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Mathematical Problem Solving Ability in Self-Directed Learning with Module From Students' Self-Regulated Learning

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Abstract

This study aims to describe students' mathematical problem solving ability from students' self-regulated learning in self-directed learning with module. The method used in this research is mixed methods research with a sequential explanatory design. The population in this research are all 11th grade students at SMA N 1 Mayong. The sampling technique from self-regulated learning has taken 7 subjects used purposive sampling. The result showed that students with high self-regulated learning categories are able to achieve three indicators of problem solving abilities namely understanding problems, making problem solving strategy plans and implementing problem solving strategy plans correctly. Students with moderate self-regulated learning categories are able to achieve two indicators of problem solving abilities namely understanding problems and making problem solving strategy plans correctly. While students' low self-regulated learning categories have not been able to achieve all four indicators of problem solving abilities namely understanding problems, making problem solving strategy plans, implementing problem solving strategy plans and looking back.

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INTRODUCTION

Mathematical problem solving ability is a part of learning mathematics which is very important in mathematics education because problem matters are an integral part of learning mathematics, so it is cannot be separated from learning mathematics. According to Carpenter in (Bahar & June Maker, 2015) states that teaching problem solving is important to encourage students to improve and build their own processes over a period of time when they discard some ideas and become aware of further possibilities. In this case solving mathematical problems is a process that uses the strengths and benefits of mathematics in solving problems, which is also a method of finding solutions through the stages of problem solving (Hasbi & Putri, 2018). Problem solving ability is a high-level thinking process, because it involves many processes in it. According to Kuzzle in (Simamora, Saragih, & Hasratuddin, 2018) states that a student's mathematical problem-solving ability can be defined as a student's ability to understand problems, plan problem-solving strategies, carry out the chosen solving strategy, and re- examine problem solving to further make solutions with other means or develop problem solving when students are dealing with math problems.

Based on the 2015 PISA results, Indonesia is ranked 62 out of 72 countries in the field of mathematics with a score of 386 which is still below the OECD average (OECD, 2018). In the same year, the study results showed that among the 49 countries participating in the TIMSS (Trends in International Mathematics and Science Study), the achievement of Indonesian students in mathematics was in the 44th place. The TIMSS research results show that Indonesia is ranked low in ability: 1) understand complex information; (2) theory, analysis, and problem solving; (3) use of tools, procedures, and problem solving; and (4) conducting an investigation (Nur & Palobo, 2018). This shows that the mathematics solving ability of students in Indonesia is still low and the need for more attention.

Based on observations made by the researcher at SMAN 1 Mayong, many students have not been able to solve problems, especially on contextual questions, one of which is derived material. Megariati (2010) states that derivative material is one of the materials that has a very wide scope of application both in mathematics itself and in other branches of science such as in the fields of science, technology, and economics and so on. The ability to solve problems is an important component for solving contextual problems in differential equations or derived functions (Khotimah & Masduki, 2016). One of the factors causing the low ability of students in solving problems on derived material in 11^{th} grade at SMAN 1 Mayong is less of independence of students in learning to solve the questions given by the teacher, students still depend on explanations from the teacher and are less active in finding his own knowledge.

In order to support students' ability to solve problems, it is necessary to strengthen in independent learning. With independent learning, it can motivate students to learn and can make a student continuously seek information in order to improve abilities (Khoo, 2018). Self-directed learning is a learning model that is closely related to learner autonomy. According to Holec in (Huda, 2014) autonomous learners are learners who have the ability to take over their own learning. Someone who can carry out learning activities independently can be said to be a lifelong learner (Malison, 2018). According to Chiang in (Malison, 2018) lifelong learner one of the characteristics is needed by each country. The self-directed learning model applies students to plan and manage learning activities, develop solutions or solve problems personally to acquire knowledge and skills (Abubakar & Arshad, 2015). There are four stages of self-directed learning, namely (1) planning; (2) implementing; (3) monitoring; and (4) evaluating (Breed, 2013).

In independent learning students need to have self-regulated learning. Self-regulated learning can improve student achievement in mathematics help achievement of students in problem solving ability (Mutawah, Thomas & Khine, 2017). Self-regulated learning that is meant is the ability of students to organize themselves in the learning process to achieve goals. According to Wolters (Pintrich, & Karabenick, 2003) self-regulation in learning includes three kinds of strategies items, namely strategies cognitive regulation (Regulation of Cognition), regulatory strategies motivation

(Regulated of Motivation) and regulatory strategy of behavior (Regulated of Behavior). Liu (2016) explains that a person must know the resources he has, the requirements of the task, the time to use strategies, how to solve problems in difficulty, self-regulation , and monitor personal work conditions when involved in tasks so that they can complete the task effectively. The explanation above is supported by findings (Tachie, 2019) which reveals that the use of students' metacognitive skills and strategies, such as task analysis, planning, monitoring, checking and reflection, self and group monitoring skills, reading and writing skills, self-regulation and self-assessment help them in solving math problem.

One of the tools that can help students in achieving mathematical problem solving abilities in self-directed learning with module. Modules can be used to foster students' enthusiasm for learning which are arranged systematically and attractively so that students can use them to gain knowledge, understand problems, control the problem-solving process, and independently examine and generalize problems. Selection of internal characters that are focused on learning design needs to pay attention to the characteristics of teaching materials and students (Hartutik et al., 2017). According to (Telaumbanua, Sinaga, & Surya, 2017) states that modules are student teaching materials that are used independently in mathematics learning which is systematically designed based on a specific curriculum, is arranged relatively briefly and specifically in the form of the smallest learning unit, and is attractively designed which contains a series of well-coordinated activities related to material, media and evaluation so that students are more focused, systematic and can easily learn them to achieve the expected competencies in accordance with the learning objectives .

Based on the description above, this study aims to describe students' mathematical problem solving ability from students' self-regulated learning in self-directed learning with module. Indicators of mathematical problem solving abilities used in this research, namely understanding problem, making problem solving strategy plans, implementing problem solving strategy plans, and looking back.

METHODS

Type of this research used is mixed method which combines quantitative and qualitative research (Sugiyono, 2018). In the first stage, quantitative data collection and analysis is carried out, followed by the collection and analysis of qualitative data, which is built on the initial results of quantitative data. The design of this research is sequential explanatory. The quantitative research method in this study is a pre-experimental design with a one-shot case study model.

The population in this study are all 11th grade students at SMAN 1 Mayong in academic year 2020/2021. The research sample is one class. The method of taking the research subjects was purposive sampling. The research subjects were selected from students' self-regulated learning who were classified into high, moderate, and low groups as well as their problem solving abilities. In addition, the researcher also saw based on the participation of students who were able to solve the mind-set of solving the problem solving ability test in speak. The total research subjects were 7 students.

Quantitative data were obtained from the results of the test of students' mathematical problem-solving abilities with derivative application materials which were used to analyze the quality of self-directed learning with module on problem-solving abilities. Meanwhile, qualitative data were obtained through observation, questionnaires, and interviews which were used to analyze problem solving abilities in terms of students' self-regulated learning in self-directed learning with module.

The quality of learning in this study includes the planning, implementation, and assessment stages. In planning stage if the quality is said learning devices and instruments were tested for validity by obtaining good results minimum criteria. At the implementation stage it is said to be of quality if the results of the learning implementation assessment are at least good. As well as at the stage of assessment, teaching quality said if the average tests the ability of solving mathematical students gain more value from KKM is equal to 68 , the proportion of class students achieve mastery learning is more than 75% and self-regulated learning influence

significant mathematical problem solving ability students.

RESULT AND DISCUSSION

Results of research is divided into two based on the formulation of the problem, namely 1) the quality of learning self-directed learning with module toward mathematical problem solving ability students and 2) describe mathematical problems soling abilities from students' self-regulated learning in self-directed learning with module

The quality of learning includes the planning, implementation and assessment stages. Assessment of the quality of self-directed learning with module. At the assessment planning stage in this study using a 5-scale grading scale.

At the planning stage the results of the validation of the syllabus, lesson plans, modules, tests of students' mathematical problem-solving abilities, students self-regulated learning questionnaires, get an average score of 81.1% with the very good category to use. The highest score was syllabus which got a score of 83.9% while the lowest was the self-regulated learning questionnaire with a score of 76.66%. Therefore, the devices and instruments are suitable to use because they are in the minimal good category. For the results of testing instruments about test of mathematical problem solving than 7 questions have 5 questions for the post-test the ability of solving mathematical students, decision was based on the results of validity, level of difficulty, distinguishing features, reliability and indicators can load the ability of solving mathematical problem students .

At the implementation stage, learning is said to be of quality if the assessment of the implementation of learning gets a good minimum score. This assessment uses a 5-scale grading scale, which is filled out by a researcher. The researcher who assessed were teachers in research schools. The implementation of learning in this study was 5 meetings with an average score of 79.86% with good categories. The minimum score that is obtained is the first meeting, which is getting a score of 55 with a percentage of 73.3% in a good category and the maximum score obtained is 64 with a percentage of 85% with a very good category at the fifth meeting .Therefore, the implementation of learning has already in the good minimum category.

At the assessment stage, an analysis of the UAS for 11^{th} grade students at SMAN 1 Mayong in academic year 2020/2021 was carried out as initial data and the value of the posttest of students' mathematical problem solving abilities. Initial data analysis carried out was the normality test, homogeneity test and average similarity test using SPSS 23.0. Based on the Kolmogorov Smirov test with a level of confidence of 5%, a significance value of $0.2 > 0.05$ was obtained, this indicates that the population is normally distributed. The homogeneity test results obtained a significance value of $0.319 > 0.05$, this shows that the population has the same variants. Meanwhile, the ANOVA test results obtained a significance value of $0.133 > 0.05$, this indicates that the population has the same ability.

In the final data posttest, the problem solving ability was carried out by individual completeness test, proportion test and regression test. With a significant level of 5% and $n = 30$, it is obtained $t_{count} = 5.18 \geq t_{table} = 1.70$ then H_0 is rejected, meaning that the average posttest results of students' mathematical problem solving abilities using the self-directed learning model with module are more than 68. As for the proportion test, obtained $t_{count} = 1.05 \geq t_{table} = 0.174$ then H_0 is rejected, means that the proportion of students who completed learning in the class using the self-directed learning model with module is more than 75%. The results of the regression test using SPSS 23.0 obtained an equation $\hat{Y} = 0{,}91 + 0{,}381\,X$ with a significance value of $.000 < 0.05$, then H_0 is rejected, means that self-regulated learning has a linear relationship with mathematical problem solving abilities or self-regulated learning has a positive effect on mathematical problem solving abilities. Great influence self-regulated learning can be seen from the value of R^2 is 67.4%, the remaining 32.6% is a factor in addition to self-regulated learning that affect students' mathematical problem solving ability. From some explaining above, it can be concluded self-directed learning quality in developing students' mathematical problem solving ability.

Each stage of self-directed learning encourages students to participate actively in understanding the material independently. The use of modules that have been prepared by the teacher in the first stage of self-directed learning, namely planning also increases the active participation of students in understanding the material and develops independent problem solving abilities. In the second stage, self-directed learning, namely implementing online, supported the module, which was used as a source for students to understand the material and develops problem solving abilities. The module used contains material, examples of questions and the solution is based on the pattern steps that are directed according to the indicators of students' mathematical problem solving abilities used in this research. The third and fourth stages of self-directed learning are monitoring and evaluating. Teachers guide students in independent learning and evaluate and confirm student learning outcomes online. Of each phase of the learning model self-directed learning and assignments with self-learning modules as mentoring support students more independent to understand the material so that it can develop students' mathematical problem solving ability. This is also supported by the results of research by Bahri , Zaenuri & Sukestiyarno (2018) which states that self-regulated learning can develop students' mathematical problem solving abilities. In addition , the results of the regression test show that learning independence affects problem solving abilities by 67.4%, this agree with Bayuningsih, Usodo, & Subanti (2017) which states that students' problem-solving abilities are influenced by how students organize themselves which is called self-regulated learning. So, the higher independence learning, the higher a student's learning outcomes are obtained one of which is the achievement of learning outcomes in problem solving capabilities (Vula et al., 2017).

Next is a qualitative analysis of students 'mathematical problem solving abilities from students' self-regulated learning. Students are given a self-regulated learning questionnaire to group students into groups of high, moderate, and low categories. Here are the results of self-regulated learning questionnaires from 30 students are presented in Table 1.

Table 1. Result Self-Regulated Learning Questionnaires

Categories	Many Students
High	8
Moderate	17
Low	5

The results showed that the description mathematical problem solving abilities from students' self-regulated learning diverse. Students with high self-regulated learning are able to achieve 3 indicators of students' mathematical problem solving abilities correctly. However on the fourth cannot able do it optimally. Here is presented example of students work with high self-regulated learning categories on the third indicators on Question 3.

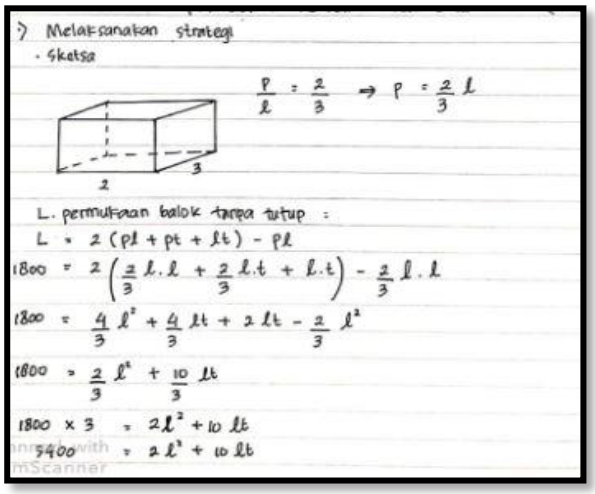

Figure 1. The example of Students Work with High self-regulated learning in implementing problem solving strategic plans

Students with moderate self-regulated learning categories are able to achieve 2 indicators of students' mathematical problem solving abilities correctly. However, on the third and fourth indicators, students in this group have not been able to do it optimally. Here is presented example of students work with moderate self-regulated learning categories on the third indicators on Question 5.

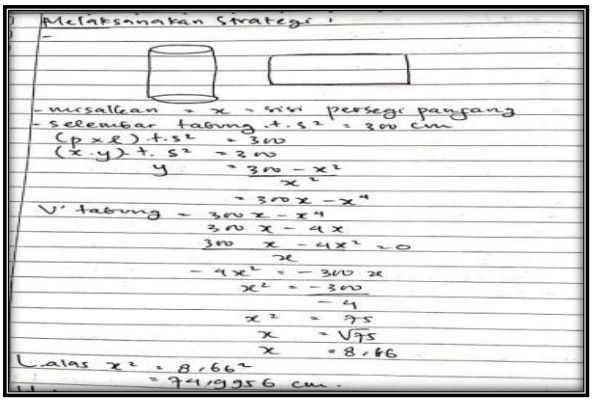

Figure 2. The example of Students Work with Moderate self-regulated learning in implementing problem solving strategic plans

Students with low self-regulated learning have not been able to achieve the four indicators of mathematical problem solving abilities optimally. Here is presented example of students work with low self-regulated learning categories on the third indicators on Question 2

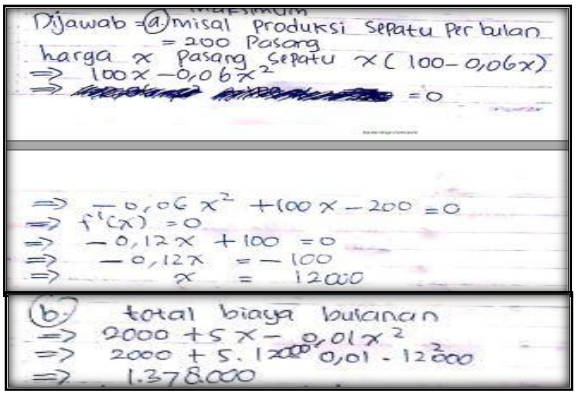

Figure 3. The example of Students Work with Low self-regulated learning in implementing problem-solving strategic plans

In learning students with high self-regulated learning on average can understand the material independently before it is explained by the researcher. This is shown from the independent tasks carried out by students with high study categories. In addition, in learning students in high study groups are also active in discussions and ask questions actively with a researcher. Students in the high self-regulated learning categories have on average high problem solving abilities, indicators of first, second and third mathematical problem solving abilities can be resolved very well (Bayuningsih, Usodo & Subanti 2017).

In the learning of students with moderate self-regulated learning categories, sometimes they can understand the material well but sometimes they cannot understand the material well, this can be seen from the assignments that are done independently before the implementation of learning is classified with the researcher. Some students in this group actively asked questions individually with the researcher, but were less active during classical learning. The results of this study are in line with Bayuningsih, Usodo & Subanti (2017), which states that students with moderate learning independence can only achieve indicators of first and second problem solving abilities.

In learning, students in the low self-regulated learning categories have low learning independence on average. This is indicated by the delay in collecting independent assignments given by the researcher. Students with low self-regulated learning on average need more time than the other two groups of independence to understand the material. In addition, in learning, students in low learning categories are also less active in discussions or less active in asking individually with the researcher. Students in low self-regulated learning categories average have problem solving abilities which lower anyway than group independence of others, students low self-regulated learning did not reach all indicators of the ability of solving mathematical well (Bayuningsih, Usodo & Subanti 2017).

CONCLUSION

Based on the results and discussion, it was found that subjects with high self-regulated learning are able to understand problems, make problem solving strategy plans and implement problem solving strategy plans correctly, but they were less able to carry out the indicators of checking back optimally. Subjects with moderate self-regulated learning are able understand problems, make problem solving strategy plans correctly but less capable in implementing problem solving strategic plans and looking back optimally. Meanwhile, subjects with low self-regulated learning have not been able to achieve understanding problems,

making problem solving strategy plan, and implementing problem solving plans strategy and looking back optimally.

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