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Analysis of Students' Problem-Solving Ability in Solving Science (Physics) Problems in Work Materials and Simple Aircraft Class VIII MTsN 2 Trenggalek

Siti Fatimah[1], Husni Cahyadi Kurniawan[1],*), Ambar Sari[1)]

[1)]*Tadris Fisika UIN Sayyid Ali Rahmatullah Tulungagung*, Indonesia

*E-mail Correspondence: huznie.kurniawan@gmail.com

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Abstract

This study aims to describe students' problem-solving abilities and percentages in solving science (physics) problems in Work materials and simple aircraft class VIII MTsN 2 Trenggalek. This research uses a qualitative approach with a descriptive type of research. The data collection techniques used are tests and interviews. The data analysis includes 3 stages: data reduction, data presentation, and concluding. The results of the research on students' problem-solving ability are based on the stages of the Polya model: (1) High-ability students have been able to meet all indicators of the Polya problem-solving stages by 82.99% in the very high category. (2) Moderately capable students are already able to meet all indicators of the problem-solving stages for Work questions but are still less capable in simple aircraft questions, with a percentage of 64.58% being in the high category. (3) Low-ability students have not been able to meet all the indicators of the problem-solving stage, with 15.42% being in the deficient category. Students cannot understand problems, draw up plans, execute plans, and look back. The reason is that students do not understand the material clearly, which impacts their ability to solve problems. The research showed that students' problem-solving ability is in a suitable category with a percentage of 54.33%. The stage of understanding the problem includes the stages the student can achieve. Students are still underprivileged in the following three stages: drawing up a plan, implementing a plan, and looking back. Students still have difficulty determining the right strategy to solve problems in Work and simple aircraft questions.

INTRODUCTION

The fundamental competencies of science learning in the 2013 curriculum are "students are expected to be able to understand the concepts and principles of science and their interrelationships and be applied in solving problems in life" [1]. Similarly, physics is one of the materials in science. Based on the 2013 curriculum, besides being a provider of knowledge, physics is also taught as a vehicle to solve problems in everyday life[2]. In addition, according to Wals, learning physics can create human beings who can solve their knowledge and understanding of everyday situations [3]. Success and effectiveness in learning physics can be seen in problem-solving abilities and changes in student learning achievement [4].

Students' problem-solving ability in doing physics problems is still relatively low based on the facts of the research results. The results of research on problem-solving ability on physics questions at SMPN 1 Banyubiru, 68.97% of students are still below the minimum completion criteria (KKM) on vibration, wave and sound materials [5]. The following fact from the results of the study on class

XI science students of SMAN 1 Sungai Geringging, Padang Pariaman Regency, shows students' ability to solve physics problems in parabolic motion material in the category is unsatisfactory[6].

Alamsyah's research shows students' difficulties in learning Work materials when solving problems [7]. These difficulties include (1) students do not know the formula that corresponds to the problem because they do not understand the concept of Work, (2) students feeling confused about the form of the problem presented in the question, (3) Many students have encountered mistakes in doing calculations. Furthermore, students' ability to solve simple aircraft questions is still low, as evidenced by the test results of class VIII MTs Alhidayah Kendal Ngawi students, most of whom are still below 50%[6].

Learning students must be trained to solve the problems encountered [8]. One of the appropriate actions is to teach students to solve physics problems using the stages of the Polya model. The set of solving the Polya model problem is a particular procedure by providing instructions in the form of questions or commands on a series of problem-solving steps to solve a problem [9]. The framework is neatly and systematically arranged so that it can help students solve complex problems is an advantage of Polya's problem-solving model [9]. According to Polya, the stages of problem-solving include: (1) understanding the problem, (2) making a resolution plan, (3) implementing the plan, and (4) looking back [10].

Based on the description, the analysis of students' problem-solving abilities is well-founded enough to be carried out at the high school level. This study aims to describe students' problem-solving ability and percentage in solving science (physics) problems in Work materials and simple aircraft class VIII MTsN 2 Trenggalek.

RESEARCH METHODS

This research uses a qualitative approach, namely the phenomenological study of students' ability to solve problems in solving Work problems and simple aircraft. The subjects of the study were 29 students of class VIII D. Research location in MTsN 2 Trenggalek.

This study uses qualitative and quantitative data types. The data collected are descriptive qualitative, that is, the actual explanation of students in solving problems with the Polya model. As for quantitative data in the percentage of students for each stage of Polya. Data collection techniques through tests and interviews. The problem-solving ability test consists of 4 essay questions with details of questions 1 and 2 about Work materials and questions 3 and 4 about simple aircraft materials. Interviews were conducted with 6 students, with 2 students each at high, medium, and low proficiency.

The data is analyzed through the stages of data reduction, data presentation, and conclusion drawing, which is Miles and Huberman's model. Data processing techniques are based on scoring and percentage guidelines, and then the results are described.

1. Score the stages of solving the Polya model

Table 1. Pedoman Penskoran

No.	Stages	Description	Score
1.	Understanding problems	Not writing down known elements and asking problems in physics problems	0
		Not writing down known elements and asking problems in physics problems	1
		Writing down elements that are known and asked in physics questions but are not quite right	2
		Correctly write down most of the known and asked elements in physics questions	3
		Write down what is known and asked in the question correctly	4

2.	Devising a plan	I didn't write down physics formulas at all	0
		Incorrectly writing the correct physics formulas in solving problems	1
		Writing down physics formulas in solving problems but not quite right	2
		Write down most of the exact physics formulas to solve the problem correctly	3
		Writing down the correct physics formulas in solving problems correctly	4
3.	Carrying out the plan	Didn't write down troubleshooting steps at all	0
		Incorrectly write down troubleshooting steps	1
		Write down the completion steps but not quite right	2
		Correctly write down most of the problem-solving steps in physics problems	3
		Correctly write down the steps for solving problems in physics problems	4
4.	Looking back	Did not answer at all or did not write down a conclusion	0
		Giving the wrong answer or writing down the conclusion	1
		Answering the element that is asked but not quite right	2
		Answering most of the elements asked correctly	3
		Answering the element being asked correctly	4

2. The final scores of the four questions at each stage are calculated using the press. (1)[11].

$$NA_i = \frac{Q_i \times 100}{E_i} \qquad (1)$$

3. Furthermore, the grades obtained are categorized according to the student's ability level [11]

Table 1. Student ability level guidelines

No	Scores	Capability Categories
1	$0 \leq$ TKS ≤ 60	Low
2	$60 <$ TKS ≤ 75	Medium
3	$75 <$ TKS ≤ 100	High

4. Students' problem-solving ability can be measured using percentage description analysis, according to Irawati in the press. (2).[12]

$$\%Score = \frac{student\ average\ score}{Maximum\ student\ score} \times 100\% \qquad (2)$$

5. An extensive categorization of the percentage of each student Polya stage is found in table 2 below:[13]

Table 3. Benchmark for Categorizing Problem-Solving Ability Test Results

Percentage (%)	Category
0-20	Very Low
21-40	Low
41-60	Enough
61-80	High
81-100	Very High

RESULTS AND DISCUSSION

The research results showed that students' problem-solving ability is in the excellent category, with a large percentage of 54.33%. The problem-solving ability test results show that some students are less able to meet all indicators of the problem-solving stage. The overall results of the questions can be seen in Table 3 below.

Table 4. Percentage of Student Problem-Solving Ability

No.	Stages of Solving the Polya Model Problem	Student Ability Level			The average percentage of the problem-solving ability of all students
		High	Medium	Low	
1.	Understanding the Problem	89,15%	67,96%	25,75%	60,95%
2.	Drawing Up a Plan	81,87%	61,56%	10,75%	51,39%
3.	Executing the Plan	80,79%	66,40%	14,06%	53,75%
4.	Looking Back	80,18%	62,49%	11,12%	51,26%
Average Percentage of Students' Problem-Solving Ability		82,99%	64,58%	15,42%	54,33%

Table 3 shows that at the stage of understanding the problem, high-ability students are in the very high category of 89.15%. Students have been able to identify issues in simple Work and aircraft questions by writing down the elements known and asked in the questions. Polya's opinion is that "at the stage of understanding the problem, the student can determine with observance what is known and what is asked [11]. High-skilled students can meet all the indicators of the following three stages of problem-solving with a percentage of 81.87% at the stage of drawing up a plan, 80.79% when executing a plan, and 80.18% at the scene of hindsight.

Moderately capable students can meet the indicators of the problem-solving stages with a large percentage of 64.58% which is in the high category of overall questions and problem-solving sets. Students have been able to identify problems, draw up plans, carry out programs and re-examine the answers obtained, especially on Work material questions, while for simple aircraft materials, students are still less able to make plans. Students are less able to write down precise physics equations with problems because students do not understand the material and still have difficulty remembering the correct formulas to solve problems. Capable students struggle to turn problems into mathematical form and solve them[14].

Low-ability students have not been able to meet all the indicators of the problem-solving stage with a percentage of 15.42%, which is in the deficient category. Students have not understood problems in Work and simple aircraft questions. Students stated that they did not understand the material because it was only a glimpse of the delivery without examples of issues and how to solve them. Low-skilled students do not understand the problem. Students have not been able to determine the physics equations corresponding to the situation in all matters of Work material and simple planes. Students will have difficulty making a solution plan to solve the problem if they have difficulty describing physics problems[15]. Students have not been able to substitute the known magnitude values into physics equations and have not been able to perform mathematical calculations, so the

correct results are not obtained. Students have difficulty executing plans when students are already having difficulty in planning those solutions[15]. Students have not been able to check every step of completion and units and have not been able to make conclusions for all questions. Students cannot solve problems properly and appropriately when they cannot find solutions to problems in difficulties [14].

Based on the results of the student's problem-solving ability test, the percentage can be known next. Based on the ratio of the final score of the questions tested from each stage of solving the Polya model problem, the results obtained by students can be seen in the diagram below.

1. Highly Capable Students

The percentage of the problem-solving ability of competent students is presented in the following diagram.

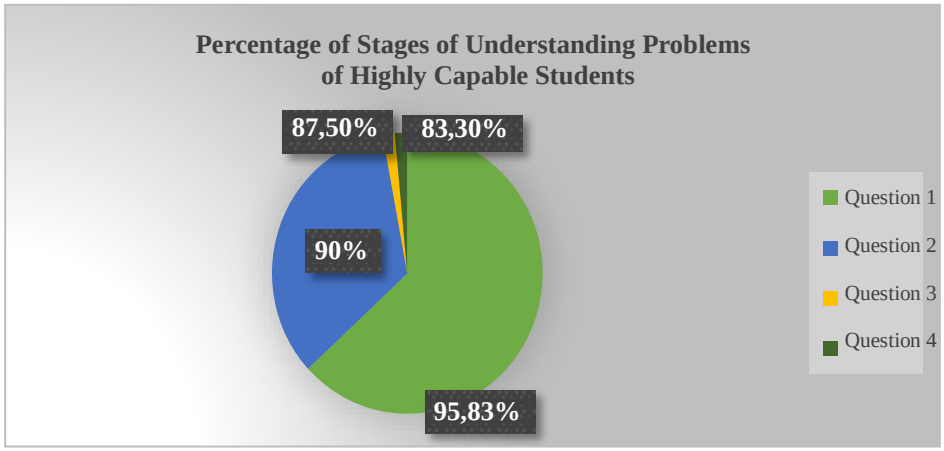

Figure 1. Percentage Diagram of the Stage of Understanding the Problem of a Highly Capable Student

Figure 1 shows that students with high abilities at the stage of understanding problems are in the very high category for all questions, with percentages of 95.83%, 90%, 87.5%, and 83.3%. That means students with high abilities can meet the indicators of understanding problems in simple Work and aircraft questions, including writing down the amount and units known and asked in the questions.

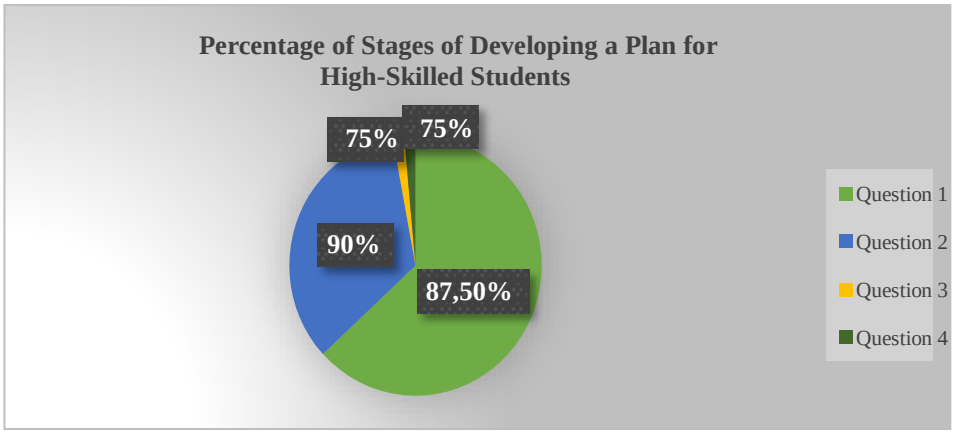

Figure 2. Stage Percentage Diagram of Planning a High-Skilled Student Plan

Based on Figure 2, students with high abilities at the planning stage are in the very high category for questions 1 and 2 with a percentage of 87.5% and 90%, and for questions 3 and 4, students with high abilities are in the high category with a rate of 75%. That means students can meet their indicators, namely, writing down the correct physics equations with the questions.

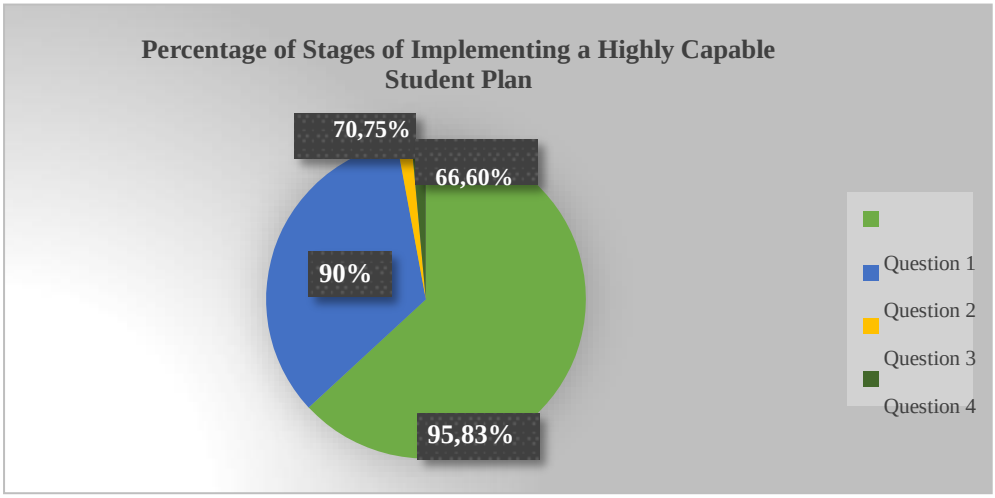

Figure 3. Stage Percentage Diagram of Executing a High-Skilled Student Plan

Based on Figure 3, students with high abilities at the stage of implementing plan questions 1 and 2 are in the very high category with percentages of 95.83% and 90%. For questions 3 and 4, students with high abilities are in the high sort, with rates of 70.75% and 66.6%, respectively. That shows students can fulfil their indicators, substituting known values into physics equations and performing mathematical calculations.

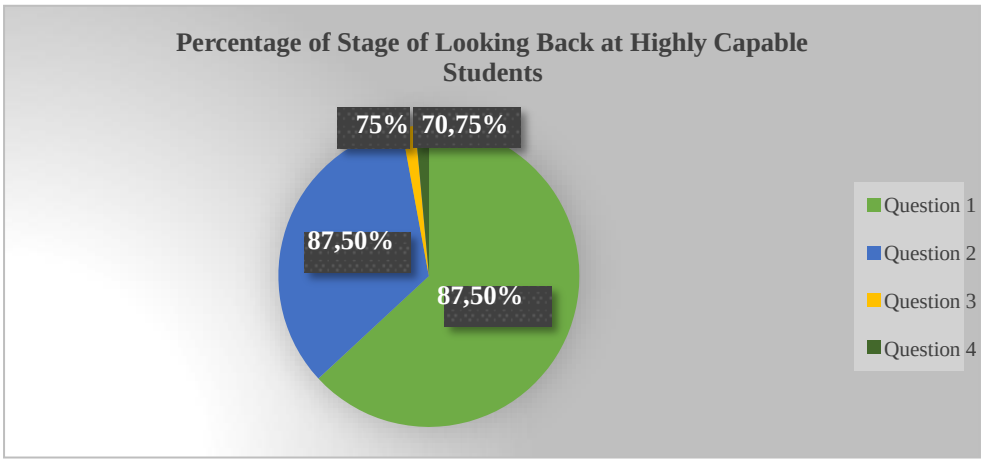

Figure 4. High-Skilled Student Re-Looking Stage Percentage Chart

Based on Figure 4. Above, students with high abilities at the stage of looking back at questions 1 and 2 are in the very high category with a percentage of 87.5%. Questions 3 and 4 are in the high sort, with rates of 75% and 70.75%. That shows students can meet the indicators of the re-viewing stage, such as checking the completion steps, matching units, and making conclusions from the results of solving the problem.

2. Moderately Capable Students

The percentage of the problem-solving ability of capable students is presented in the following diagram.

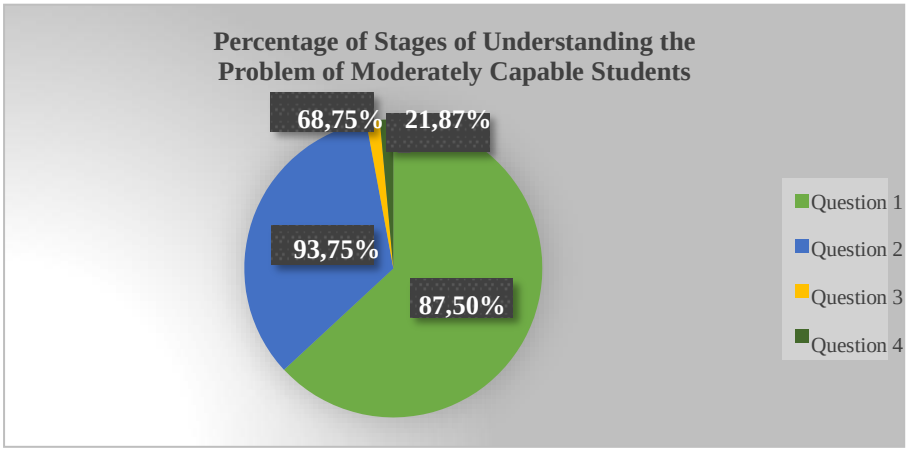

Figure 5. Percentage Diagram of the Stage of Understanding the Problem of Moderately Capable Students

Figure 5 shows that at the stage of understanding the problem, students with moderate ability are in the very high category for questions 1 and 2, with percentages of 87.5% and 93.75%. Question 3 is in the high class, with a rate of 68.75%. That means students can meet their indicators. While in question 4, students are in a low category with a percentage of 21.87%. Students can still not meet indicators, such as not being precise in writing down what is known or asking simple aircraft material questions.

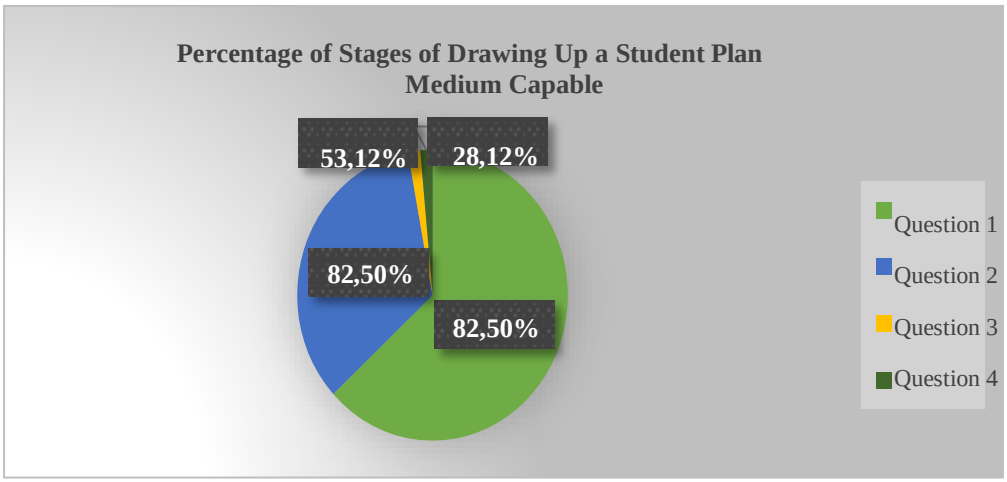

Figure 6. Stage Percentage Diagram of Planning Medium-Skilled Students

Based on Figure 6, students with moderate abilities are in the excellent category for preparing plans for questions 1 and 2, with a percentage of 82.5%. That means students can make a plan, namely writing down the correct physics equations with the problem. Meanwhile, question 3 is in a suitable category with a percentage of 53.12%, which means that students are less able to make plans. Then in question 4, students are in a low sort with a rate of 28.12%, which means that students are still not able to draw up the right plan with the problems in the questions.

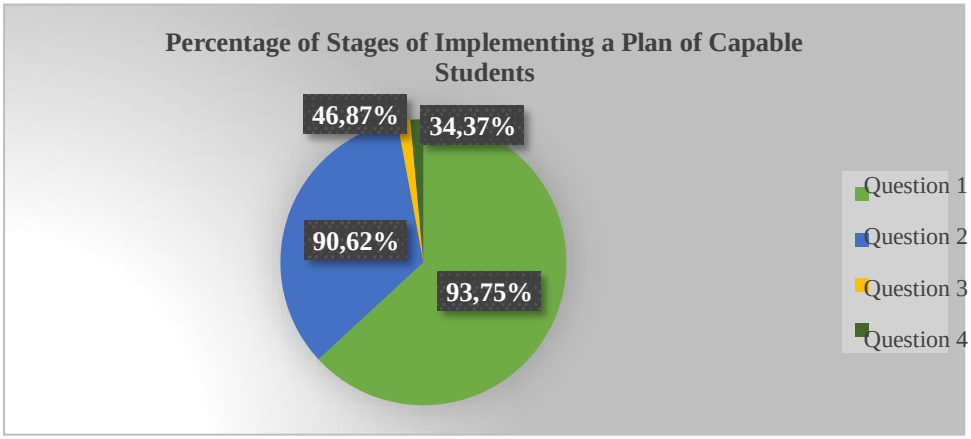

Figure 7. Stage Percentage Diagram of Executing a Medium Ability Student Plan

Based on Figure 4.23, students with moderate ability are in the very high category, with percentages of 93.75% and 90.62% for the stage of implementing plan questions 1 and 2, which means that students are already capable of completing the steps. Then for question 3, it is in a suitable category with a percentage of 46.87%, which means that students are less able to meet the indicators. Meanwhile, question 4, namely simple aircraft material, is in the low category with a percentage of 34.37%, which means that students have not been able to meet the indicators.

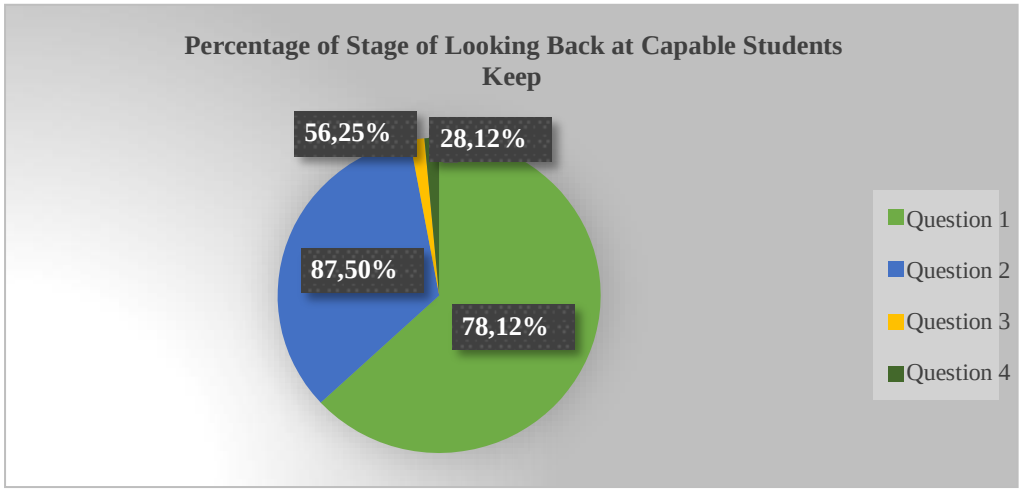

Figure 8. Stage Percentage Chart Looking Back at Moderately Capable Students

Based on Figure 8, students with moderate abilities are in the high and very high categories with percentages of 78.12% and 87.5% for the stage of looking back at questions 1 and 2, which means that students are already capable of meeting the indicators. Then for question 3, it is in a suitable category with a percentage of 56.25%, which means that students are less able to meet the indicators. And in question 4, students are in a low category with a percentage of 28.12%, which means that students have not been able to check the completion steps and units and make conclusions.

3. Low-Ability Students

The percentage of the problem-solving ability of low-ability students is presented in the following diagram.

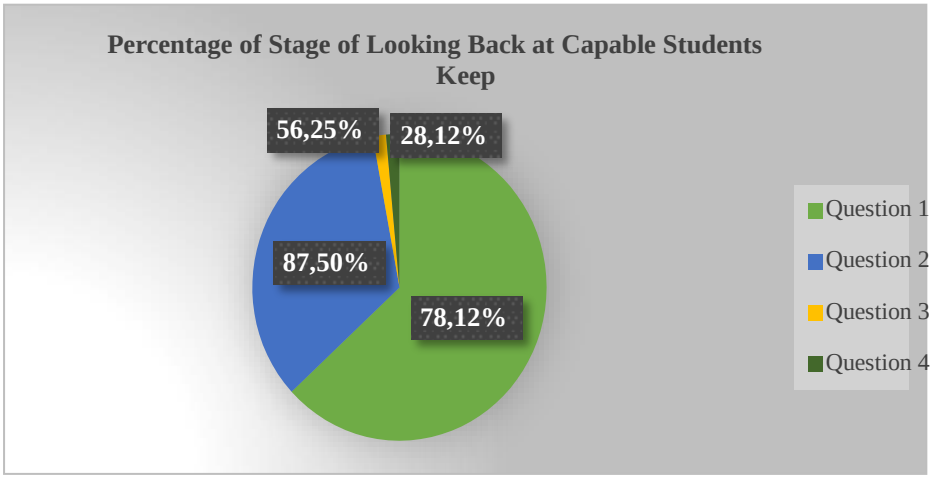

Figure 9. Low-Ability Student Problem Understand Stage Percentage Diagram

Figure 9 shows that students with low abilities are in the high category for the stage of understanding the problem of question 1 with a percentage of 65%, which means that students are still able to meet the indicators. However, for questions 2, 3, and 4, students are in the deficient categories with percentages of 35%, 1.5%, and 1.5%. That means students cannot understand the problems in the questions.

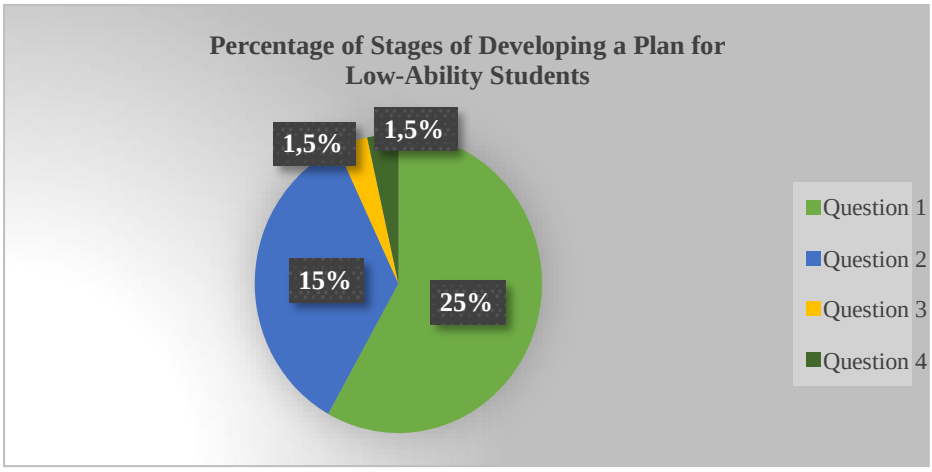

Figure 10. Low-Ability Student Plan Stage Percentage Diagram

Based on Figure 10, students with low ability are in the low category for the stage of preparing a plan for question 1 with a percentage of 25% and are in the deficient category for the set of preparing a plan for questions 2, 3, and 4 with rates of 15%, 1.5%, and 1.5%, which means that students are very unable to compile the right plan to solve problems in the problem.

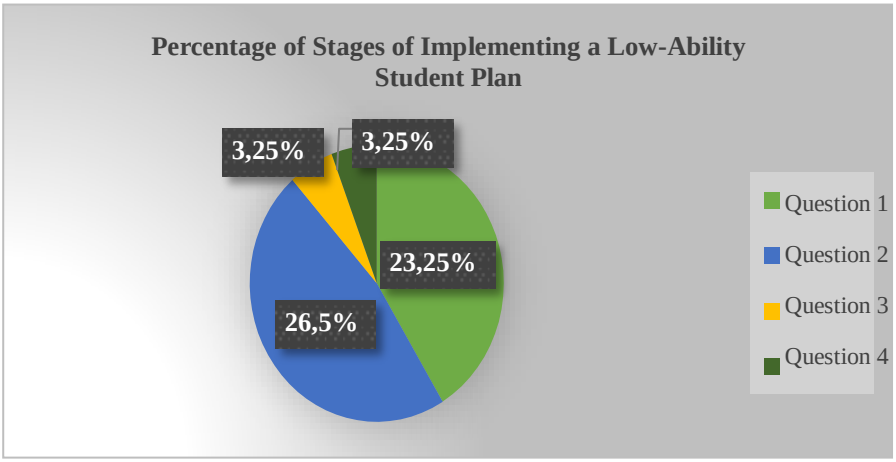

Figure 11. Low-Ability Student Plan Implementation Stage Percentage Diagram

Based on Figure 11, students with low abilities at the plan implementation stage are in a low category, namely in questions 1 and 2 with percentages of 23.25% and 26.5%, and are in the low order in questions 3 and 4 with a level of 3.25%. That shows students cannot complete the proper steps to solve the problem.

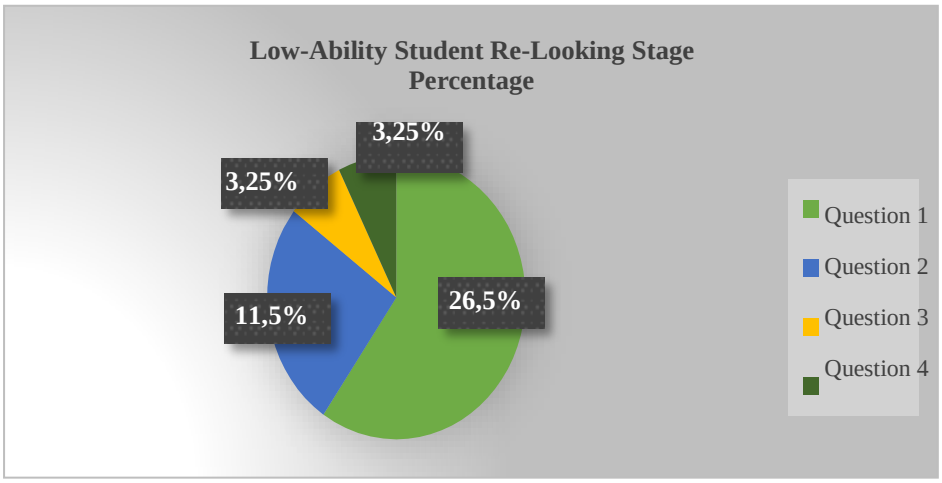

Figure 12. Low-Ability Student Re-Looking Stage Percentage Chart

Based on Figure 12, students with low ability are in a common category with a percentage of 26.5% for the stage of looking back at question 1. Then, questions 2, 3, and 4 are in the shallow category with rates of 11.5%, 3.25%, and 3.25%. That means students cannot examine every step of the solution and units and make conclusions about the problem.

CONCLUSION

The research results at MTsN 2 Trenggalek showed that students' problem-solving ability is in the excellent category, with a large percentage of 54.33%. The stage of understanding the problem includes the steps that the student can achieve. Students are still underprivileged in the following three phases: drawing up a plan, implementing a plan, and looking back. Students still have difficulty determining the right strategy to solve problems in Work and simple aircraft questions. Students have difficulty choosing the right physics equations with the problem, so they also have difficulty completing the steps of solving them. The results obtained are ultimately not quite right. The stage of looking back at students also has a problem in examining their efforts, results, and units because they have not understood correctly, starting from what is known and asked, then the exact physics equations, as well as the steps for solving them.

Therefore, an appropriate learning model and method are needed to train students' problem-solving skills in problems, especially physics, to obtain better problem-solving ability.

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