Muhtarom

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Analysis of Mathematics Problem-Solving Ability of Junior High School Students in terms of Learning Independence

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Abstract. A description of students' mathematical problem-solving abilities is the goal to be achieved in this study. Six students became research subjects. The research phase was carried out through two phases: the administration of self-sufficiency questionnaires, problem-solving tests, and interviews. Test the credibility of the research data using the triangulation technique of problem-solving test methods and interviews. The study concluded that students with high independence could describe sufficient and necessary conditions of the problem, make connections between information, solve problems appropriately, and re-examine the answers obtained. Students with moderate independence can describe the sufficient and necessary conditions of the problem, make connections between information, are incomplete in solving problems, and cannot re-check their answers. Whereas students who have low independence are unable to describe the sufficient requirements of the problem, are unable to explain information links, are unable to solve problems, and are unable to check the answers they produce.

Keywords: Independence, Mathematical Problem Solving, Problem Solving.

INTRODUCTION

Rarely does a person not face problems in his daily life. Problems have become an integral part of human life, both in social life and education. The existence of problems in life will make humans more advanced and developed in the process of thinking [1], [2]. Therefore, it is not surprising that overcoming problems in one's life becomes very important. Seeing the importance of solving this problem, problem-solving activities become central to learning at the elementary, secondary, and tertiary levels. Problem-solving is simply a process of accepting a problem as a challenge to solve it [3]–[5]. Problem-solving involves accepting a problem as a challenge to solve it. Thus, problem-solving activity is an attempt to find a way out of a difficulty to achieve a goal that cannot be completed immediately [4].

The ability to solve problems is part of the mathematics curriculum. This means that problem-solving cannot be separated from the process of learning mathematics. Problem-solving can help students develop their thinking process skills [1], [5]–[7]. To solve math problems, students need to manage their minds well by utilizing the knowledge they already have, and controlling and reflecting on the process of the results of their thinking because what they think can help them solve problems. Thinking for oneself is related to students' awareness of the ability to develop various possible ways to solve mathematical problems. This understanding is based on the opinion that problem-solving must carry out a sequence of steps to solve the problem [8].

Students must have the ability to solve problems. But the facts show that students cannot yet solve mathematical problems. This is confirmed that only 11.77% of students with problem-solving skills are in the high category; 35.29% of students have moderate problem-solving abilities, and 52.94% have low problem-solving abilities [9]. This further reinforces that mathematical problem-solving skills need to be mastered by students, including problem-solving skills

in Algebra material. Algebra is a mathematical material that is difficult to understand [10]. The results of the Mathematics Assessment Test show that the percentage of solving a system of linear equations graphically, algebraically, and related to solving an approach of linear equations problems is still below 50% of the specified minimum limit. In learning Algebra material, students are often presented with story problems [11]. Solving problems for word problems begins with the formulation of a mathematical model of the given story. Thus, the selection of Algebra material is suitable for use because there are still problems solving problems, so it is hoped that it can assist teachers in training students' mathematical problem-solving skills [3], [4], [12], [13].

If the same math problem is given to several individuals, they may get different responses in solving it. The difference in student independence in learning might bring out individual differences in solving math problems [1]. Learning independence is when students learn without waiting for help from others [2], [14], [15]. Learning independence requires an attitude of initiative, diagnosing learning needs, setting learning goals to be achieved, and the ability to monitor, organize and utilize various sources to achieve the goals that have been set. This is in line with the opinion that independent learning is an active activity driven by internal motivation related to the achievement of a competency [14], [16], [17]. If students have independent learning, they will not give up easily. Students who give up easily have an impact not having the fighting spirit and effort to solve problems, so they cannot achieve the goals set. This description shows that independence is closely related to self-concept, the ability to organize learning activities, and overcome difficulties encountered. Eight indicators for measuring learning independence are described by Badjeber [18]. In this research, student learning independence was grouped into three types, namely high, medium and low independence groups. Based on the description above, the formulation of the problem in this study is how is the ability of students to solve mathematical problems in solving algebraic problems in terms of learning independence?

RESEARCH METHOD

Qualitative research was conducted to answer the research problem formulation. In qualitative research, the researcher is the main instrument [19]–[21]. Retrieval of research data using auxiliary instruments, namely: independent learning questionnaires, problem-solving ability tests, and interview guidelines. The learning independence questionnaire aid instrument is used to categorize student independence. A learning independence questionnaire was given to 33 students. Figure 1 shows the results of grouping the levels of independence of 33 students. The results showed that 6.06% of students had low learning independence of 2 students, 24.24% of students had moderate learning independence of 8 students, and 69.70% of students had high learning independence of 23 students.

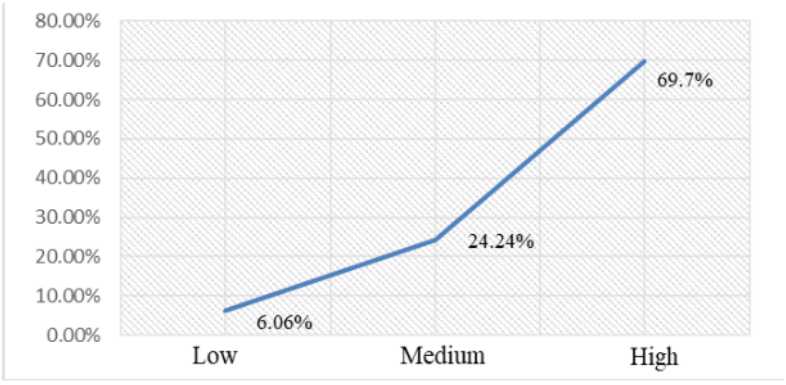

Figure 1. Percentage of Student Learning Independence

Written test auxiliary instruments and interview guidelines were used to measure students' problem-solving abilities. The selection of research subjects used a purposive sampling technique based on the results of the independent learning questionnaire and the opinions of class teachers. The subjects of this study were classified into 3 groups, namely students with high, medium, and low levels of independence. A total of six students consisting of 2 students in each category of learning independence, namely two high learning independence students, two medium

learning independence students, and two low learning independence students. The selected subjects are presented in Table 1.

TABLE 1. Selected Research Subject

No	Subject Code	Learning Independence
1.	SA	High
2.	ZBA	High
3.	DL	Moderate
4.	INH	Moderate
5.	FS	Low
6.	SK	Low

After the research data is collected, it is analyzed using the stages of reduction, presentation and concluding. The method triangulation technique was used to test the validity of the research data [21], [22].

RESULT AND DISCUSSION

Retrieval of research data begins with the implementation of a written test. Interviews were conducted after the students completed the written test. The results of each subject's mathematical problem-solving ability are as follows.

Students' Ability to Solve Math Problems on Subjects with High Independence Abilities

SA and ZBA subjects understand the problem by explaining the known information and what must be completed from the given problem-solving test. Both subjects were able to write down what was known from the problem in the form of a mathematical model. SA and ZBA subjects can plan by developing two plans: elimination and substitution. In this planning stage, the subject connects the information that is known, and what is asked with the knowledge that has been owned so that they can develop a solution plan for the given problem. When solving problems, students connect problem situations with the understanding that students have [1], [2], [16]. At the stage of implementing the problem-solving plan, the SA and ZBA subjects were able to carry out the projects that had been made. The subject is able to use the stages of the process of elimination and substitution in solving the questions given. In addition, the calculations made are also correct. To find a solution, students must use what they have learned and they must develop new mathematical understandings [4], [16], [23]. At the re-checking stage, the two subjects were able to explain how they would re-check their answers. The subject checks the answers by returning the results obtained to the known equations. Both subjects were able to re-check their answers using known information. This is in line with research which states that after students get the results of completion, then students control the process from the beginning of the solution to the final solution [3].

Students' Ability to Solve Math Problems on Subjects with Moderate Independence Abilities

DL and INH subjects understood the problem by explaining the sufficient and necessary conditions to be able to solve the given questions. Terms are sufficiently described from the subject's explanation of all known information. At the same time, the terms need to be described from the student's explanation of what is being asked from the problem. Both subjects were able to write down information that was known in the form of a mathematical model. The DL and INH subjects make the completion plan by connecting with all the information in the problem. Students can understand the problem and identify the stages and arithmetic operations needed to solve the problem [2], [5], [6], [9], [16]. At the stage of carrying out the settlement plan, the two subjects were able to do the calculations correctly even though there were answers that were not detailed. Subjects tend to have still difficulty working on questions with more complicated levels. As is the case in working on questions number 3, 4, and 5, which have a high level of complexity than questions number 1 and 2, the subject tends to experience errors in making calculations. The cause of students' weak ability to solve problems is that students are not used to doing the problem-solving process correctly [9].

At the stage of re-checking the answers, both subjects were able to believe the correctness of their answers. The subject re-checked the answers by returning the results obtained to the known equations. This is in line with Phonapichat's [24], which states that to re-examine the answers received, students look for compatibility between the solution and what is known by returning the results they get to what is known. However, for questions with a more complicated level, the subject still has difficulty determining how to re-check the answers. This is because students still experience errors during the calculation process.

Students' Ability to Solve Math Problems on Subjects with Low Independence Abilities

FS subjects and SK subjects were less able to understand the problem well. The two subjects were less able to determine the sufficient and necessary conditions to be able to complete problem-solving. The condition is enough to be used when the subject writes down what is known from the problem. Meanwhile, the conditions need to be used when students write down what is asked of the questions. At this step, the two subjects tend to have difficulty in determining the adequacy of the conditions needed to solve the problem. The subject has not been able to write down what is known from the problem in the form of a mathematical model. Students can describe what is known and what is being asked but do not understand some of the sentences in the questions. Utami [5] expressed the opinion that students have less ability to process information in one or all of the domains of mathematics.

When planning how to solve the problem, the two subjects could not plan the problem-solving properly. The two subjects could not precisely explain the relationship between what was known and what was asked in the question. This situation is in accordance with the research results that many students find it difficult to analyze the facts in the problem to be associated with relevant mathematical concepts, so students transform the problem incorrectly into a mathematical model [1], [2], [6], [8], [9]. The two subjects could not write it down precisely in writing the method to complete the solution. The subject is wrong in choosing the formula or concept to solve the problem. In the step of carrying out the problem-solving plan, the FS subject and SK subject could not carry it out correctly and precisely. This is because, from the initial understanding of the problem to the planning of problem-solving, the students did not carry it out correctly. At this stage, the two subjects could not make a mathematical model based on the data in the questions. Nizaruddin et al [25] stated that students incorrectly changed the information provided into mathematical expressions because students ignored the intent of the questions. As a result, the subject cannot provide answers correctly. The steps taken did not lead to a solution. Subjects were unable to write down their way of checking back answers. The two subjects also could not make the correct conclusions because they could not perform the calculations correctly. This is also in line with Phonapichat's research [24] which states that when students do not understand a problem, they are most likely to guess without a mathematical thinking process, cannot guess without using a mathematical thinking process, cannot find what to assume, what information must be completed from problems and difficulties in understanding the keywords that appear in the problem so they cannot interpret them as symbols.

CONCLUSION

Students' mathematical problem-solving abilities on subjects with high independence are being able to understand problems well, being able to plan ways of solving them even though they are not so detailed, being able to use the steps correctly, and being skilled in algorithms and being precise in answering questions and being able to check their answers again with use the elements known in the problem. Students' mathematical problem-solving abilities on subjects with moderate independence are being able to understand problems well, being able to plan ways of solving them, being less able to use the steps correctly and being skilled in algorithms and being precise in answering questions, and being less able to re-check their answers using elements that known in question. Students' mathematical problem-solving abilities in subjects with low independence are unable to understand the problem correctly, unable to plan a solution plan, unable to use the steps correctly are not skilled in algorithms and are not precise in answering questions, and unable to check to reconsider their answers using elements known to the problem.

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