basic skills of learning mathematics (Kozikoglu, 2019:112). Where in line with the objectives of learning mathematics according to the demands of the curriculum are: the ability to understand concepts, reason, solve problems, communicate ideas, and have an attitude of appreciating the benefits of mathematics (Kamarullah, 2017:29). Therefore, efforts are needed to improve students' mathematical problem solving abilities in schools as basic abilities in learning mathematics.

The non-optimal performance of students' mathematical problem solving needs to be studied from their metacognition performance. According to Sandewa (2018: 98) defines performance as a person's work (output) in the form of quality and quantity in a particular activity. Then, Chairani (2016: 38) defines metacognition as a person's awareness of his thinking abilities related to the cognitive process. Therefore, the authors in this study conclude the notion of metacognition performance as a result of the work of a person's form of awareness of thinking about his cognitive abilities related to what he knows and does not know.

Education today, is aimed at educating students who can build knowledge by bypassing their own cognitive filters, not just memorizing existing knowledge (Kozikoglu, 2019:111). When solving problems, high-level thinking processes are needed by involving awareness of thinking so that an understanding of the problems given is obtained. According to Amin & Sukestiyarno (2015:216) states that the success of students in solving problems depends on their awareness of thinking which is closely related to metacognition so that good metacognition performance is needed because all problem solving steps are characteristics of metacognition (Siagian et al., 2019:333). Several studies by researchers also stated that there was an effect of metacognition on students' problem solving abilities. According to Izzati & Mahmudi (2018:5), metacognition has a positive influence on students' mathematical problem solving abilities. The better metacognition a person has, the better problem solving abilities he has. Metacognition also has a close relationship with behavior so that it can trigger problem solving behavior, monitor performance, and change behavior if things don't go as expected (Ozcan & Gumus, 2019:119). Metacognition will help students to recognize the problem to be solved, and understand how to obtain a solution to the problem (Kuzle, 2013: 21). Thus, it is necessary to review the mathematical problem solving abilities of students from the metacognition performance of Vocational High Schools Perdana students.

Students' mathematical problem solving ability is measured by assessing each step of problem solving taken. Problem solving steps according to Polya are the steps used by researchers to determine students' mathematical problem solving abilities. The problem solving step, according to Polya, was chosen on the grounds that it showed a link between cognitive processes and students' metacognition experiences. The Polya troubleshooting steps include:

1) Understand the problem.
   What is known and asked from the given problem is determined by the student at this stage.
2) Planning a solution.
   Students determine the right strategy or problem-solving step to solve the problem at this stage.
3) Solve problems according to plan.
   Students carry out problem solving using a planned strategy to determine the answer at this stage.
4) Do a re-check.
   Students re-check the results of their calculations at this stage, whether the calculations are in accordance with the provisions and do not contradict what was asked (in Astutiani et al., 2019:299).

Metacognition performance indicators in this study are based on the 10-step metacognition strategy according to Darling-Hammond which consists of: 1) predicting outcome, which is predicting solutions using available information to understand the problem; 2) evaluating work, useful for reviewing the weaknesses and strengths of their work; 3) questioning by the teacher, to ask the teacher the difficulties encountered when solving problems; 4) self-assessing, namely how students reflect on their learning activities and decide how well they have learned something; 5) self-questioning, useful for testing their knowledge using questions; 6) selecting strategies, to be able to decide the right strategy or step to solve the problem; 7) using directed or selective thinking, if students can consciously use a certain line of thought or selectively to find the answer; 8) using discourse, namely discussing ideas or ideas that have been planned; 9) critiquing, useful for giving the weakness of the work; and 10) revising, useful for improving the results of their work (Amin et al., 2018:2).

In 2020, it was an unexpected year throughout the world, including Indonesia because of the pandemic COVID-19. Policy The implementation of learning from home is carried out as an effort to prevent the spread of the COVID-19 Virus. The learning model that is usually applied face-to-face must now be changed to adapt to the current situation. according to Mustakim (2020), online learning is considered as an effective learning alternative during the COVID-19 pandemic. Mathematics learning at SMK Perdana applies an online-based expository learning model. The learning model is less structured, varied, and more centered on teacher activity. The expository learning model seems to make students passively solve problems, resulting in a lack of student understanding and student difficulties in solving problems. according to Meika et al., (2021:385), learning model is one of the factors needed to improve students' mathematical problem solving abilities.Thus, an appropriate learning model is needed to improve students' mathematical problem solving abilities.

The PME (Planning, Monitoring, and Evaluating) learning model in this study was carried out online and then combined with Polya's steps to improve students' problem solving abilities. The PME learning model is carried out with learning activities through 3 stages, namely: preparation or introduction, core, and closing. The PME learning model emphasizes activities, namely: planning, monitoring and evaluation (Amin & Mariani, 2017:342).

Based on the description above, the researcher aims to carry out research related to "**Mathematical Problem Solving Skills Reviewed from Students' Metacognition Performance in Online-Based PME Learning Model**" so that it can be useful for the mathematics learning process in the future. The aims of this study were to determine: 1) whether students' mathematical problem solving abilities in the online-based PME learning model achieved classical learning completeness; 2) is the average mathematical problem solving ability of students in the online-based PME learning model better than the online-based expository learning model; 3) does metacognition performance affect mathematical problem solving ability in online-based PME learning models; 4) how is the description of mathematical problem-solving abilities in terms of the metacognitive performance of Vocational High Schools Perdana Semarang students on the online-based PME learning model.

2. Methods

The type of research used by the researcher is study *mixed methods* which combines qualitative with quantitative research. This research focuses on collecting, analyzing, and mixing qualitative and quantitative data. The mixed research method in this study uses a model *explanatory sequential* design. Explanatory sequential character begins with the collection of quantitative data followed by qualitative data in order to describe in general and describe the results of quantitative data.

This research design uses *Quasi Experimental Design* with the form of Pre-test-Post-test Control Group Design. Quasi-experimental design is used because the control group owned cannot affect the full implementation of the experiment (Rukminingsih et al., 2020:57). The population of this research is all students of class XI SMK Perdana Semarang. The sample of this study was randomly selected with all students of class XI MMA as the experimental class, all students of class XI of MMB as the control class, and all students of class XI MMC as the trial class. The experimental class and the control class will get different treatment. The experimental class applies an online-based PME learning model while the control class applies an online-based expository learning model.

The data collection methods used in this study were in the form of tests, interviews, and questionnaires. The test method is used to measure students' problem solving abilities. The test questions given in the form of pre-test and post-test in the form of descriptions were given to the experimental and control classes. The questions were tested in the test class first to analyze their validity, reliability, level of difficulty, and distinguishing power. Questionnaire method was used to measure students' metacognition performance. The results of the questionnaire score analysis were used to select research subjects. The research subjects were selected as many as 6 students to carry out interviews including 2 people from each level of metacognition performance (high, medium, and low) in the experimental class.

Quantitative data analysis was carried out to test the hypothesis, namely whether the student's learning mastery achieved individual and classical mastery, to test whether the student's mastery students' mathematical problem-solving abilities in the online-based PME learning model are better than online-based expository learning models, and examine the effect of metacognition performance on students' mathematical problem-solving abilities in online-based PME learning models.

Qualitative data analysis in this study was conducted to describe mathematical problem solving abilities in terms of students' metacognition performance. Qualitative analysis was carried outwith stages: data reduction (data reduction), data presentation (data display), as well as drawing conclusions and verification. Data reduction in this study was carried out to simplify and discard data that was not needed so that a clearer picture of the data was obtained. The data to be presented are the results of the post-test and transcripts of interviews with students. Furthermore, the findings will be discussed and conclusions drawn.

3. Results & Discussions

This research was carried out at Vocational High Schools Perdana Semarang in class XI in the 2021/2022 academic year from July 27 to August 31, 2021. Learning was carried out in class XI MMA and class XI MMB for 3 online meetings with an allocation of 1x60 minutes for each meeting. The learning material given is geometric transformation. At the first meeting in the experimental class, students were given pre-test questions and at the last meeting were given post-test questions to measure students' mathematical problem solving abilities which were collected using the Google Classroom application. At each learning meeting, at the beginning, the initial knowledge/prerequisites of the sub-chapters of the material provided are checked. After that, students are given an understanding of the prerequisite material provided. Furthermore, the teacher explains the material to be delivered with the help of PPT (Power Point) through the Zoom Meeting application or by uploading an explanation video/learning material in Google Classroom. Students are given examples of problem questions to increase student understanding. Students record their understanding of the material presented. Students are given questions to work on in groups to develop students' ideas on the second day. Each lesson at the end is continued by giving questions to students to be done individually as a form of learning evaluation. Students record their understanding of the material presented. Students are given questions to work on in groups to develop students' ideas on the second day. Each lesson at the end is continued by giving questions to students to be done individually as a form of learning evaluation. Students record their understanding of the material presented. Students are given questions to work on in groups to develop students' ideas on the second day. Each lesson at the end is continued by giving questions to students to be done individually as a form of learning evaluation. Data on students' mathematical problem solving abilities were obtained from the results of a written test consisting of a pre-test and a post-test totaling 5 questions that were carried out by 23 students.

3.1. Result and Discussion of Preliminary Data Quantitative

Researchers conducted a test to determine the students' initial mathematical problem solving ability. The test was carried out using the data from the pre-test results. First, the normality test was carried out, the homogeneity test was carried out, then the average similarity test was carried out.

Based on the results of the normality test using the help of IBM SPSS Statistic 26, the value for the experimental class Sig.= 0.149 > 0.05, H_0 it was accepted and the control class obtained the Sig value. = 0.088 > 0.05, then H_0 it is accepted so that the initial data comes from a normally distributed population. Furthermore, based on the results of the homogeneity test, the value of Sig. = 0.686 > 0.05, H_0 it is accepted, indicating that the two groups have the same or homogeneous variance. After the normality and homogeneity tests were carried out, the researchers conducted a mean similarity test. Based on the results of the average similarity test with the two-party t-test, it was found that the value of $t_{count} = 0.167 < t_{table} = 2.015, H_0$ was accepted. These results indicate that there is no significant difference between the initial value of the experimental class and the control class so that the average initial ability between the experimental class and the control class is the same.

3.2. Result and Discussion of Final Data Quantitative

The final data comes from the results of the students' post-test. The quantitative analysis carried out consisted of testing hypothesis 1 to determine classical learning completeness, testing hypothesis 2 to determine whether the average mathematical problem solving ability of students in the online-based PME learning model was better than the online-based expository learning model, and hypothesis testing 3 to determine the effect of metacognition performance on mathematical problem solving ability in online-based PME learning models.

First, the normality test and homogeneity test were carried out on the final data. Based on the results of the normality test using the Kolmogorov-Smirnov test using the help of IBM SPSS Statistic 26, the same significance value was obtained for the post-test results of the experimental class and control class students, namely Sig.= 0.200 > 0.05 so that the final data came from a normally distributed population. Then, based on the output of the homogeneity test results obtained the value of Sig. = 0.898 > 0.05 indicates that the variance of the two groups is the same or homogeneous. After the normality test and homogeneity test are carried out, it will be followed by hypothesis testing.

Hypothesis 1 test was conducted to test the mastery of classical learning. The classical learning mastery test was carried out by using the proportion test. Based on the results of the analysis, the value z_{count} = 1.867 > z_{table} = 1.64, then H_0 it was rejected. This means that the proportion of students who complete learning in online-based PME learning is more than 0.75, students' learning completeness is significant classically.

Hypothesis 2 test was conducted to determine whether the average mathematical problem solving ability of students using the online-based PME learning model was better than those using the online-based expository learning model. This hypothesis 2 test uses a difference test of two averages. Based on the results of the two-average difference test with a one-sided t-test obtained $t_{count} = 2.160 > t_{table} = 1.680$, H_0 it was rejected so that the average final test result of students' mathematical problem solving abilities who took online-based PME learning was better than those who took online-based expository learning.

Hypothesis 3 test was used to test the effect of metacognition performance on students' mathematical problem solving ability using simple linear regression test. Based on Anova output results obtained the value of Sig. = 0.000 < 0.05 then H_0 it is rejected. So, it can be concluded that there is a significant effect between metacognition performance and students' mathematical problem solving abilities. The simple linear regression equation of the two variables is as follows:

$$\hat{Y} = \alpha + \beta X = 32.539 + 0.503\, X$$

Based on the output of the Summary Model, it is known that the correlation / relationship (R) value is 0.738 which indicates a strong and positive relationship between the two. From the output, the coefficient of determination (R square) is 0.544. Which means that the influence of metacognition performance variables and students' mathematical problem solving ability variables is 54.4%, the rest is caused by other factors.

3.3. Result and Discussion of Data Qualitative

Metacognition performance categories were identified based on the analysis of the results of the metacognition performance questionnaire scores. The research subjects selected 6 people from each level of metacognition performance, namely 2 students in the high category, 2 students in the medium category, and 2 students in the low category. Students who were selected as subjects of this study based on the results of the metacognition performance questionnaire scores were as follows:

Table 2. Metacognition Performance Categories

Category	Subject Code
High	E-3, E-22
Moderate	E-2, E-19
Low	E-14, E-21

3.3.1 High Metacognition Performance

Subjects with high metacognition performance, namely subjects E-3 and E-22 fulfilled the four steps of solving mathematical problems. In the first step, namely understanding the problem, both subjects were able to write down and reiterate the information related to what was known and asked from the question correctly and completely. The subject is able to relate what is known to be asked in the question to solve the problem. Subjects have good conceptual and reasoning abilities, can represent the intent of the question in the form of pictures to help make plans. This shows that both subjects with high metacognition performance have very good predicting outcomes and can understand the problem using the available information. In the second step, namely planning a solution, the two subjects developed a strategy before working on the problem. The subject is able to determine the right strategy and formula to solve the five questions given. Subjects are also very focused or selective in finding solutions, answering easy questions first and then difficult questions. In the third step, namely solving the problem, the two subjects were able to implement and solve the problem according to the plan made. Subjects are able to perform calculations correctly and sequentially. Subjects use focused and selective thinking to easily find the right steps and results. Subject E-3 seemed to write more complete problem solving than subject E-22. In the fourth step, namely re-checking, the subject re-checks the results of his calculations and determines the conclusions of the answers correctly. The subject also knows other ways that can be used to solve the problem. This means that subjects with high metacognition performance can evaluate the results of their work by criticizing and even being able to revise the error in their calculation results. Based on the description above, it can be concluded that subjects with a high level of metacognition performance are able to meet the indicators in all problem solving steps.

3.3.2 Moderate Metacognition Performance

At the moderate level of metacognition performance, there were two research subjects, namely E-2 and E-19. In the first step, which is understanding the problem, it can be seen that subjects E-2 and E-19 are both able to understand the problem well. Subjects are able to write and reiterate information related to what is known and asked from the question. The subject is able to relate what is known to be asked in the question to solve the problem. The subject has a fairly good conceptual ability but is still weak in reasoning. The subject can only be seen to represent the meaning of the question in the form of an image of an easy question. The subject seems to have a fairly good predicting outcome using the available information to understand the question. In the second step, which is planning a solution, both subjects are equally able to plan a solution. The two subjects developed a strategy in advance before working on the questions. Both subjects were able to determine the right strategy to solve the problem. The subject also has enough directed or selective thinking in finding solutions to the problems given. Subject E-19 seems to be more capable of strategizing in determining the right formula. Subject E-2 seemed less able to determine the right formula for question number 5. In the third step, namely carrying out the settlement according to the plan, the two subjects were able to carry out and complete the problem solving according to the plan made. It's just that the subject is still not thorough, making some errors in calculations. Subject E-2 was less careful in calculating questions number 2 and 4. Then for question number 5, subject E-2 is less able to carry out the settlement because he made a mistake in planning the solution. Subject E-19 also made a calculation error for numbers 2, 4, and 5 so that they got the wrong answer conclusion. In the fourth step, which is to re-check, the two subjects have not fulfilled this step. It was seen that the two subjects only re-examined some of the answers from the results of their work. Both subjects did not know any other way to solve the problem. The two subjects only re-checked the results of work numbers 1 and 3. The results of the analysis of student work, showed that the results of student work that were re-examined concluded the correct answers and vice versa. This means that students with moderate metacognition performance have not been able to evaluate the results of their work, criticize and revise the error in the calculation results. Based on the description above, it can be concluded that subjects with moderate metacognition performance have not yet been able to meet the indicators in the fourth problem-solving step, namely re-checking.

3.3.3 Low Metacognition Performance

At the low level of metacognition performance, there are two subjects, namely E-14 and E-21. In the first step, namely understanding the problem, the two subjects seemed equally able to write and mention what was known and asked about the question but it was incomplete. Subjects with low metacognition performance were less able to represent the meaning of the questions in the form of pictures. This means that the subject understands the problem by using information on the adequacy of data that can be used to solve the problem. Subjects have a poor predicting outcome. Subject E-14 seems to be more able to determine and relate what is known and asked than subject E-21. Subject E-21 seems less able to relate what is known and asked with their own sentences for question number 4. In the second indicator, namely planning a solution, both subjects seem less able to make plans / steps to solve problems properly. Subjects E-14 and E-21 did not develop a strategy before working. Subject E-14 has not been able to determine the right formula and steps to solve questions number 2, 3, and 5. Subject E-21 is not able to plan a solution, still makes mistakes for numbers 2, 4, and 5. directed or selective in finding solutions. In the third step, namely completing the plan, the two subjects were equally less able to carry out problem solving steps. Subject E-14 was not able to solve questions well for numbers 2, 3, 4, and 5. E-14 was not able to solve questions number 2, 3, and 5 properly because the subject did not properly plan the completion, while for number 4 students are confused in determining the right value to be substituted. Subject E-21 is less able to solve questions number 2, 4, and 5, this happens because students make mistakes in planning solutions. In the fourth step, namely re-checking, the two subjects did not meet this step. Subject E-14 only re-checked the results of his work calculations which were considered easy for number 1. While E-21 did not check at all on the results of his calculations. The two subjects also did not know any other way to solve the problem. This shows that students cannot evaluate the results of their work, criticize or revise the errors in their calculations.

The results of this analysis are supported by the statement Amin & Sukestiyarno (2015:216), that the success of students in solving problems depends on their awareness of thinking. Further research Amin et al. (2018:11), states that metacognition enables students to become successful learners who can stimulate higher-order thinking that involves active control over the cognitive processes of learning. Therefore, metacognition performance will have an impact on student learning outcomes. Students with good mathematical problem solving skills will meet all indicators of problem solving abilities so that it has an impact on good learning outcomes. On the other hand, students with poor mathematical problem solving skills will have an impact on poor learning outcomes as well.

3.4 Research Finding

Based on the results of research and data analysis obtained several findings in this study, namely:

1. The PME learning model has advantages, namely:
   a. Increase student activity.
   b. Students have the ability to build their own knowledge.
   c. Encourage students to have problem solving skills.
   d. Encouraging students to have metacognition abilities.

   The PME learning model has weaknesses, namely:
   a. Less effective if students are less active in learning.
   b. Takes quite a long time.
2. Several factors caused the low mathematical problem solving ability of SMK students:
   a. There is still a lack of student interest in mathematics, this is because students assume that not all mathematics material will be useful in the world of work.
   b. Students are less accustomed to working on problem solving and more challenging questions.
   c. Students do not understand the concepts and prerequisites of the material provided.
   d. Students are not accustomed to re-checking their work.
3. There is a relationship between metacognitive performance and mathematical problem solving abilities, thus to improve mathematical problem solving abilities metacognitive performance needs to be improved first. Here's the relationship:
   a. Subjects with high metacognitive performance can perform all steps of Polya's problem solving well. Subjects perform all indicators of metacognition performance well.
   b. Subjects with moderate metacognitive performance were able to perform the three problem-solving steps well but were still weak in re-checking. Subjects emphasized metacognitive performance indicators, namely predicting outcomes, selecting strategies, using direct or selective thinking, evaluating work, critiquing, revising, using discourse, question to the teacher, self-assessing, and self-questioning.
   c. Subjects with low metacognition performance are still not able to carry out all the problem solving steps properly. Where the subject is still weak and unfamiliar with all indicators of metacognition performance.

4. Conclusion

Based on the results of the analysis of this study, the following conclusions were obtained: (a) students' mathematical problem solving abilities in the online PME learning model can achieve classical learning completeness, which is more than 75%; (b) the average mathematical problem solving ability of students in the online-based PME learning model is better than the online-based expository learning model; (c) there is a positive effect of metacognition performance level on students' mathematical problem solving abilities in the online based PME learning model of 54.4%; (d) description of mathematical problem solving abilities in terms of students' metacognition performance levels, namely: (1) students with high metacognition performance levels are able to meet all indicators in the four steps of mathematical problem solving, namely understanding the problem, planning problem solving, solving problems according to plan, and re-checking; (2) students with moderate metacognition performance levels are able to meet the indicators in the three steps of solving mathematical problems, namely understanding problems, planning problem solving, and solving problems according to plan; (3) students with low metacognition performance levels are only able to meet the indicators in the mathematical problem solving step, namely understanding the problem.

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