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DESCRIPTION OF STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITY IN THE TOPIC OF SETTING UP EQUATIONS IN THE CAMBRIDGE CURRICULUM

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ABSTRACT

Mathematical problem-solving is a crucial ability that needs to be developed to prepare students to face the challenges of the 21st century. The aim of this research is to describe the mathematical problem-solving abilities of high school students in the Setting Up Equations topic within the Cambridge Curriculum schools. This research used descriptive qualitative approach. The sample for this research was taken using purposive sampling technique, consisting of 23 students from the 10th grade of Semesta Bilingual School Semarang. Data were obtained through test technique, then scoring was conducted to gather percentages at each stage, followed by an averaging process for the final interpretation of students' mathematical problem-solving abilities. The instrument used has been well validated and consists of 5 contextual questions in the form of essay questions. The results obtained were that 74% of students understand the problem, 67% can devise a plan, 78% can carry out the plan, and 4% can look back. The average final percentage of students' abilities was 56%, categorized as medium. It is concluded that students' mathematical problem-solving abilities are still considered medium, indicating the need for improvement efforts.

KEYWORDS *Equations, Problem-solving, Cambridge*

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INTRODUCTION

Problems in everyday life lead every human being to be able to solve these problems coherently and well. In mathematics, problem solving skills are an important consideration for students to master. In line with the competencies in Permendikbud No. 21 of 2016 concerning Content Standards for Primary and Secondary Education states that one of the competencies of learning mathematics is not giving up easily in solving problems. Students can solve problems, gain experience, use knowledge and skills for everyday life. (Elita *et al.*, 2019). By understanding the flow of problem solving in mathematics, students gain systematic thinking processes, consistency, perseverance, curiosity, and confidence in unfamiliar conditions that they will face outside of math class (NCTM 2000). (NCTM, 2000). Problem solving is an activity that demands adequate cognitive knowledge, skills, and methods, as well as a systematic approach to solving a problem. (Mahanal et al. 2022).. Mathematical problem solving ability is a person's ability to solve non-routine mathematical problems in the form of textual and contextual mathematical questions that can measure students' ability to solve problems. (Amam, 2017). Students' mathematical problem solving ability is the ability to solve mathematical problems using literal, inferential, and critical interpretation of texts (Hijada and Dela Cruz 2017). (Hijada and Dela Cruz 2022).. Mathematical problem solving skills are necessary to prepare students to face the challenges of the 21st century. (Funke, Fischer, and Holt 2018).. The goal of 21st century skills is to understand, practice, and adapt methods to everyday life situations (Szabo et al. 2020). (Szabo *et al.*, 2020).

Based on the background that has been described, a problem can be formulated in the form of "How is the mathematical problem solving ability of high school students on *Setting Up Equations* material on the Cambridge Curriculum?" with the research objective of describing the mathematical problem solving ability of high school students on *Setting Up Equations* material on the Cambridge curriculum in the form of contextual questions with stages of problem solving ability. The stages of mathematical problem solving skills used in this study are according to Polya 1985). (Polya, 1985):

Table 1. Stages of Problem Solving Ability

Stages	Indicator
Understanding Problems	Students are able to interpret what they know by writing the information coherently in their own language.
Devising a Plan	Students can write a mathematical model or memorization from the information obtained at the stage of understanding the problem and or write a good strategy with the appropriate sentence or formula.
Carrying Out the Plan	Students can substitute known data into the formula or strategy that has been written; students can carry out the calculations needed to support the answer to the problem correctly; and students can write the solution steps systematically and correctly.

Looking Back	Students can check their work by writing the working strategy in their own language and can conclude the results of their work.

RESEARCH METHOD

This research uses a combination of quantitative and qualitative *methods* (*mixed method*). The combination method is defined as a method that combines quantitative methods and qualitative methods to be used together in a study so as to obtain comprehensive, valid, reliable, and objective data. (Sugiyono, 2016). This research design uses the *Sequential Explanatory* design type. *Sequential Explanatory* design is a combination of quantitative and qualitative research carried out sequentially, in the first stage of quantitative data collection and analysis and then continued data collection and qualitative analysis in the second stage. The instrument used is in the form of 5 problem solving skills questions, each of which consists of 4 stages of problem solving based on Polya's theory, namely understanding the problem, determining the strategy, carrying out the strategy, and checking back. This study uses instruments that have been validated by 3 expert validators and tested for reliability. Reliability testing uses the *Alpa Cronbach* formula.

The sampling technique in this study used *simple random sampling* technique. The *simple random sampling* technique is taking sample members from the population randomly without regard to the strata contained in the population. (Sugiyono, 2016). The samples used in this study were two classes, namely classes 10C and 10D. The subjects in this study were 6 students 10C and 6 students 10D SMA Semesta Bilingual Boarding School. Taking 6 students per class as samples based on the classification of *slow learners*, *middle learners*, and *fast learners* categories, namely 2 *slow learners*, 2 *middle learners*, and 2 *fast learners*.

The data collection technique in this study used the provision of expert-validated initial mathematical problem solving ability test instruments in the form of contextual description questions on *setting up equations to solve problems* in the *Cambridge* curriculum. Initial ability data analysis was carried out to determine that the experimental class and control class were in the same state or had the same ability before being given treatment. The initial data analysis in this study includes normality test, homogeneity test, and two mean similarity test with the help of SPSS program.

The results of student work were assessed using an assessment rubric and grouped based on the scores obtained by students. Students are grouped into high, medium, and low ability students based on the student ability grouping table below.

Table 2. Student Ability Grouping

Ability Category	**Score Acquisition**
High	$X \geq 80$
Medium	$65 < X < 80$
Low	$X \leq 65$

The results of the percentage of each stage on each question number are averaged, so that the average ability is obtained. The formula used by researchers

$$P = \frac{f}{N} \times 100\%$$

Where

P : Percentage of Ability Stages
f : Acquisition Score
N : MaximumScore

Table 3. Classification of Mathematical Problem Solving Ability

Percentage	Category
$0\% \leq P < 20\%$	Very low
$20\% \leq P < 40\%$	Low
$40\% \leq P < 60\%$	Medium
$60\% \leq P < 80\%$	High
$80\% \leq P \leq 100\%$	Very High

(Romika and Amalia, 2014)

Based on the classification table of mathematical problem solving ability, the percentage obtained can be categorized based on the class. The categories obtained were then analyzed qualitatively and structured interviews.

RESULT AND DISCUSSION

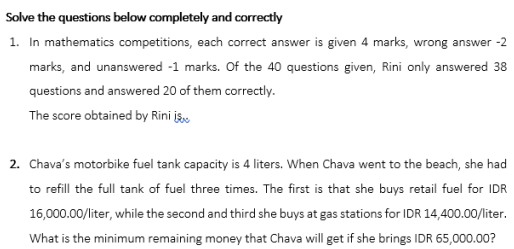
Result

The test instrument in this study is a test of mathematical problem solving ability on Setting Up Equations to Solve Problems material analyzed quantitatively. The following are the results of the analysis summarized in:

Table 4 Summary of Quantitative Analysis Results of Problem Instruments

Testing Name	Results
Expert Validation	Valid (Very Good)
Reliability	Reliable

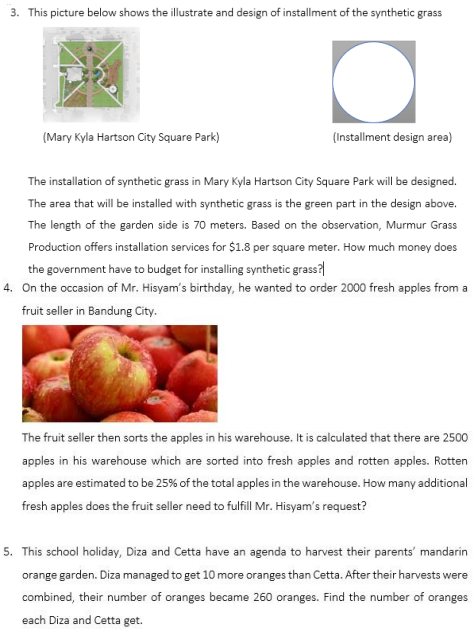
Analysis of the tests carried out obtained the results that the instrument is valid and reliable. Valid means that the instrument can be used to measure students' mathematical problem solving ability. Reliable means that if the instrument is used several times to measure the same object, it will produce the same data. The valid and reliable mathematical problem solving ability instruments were then tested on students. The following is a display of the questions tested on students:



Solve the questions below completely and correctly

1. In mathematics competitions, each correct answer is given 4 marks, wrong answer -2 marks, and unanswered -1 marks. Of the 40 questions given, Rini only answered 38 questions and answered 20 of them correctly.
   The score obtained by Rini is...

2. Chava's motorbike fuel tank capacity is 4 liters. When Chava went to the beach, she had to refill the full tank of fuel three times. The first is that she buys retail fuel for IDR 16,000.00/liter, while the second and third she buys at gas stations for IDR 14,400.00/liter. What is the minimum remaining money that Chava will get if she brings IDR 65,000.00?



3. This picture below shows the illustrate and design of installment of the synthetic grass

(Mary Kyla Hartson City Square Park) (Installment design area)

The installation of synthetic grass in Mary Kyla Hartson City Square Park will be designed. The area that will be installed with synthetic grass is the green part in the design above. The length of the garden side is 70 meters. Based on the observation, Murmur Grass Production offers installation services for $1.8 per square meter. How much money does the government have to budget for installing synthetic grass?

4. On the occasion of Mr. Hisyam's birthday, he wanted to order 2000 fresh apples from a fruit seller in Bandung City.

The fruit seller then sorts the apples in his warehouse. It is calculated that there are 2500 apples in his warehouse which are sorted into fresh apples and rotten apples. Rotten apples are estimated to be 25% of the total apples in the warehouse. How many additional fresh apples does the fruit seller need to fulfill Mr. Hisyam's request?

5. This school holiday, Diza and Cetta have an agenda to harvest their parents' mandarin orange garden. Diza managed to get 10 more oranges than Cetta. After their harvests were combined, their number of oranges became 260 oranges. Find the number of oranges each Diza and Cetta get.

Figure 1 Problem of Initial Mathematical Problem Solving Ability

Students work on the mathematical problem solving ability instrument with the stages of problem solving ability. The instrument was tested on students of SMA Semesta Bilingual Boarding Shool Semarang on February 13, 2024 and scoring was carried out. The following is the student's final score and the category obtained based on the student ability grouping table.

Table 5. Student Ability Grouping Based on Final Score

Research Subject	Score Acquisition	Ability Category
A11	54	Low
A03	56	
S02	58	
S08	58	
A02	58	
S07	60	
S10	60	
S09	66	Medium
S11	66	
A10	66	
S06	68	
A13	68	
S01	70	
S05	70	
A12	72	
A01	76	
S03	78	
A05	78	
A04	80	
A08	80	

S04	82	High
A05	84	
A09	86	
A07	92	

Table 5 presents the results that as many as 7 students have low abilities with a score range of 0-65, 13 students have medium abilities with a score range of 66-79, and 4 students have high abilities with a score of more than 80. Scoring is focused on each stage of ability in each problem number so that it illustrates the ability of students to solve problem solving problems. The following are the results of the percentage of students' abilities at each stage.

Table 6. Average Percentage of Student Ability at Each Stage

Question No.	**Stages of Problem Solving Ability**			
	1st	2nd	3rd	4th
1	75%	72%	89%	0%
2	79%	68%	61%	13%
3	56%	74%	75%	0%
4	71%	72%	78%	8%
5	88%	49%	85%	0%
Average percentage per stage	74%	67%	78%	4%
Category	High	Medium	High	Very Low
Final Average	**56%**			
Category	**Medium**			

Table 6 shows the results of student work at each stage showing that: 74% in the high category for understanding the problem; 67% in the medium category for planning the strategy; 78% in the high category for executing the plan; and 4% in the very low category for checking back. If the average percentage per stage is combined, the final average becomes 56% and students' mathematical problem solving ability is categorized as moderate.

Discussion

In each of the stages in each problem number, the looking back stage is the lowest percentage, namely 4%. This indicates that students do not perform the looking back stage. The results of students' work in solving problems are studied more deeply in each subject according to their ability category:

Students with Low Mathematical Problem Solving Ability

There are 7 students who have low mathematical problem solving ability, namely A11, A03, S02, S08, A02, S07, S10. The percentage of students who have low mathematical problem solving ability is 29% of the total number of students. Two subjects, A03 and S07, were taken to be interviewed and analyzed. The complete description of low mathematical problem solving ability is as follows.

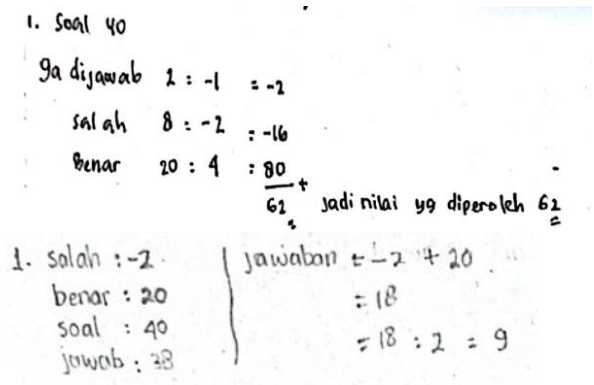


Figure 2 Completion of Problem No. 1 by Subjects A03 and S07

Based on Figure 2, it can be seen that A03's work has not shown mathematical problem solving ability. This is indicated by subject A03 skipping the *Understanding Problems* stage by not writing any information known from the problem. Subject A03 has not been able to carry out the *Devising a Plan* stage by not being able to determine what strategy will be implemented to solve the problem. Subject A03 was not correct in carrying out the *Carrying Out a Plan stage* because the previous stage was missed. *The Looking Back* stage has also not been carried out, it can be seen that there is no proof of the answers obtained. Based on the results of the interview, it was concluded that Subject A03 understood the problem but did not write down the information at the *Understanding Problems* stage but was not able to solve the problem in number 1 properly because he was not careful in calculating many unanswered questions.

Based on Figure 2, it explains that S07 has not shown mathematical problem solving ability. This is indicated by the subject S07 has not been perfect in performing all stages of mathematical problem solving ability. Subject S07 did the *Understanding Problems* stage well because he wrote down what was known but had not done the *Devising a Plan* stage because Subject S07 had not compiled the strategy used to solve the problem. Subject S07 was not able to carry out the *Carrying Out a Plan* stage properly because the previous stages were missed and did not carry out the last stage, namely *Looking Back to* recheck the answers obtained, whether correct or not. Based on the results of the interview, it was concluded that Subject S07 did not understand the problem presented, Subject S07 only wrote down the explicit information in the problem and did not know what strategy to use to solve the problem.

Students with Moderate Mathematical Problem Solving Ability

There were 13 students who had low mathematical problem solving ability, namely S09, S11, A10, S06, A13, S01, S05, A12, A01, S03, A05, A04, and A08. The percentage of students who have low mathematical problem solving ability is 54% of the total number of students. Two subjects, A05 and S03, were taken to be interviewed and analyzed. The full description of low mathematical problem solving ability is as follows.

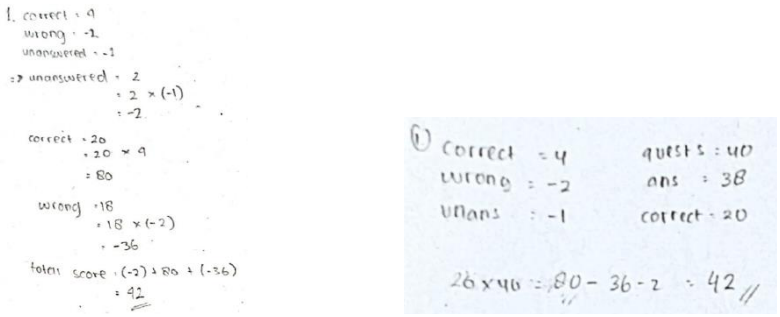


Figure 3 Completion of Problem No. 1 by Subjects A05 and S03

Based on Figure 3, it explains that A05 is good enough to show mathematical problem solving ability. This is indicated by Subject A05 being able to solve the problem with the correct answer but not performing the stages of mathematical problem solving ability coherently. Subject A05 did the *Understanding Problems* stage by writing the known information well. Subject A05 wrote the *Devising a Plan* stage and could solve the problem at the *Carrying Out the Plan* stage correctly. The last stage was skipped, Subject A05 did not re-examine the answers obtained. Based on the interview results, it was concluded that Subject A05 understood what was known, what strategies were known, and knew how to implement the strategy but did not look back at the overall answer.

Based on Figure 3, S03 showed good mathematical problem solving skills. This is indicated by Subject S03 being able to solve problems with correct answers but not performing the stages of mathematical problem solving skills coherently. Subject S03 performed the *Understanding Problems* stage by writing the known information well. Subject S03 did not write the *Devising a Plan stage* but could solve the problem at the *Carrying Out the Plan* stage correctly. The last stage was skipped, Subject S07 did not re-examine the answers obtained. Based on the interview results, it was concluded that Subject S07 understood what was known, what strategies were known, and knew how to implement the strategy but did not recheck.

Students with High Mathematical Problem Solving Ability

There were 4 students who had low mathematical problem solving ability, namely S04, A05, A09, and A07. The percentage of students who have low mathematical problem solving ability is 17% of the total number of students. Two subjects, namely A07 and S04, were taken to be interviewed and analyzed. The full description of low mathematical problem solving ability is as follows.

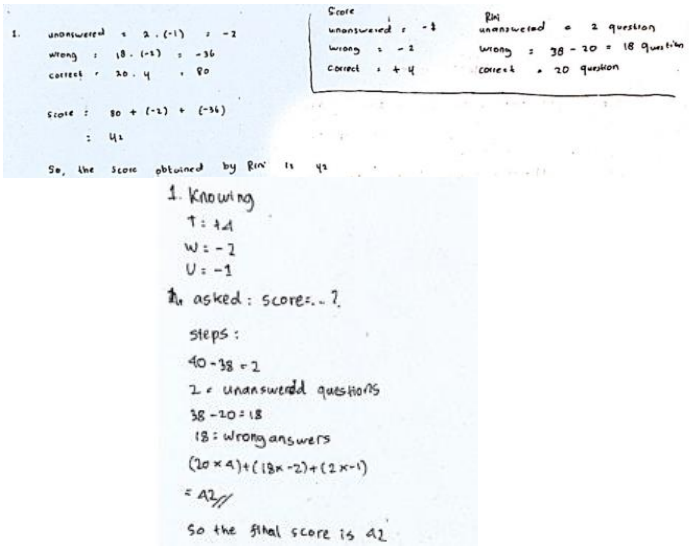


Figure 4 Completion of Problem No. 1 by Subjects A07 and S04

Based on Figure 4, A07 showed excellent mathematical problem solving skills. This is characterized by Subject A07 being able to solve problems with correct answers and perform the stages of mathematical problem solving skills coherently. Based on the results of the interview, it was concluded that Subject A07 understood what was known, what strategies were known, and knew how to implement the strategies and perform back checking.

Based on Figure 4, S04 showed excellent mathematical problem solving skills. This is characterized by Subject A07 being able to solve problems with correct answers and perform the stages of mathematical problem solving skills coherently. Based on the results of the interview, it was concluded that Subject A07 understood what was known, what strategies were known, and knew how to implement the strategy and perform back checking.

Table 7. Summary Results of Comparison of Achievement of Polya's Stages of Mathematical Problem Solving Ability

Stages	**Mathematical Problem Solving Ability**					
	Low		**Medium**		**High**	
	Subject A03	**Subject S07**	**Subject A05**	**Subject S03**	**Subject A07**	**Subject S04**
Understanding the Problems	-	-	√	√	√	√
Devising a Plan	-	-	√	-	√	√
Carrying Out the Plan	√	√	√	√	√	√
Looking Back	-	-	-	-	√	√
Conclusion						
All stages can be mastered by subjects with high category mathematical problem solving ability, contrary to this, subjects with low category mathematical problem solving ability have not been able to solve problems using the stages of mathematical problem solving ability. Subjects in the medium category were only able to master the stages of *Understanding the Problems* and *Carrying Out the Plan.*						

CONCLUSION

Based on the results and discussion at each stage in terms of low, medium, and high ability students, it is found that students are able to understand the problem which means that students answer the problem by writing information, known data with their own sentences. Students are also quite capable of finding strategies from problems, performing calculations systematically and paying attention to strategies, and based on the results of research at this stage is the highest percentage. The rechecking stage is the lowest percentage. This is the cause of the less than optimal results on student answers obtained.

Based on the research that has been conducted at SMA Semesta Bilingual Boarding School Semarang, the percentage data on each stage is obtained, then the errors are analyzed and the final average percentage of problem solving ability is obtained. The final result obtained that the average percentage of problem solving ability based on Polya's stages of high school students is in the moderate category. To further maximize the results, educators need to emphasize concepts and provide many contextual problems, so that mathematics learning becomes meaningful and non-routine, so that students are accustomed to facing difficult problems.

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