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Mathematics Problem-Solving Skill Reviewed from *Self-Regulated Learning* of the Eleventh Graders

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Abstract

This research aims to describe the learners' problem-solving skills reviewed from the self-regulated learning of the eleventh graders. Self-regulated learning in this research did not function as a learning method. It was instead a self-planning and monitoring process toward the affective process to solve the academic tasks. The applied method in this research was descriptive qualitative. The data collection techniques in this research were observation, test, questionnaire, and interview. The subjects were determined by the purposive sampling technique. The subject selection resulted in six subjects. Every two subjects were categorized into high, moderate, and low self-regulated learning. The findings showed that (1) the eleventh graders with high self-regulated learning autonomously joined the online learning and had self-confidence in their skills; (2) the moderate-self regulated learners committed a few mistakes while calculating, writing the units, and reflecting their mathematics problem-solving process; (3) the low-self regulated learners had low-mathematics problem-solving skill since they could only apply and adjust the strategy to solve the problems

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INTRODUCTION

Mathematics for schools is mathematics taught in primary and senior education. This mathematics is adjusted to the learners' intellectuals and is grouped into abstract and concrete parts (Kristanti, 2015). Mathematics science will be better for the learners if they could construct it via their previous experience. Therefore, the active participation of learners is important in this learning activity. In this case, learning mathematics is a mindset establishment to understand a correlation between a concept and another concept (Fitri, R., Helma., & Syarifuddin, 2014). NTCM, (Siagian, 2016), applied the standards of mathematics skills. They were such problem-solving, reasoning and proofing, communicating, correcting, and representing skills. These skills must be mastered by the learners.

Mathematics problem-solving skill is an important aspect and becomes the needs of the whole-world mathematics curriculum (Santos-Trigo, 2014). The habituated learners to deal with a learning problem could make them prepare better mentality and to engage the real-world problems (Cahyani & Setyawati, 2016). NTCM, (Lorensia, 2017), states that the focus of mathematics learning at school is to establish the learners' skills to solve problems. It is important because the skill cannot be separated from mathematics learning. The obtained problem-solving skills in mathematics refer to problem-solving skills applied by learners in their daily life. It also has the function to learn mathematics ideas and developing other mathematics skills. The book of George Polya, How to Solve it (Bertelle et al., 2012) explains four stages to solve problems. They are (1) understanding the problems (determining the observed matters), (2) arranging the plan (seeking the connection to obtain ideas for solution), (3) carrying out the plan, and (4) re-checking the completed solution (review and discuss).

The PISA research results showed that Indonesia obtained the 62nd rank from 70 participating countries in the mathematics field. The obtained score was 386, lower than the OECD average score (Schleicher, 2018). Meanwhile, according to the International survey research of TIMSS in 2015, Indonesia obtained the 49th rank from 53 participating countries (Mullis, Martin, Foy, & Hooper, 2015). Based on the International research results, the Indonesian learners' performance to solve problem-solving questions was not maximum (Junaedi, 2012).

Based on the preliminary study conducted in Public Senior High School 1 Purwodadi, the learners' mathematics problem-solving skills were still unknown. The school's teachers had never analyzed the learners' mathematics problem-solving skills. Most learners could not apply the appropriate strategies to solve problems especially within the rational and irrational inequalities of one variable. Thus, it made the learners' mathematics problem-solving skills lower.

According to (Haryati, Suyitno, & Junaedi, 2015), the learners' lower mathematics problem-solving skills occurred since they had not sufficient time to practice the skills. It made them unskilled to manipulate which influenced their mathematics model creations.

Most mathematics teachers agreed with the importance of various factors and decisions as to the main objectives of teaching and require problem-solving skill development (Lester, 2013). Problem-solving skills can be trained by providing opportunities for learners to use their thoughts, develop ideas, find problem solutions, and use their arguments to make decisions (Alba, Chotim & Junaedi, 2013).

An autonomous and skillful person requires training from the educational sector by improving his self-regulated learning (Dinata, Rahzianta, & Zainuddin, 2016) Self-regulated learning or autonomous learning is a careful planning and monitoring process toward the affective process to solve the academic tasks (Hidayati & Listyani, 2011).

Self-regulated learning and problem-solving are two primary concepts for mathematics education. (Fadlelmula, 2015) found that mathematics problem-solving skills and self-regulated learning were two important and interconnected concepts in mathematics education. They also had contributed to mathematics learning to be effective. In this aspect, the self-regulated and mathematics problem-solving skill theories demand some important changes in the current mathematics teaching practices.

(Broadbent & Poon, 2015) States that there is a need to understand how the best learners could apply self-regulated learning to achieve academic success. Schunk (cited in (Ghufron & Suminta, 2017) argues that self-regulated learning occurs systematically. It directs the behaviors and the cognition to join and consider the individuals, to process and integrate knowledge, to repeat information, to develop and maintain the positive learning skill belief, and to anticipate the results of the learning activity.

From the explanation, theoretically, problem-solving skills and self-regulated learning influence each other. They also have important roles to reach the learning objectives. Studies about this topic are still limited. It motivated and became the reason to investigate it.

The problem formulation in this research was - how mathematics problem-solving skills of the eleventh graders were reviewed from self-regulated learning.

METHOD

The applied in this research was descriptive qualitative. This research described a phenomenon with its characteristics. This research emphasized the what question rather than the how and why questions (Nassaji, 2015).

It was carried out in Public Senior High School 1 Purwodadi, odd semester, the academic year 2020/2021. The selected subjects were learners from XI Science 1. It was based on certain considerations (Sugiyono, 2015). They were the subjects as the selected data. The data should represent a range of different individuals in a group. The selected subjects consisted of six graders. Every two graders were grouped in a self-regulated learning category. The subject selection process was done by applying subject-selection criteria. The criteria were (1) the learners had to obtain materials about the rational and irrational inequalities of one variable; (2) they had obtained the mathematics problem-solving skill test results; (3) they met the requirement of self-regulated learning categorizations; and (4) they were selected for their excellent communication skills to facilitate the better investigation.

This research also distributed the self-regulated learning questionnaire, problem-solving skill test, and interview to collect data from various sources. The data collection and the qualitative analysis had the purpose to describe the learners' mathematics problem-solving skills based on the self-regulated learning categories: high, moderate, and low.

RESULTS AND DISCUSSIONS

For the subjects of XI Science, I obtained the self-regulated learning questionnaire to group them based on the high, moderate, and low categories. Here are the results of self-regulated learning, shown in Table 1.

Table 1 The *self-regulated learning* categorization results.

Groups	The numbers of the learners
High	7
Moderate	22
Low	7

The findings showed that various results of the learners' mathematics problem-solving skill descriptions. Seven high-self regulated learning learners obtained various mathematics problem-solving skills. Three learners had high mathematics problem-solving skills. The other two learners had moderate skills while the remaining learners had low skill category. Twenty-two moderate-self regulated learning learners obtained various mathematics problem-solving skills. Ten learners had high mathematics problem-solving skills. The other eleven learners had moderate skills while the one learner had low skill category. Seven low-self regulated learning learners obtained various mathematics problem-solving skills. Two learners had high mathematics problem-solving skills. The other two learners had moderate skills while the remaining learners had low skill category.

The chosen learners as the subjects of the high self-regulated learning category were S-1 and S-2. They had different mathematics problem-solving skills. The test score of S-1 was 88 while S-2 was 100. The findings showed the problem-solving skills of S-1 and S-2 were different for each indicator of mathematics problem-solving skill.

Based on the first indicator - establishing new mathematics science by solving problems, S-1 and S-2 could work on all mathematics problem-solving skill questions. S-1 and S-2 could understand the problems properly. They could write the given and the requested elements correctly.

Based on the second indicator, applying and adjusting the appropriate strategy to solve problems, S-1 had not been excellent to apply the strategy correctly. S-2 could make the strategy correctly, orderly, and excellently. It was based on the mathematics problem-solving skill tests and the interview. S-2 was more excellent to apply the strategy.

Based on the third indicator, the mathematics problem-solving skill, S-1 had difficulties understanding the concept. He was also careless to solve the problems. On the other hand, S-2 could solve the problems orderly and carefully.

Based on the fourth indicator, monitoring and reflecting the mathematics problem-solving process, S-1 could re-check the answer properly and write the conclusion from the problems. On the other hand, S-2 could reflect each question and write the conclusion correctly.

The high self-regulated learning category could meet four indicators properly. It was because they had excellent autonomous learning or self-regulated attitude. Thus, when the class had been changed into online media, they could still obtain excellent achievements. The learners' behaviors in realizing their will did not rely on other people. In this case, the learners still could do the learning activities. They could determine effective learning, finish all tasks excellently, do autonomous learning (Rachmayani, 2014). This finding is in line with (Darma, Firdaus, & Haryadi, 2016). They found higher self-regulated learning led to higher problem-solving skills. Besides that, the high self-regulated learning learners could participate in the learning autonomously. They could also answer the questions confidently while being interviewed. It was also in line with (Alfiana, 2013). They found that self-regulated learning by individuals had higher influences on achievement and vice versa. Besides that, according to Woolfolk (cited in (Kusaeri & Mulhamah, 2016), learners that applied self-regulated learning could recognize themselves and determine the learning ways and vice versa.

The chosen learners as the subjects of the high self-regulated learning category were S-3 and S-4. They had moderate mathematics problem-solving skills. The test score of S-3 was 68 while S-4 was 60. The findings showed the problem-solving skills of S-3 and S-4 were almost similar for each indicator of mathematics problem-solving skill.

Based on the first indicators, S-3 could finish all mathematics problem-solving questions and understand the problems properly. He could write the given and requested elements. On the other hand, S-4 could not complete all questions and understand the problems properly. He could write the given and requested elements correctly.

Based on the second indicator, S-3 and S-4 could adjust the solution-strategy arrangement orderly and completely.

Based on the third indicator, S-3 and S-4 were lack of carrying out the planned strategy and had incorrect calculations.

Based on the fourth indicator, monitoring and reflecting the mathematics problem-solving process, S-3 could re-check the answer properly and write the conclusion from the problems. On the other hand, S-4 did not write and reflect on each question and write the conclusion correctly.

The moderate self-regulated learners performed excellent mathematics problem-solving skills in two indicators. They had a few mistakes to calculate, writing the units, and reflecting on the solution process. From the explanation, the moderate self-regulated learners had lower skills to apply problem-solving and lower self-regulated learning. The learners should have mastered self-regulated learning properly and could have controlled themselves while learning. It was in line with Zimmerman in (Schunk, 2012). He found that self-regulation referred to the systematic individual processes to direct the thoughts, feelings, and actions toward the objectives. Therefore, the learners should have some characteristics to solve problems. According to Han Kim, cited in (Ahghar, 2012), the characteristics of self-regulated learning were (1) learning autonomy, (2) learning efficiency, (3) learning responsibility, and (4) problem-solving skill implementation.

The findings were in line with Zimmerman, cited in (Harahap & Harahap, 2020). He found that excellent self-regulated learning could be described as

processes that encouraged learners' behaviors, cognition, and affection systematically with learning-objective orientation. The findings also showed that the average self-regulated learning of the high learning output learners indicated the criteria of high self-regulated learners. According to Yang, cited in (Mukhid, 2018), the high self-regulated learners tended to learn better so they could improve their learning outcomes.

The chosen learners as the subjects of the low self-regulated learning category were S-5 and S-6. They had moderate mathematics problem-solving skills. The test score of S-5 was 44 while S-4 was 48. The findings showed the problem-solving skills of S-3 and S-4 were almost similar for each indicator of mathematics problem-solving skill.

Based on the first indicator - establishing new mathematics science by solving problems, S-5 and S-6 could not work on all mathematics problem-solving skill questions. S-5 and S-6 could not understand the problems properly. They could not write the given and the requested elements correctly.

Based on the second indicator, S-5 and S-6 could adjust the solution-strategy arrangement orderly and completely. They even could create the solution strategy in two versions.

Based on the third indicator, S-5 was lack of carrying out the planned strategy and had many incorrect calculations. On the other hand, S-6 had a few general mistakes but he could solve the problems orderly.

Based on the fourth indicator, both of them could not re-check their answers and write the conclusion either.

The low self-regulated learners could only achieve one indicator, establishing the new mathematics science from problem-solving. They had low self-regulation to control themselves or to work on the questions because they committed many mistakes. According to Esther and Henk, cited in (Baumiester, 2013), the term of self-regulated learning referred to self-control. It made the individual change by involving his feeling, thought, and behavior. He instructed them in a short period. Besides that, learners with low self-regulated learning categories easily gave up solving problems. They did not have the autonomous character to learn so it made their works uncompleted. It was in line with Robins, cited in (Elfiadi, 2016). He found that the skills referred to individual capacity to carry out a task. It also referred to a skill as a power to do mental activities, such as character and training results. Autonomous learning was influenced by various factors. One of them was self-regulated learning. According to Zimmerman and Martinez Ponds, cited in (Latipah, 2015), learners would obtain better learning outcomes if they realized, had responsibilities, and known how to learn efficiently. (Santrock, 2010) Found that low learning outcome of learners was caused due to lack of motivation, confidence, and spirit to learn.

CONCLUSION

Based on the result and discussion, the descriptions of the learners' mathematics problem-solving skills based on their self-regulation were (1) having excellent autonomous learning attribute, self-confidence, and online learning participation for high self-regulated learners proven with four achieved indicators; (2) having capabilities to calculate, write units, and reflect the mathematics problem-solving process with minor mistakes for moderate self-regulated learners proven with at least three achieved indicators, such as establishing new mathematics science. Unfortunately, they lacked applying and adjusting strategies and solving the problems within mathematics and other learning contexts. (3) the low self-regulated learners only achieved an aspect of mathematics problem-solving skills. It was applying and adjusting the appropriate strategy to solve problems. There was one of them that could achieve three aspects, but he lacked the calculation.

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