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PROBLEM SOLVING ABILITY OF JUNIOR HIGH SCHOOL STUDENTS IN SOLVING HOTS QUESTIONS

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Abstract

In the 21st Century Learning, students are encouraged to be more creative in solving mathematical problems that lead to the High Order Thinking Skill (HOTS) level of thinking. The ability to solve problems is the ability to reason, understand problems, plan strategies, carry out procedures in solving problems, and draw conclusions. This study aimed to analyze students' mathematical problem-solving skills in solving HOTS questions. It is qualitative research with a descriptive method. The subjects of this research were 15 7th grade class students of Public Junior High School 39 Pekanbaru. The data collection method used was a test technique using a test instrument consisting of 2 HOTS questions of mathematical problem-solving ability and using the method of independent interviews to research subjects. The data collected was then analyzed through 3 stages: data reduction, data presentation, and conclusion. The results showed that 3 students had problem-solving skills, 8 had moderate problem-solving skills, and 4 had low problem-solving skills. Based on student self-tests and interviews, the seventh-grade Public Junior High School 39 Pekanbaru students average have moderate mathematical problem-solving abilities. Based on the results of the study it can be concluded that students can answer HOTS questions quite well in arithmetic material. each category of students has abilities and deficiencies in answering HOTS questions. From the results of this study, the teacher's role is very important to familiarize students with solving HOTS questions and creating learning innovations. By familiarizing students with solving problems in learning mathematics, students will not only be able to solve the questions given but also solve problems in everyday life.

Keywords: hots questions, mathematical problem solving ability, social arithmetic

1. Introduction

Mathematics as an aspect of science studied from elementary school students to college students becomes proof that mathematics is an inseparable part of human life. In the (Permendikbud, 2016) Regulation of the Minister of Education and Culture Number 21 of 2016, problem-solving is one of the goals of mathematics education in schools and is essential for students to master. In other words, mathematical problem solving ability is at the core of learning mathematics. If students have problem-solving skills, they will get used to facing and solving problems in everyday life.

Raufany & Solfitri, (2019) said achievement of learning objectives mathematics is reflected in the success of students in understanding mathematics and solving mathematical problems. In Sumartini (2016) said problem-solving is an essential and core process in the mathematics curriculum, which includes methods, procedures, and strategies. According to Hasratuddin in Simatupang & Napitupulu (2020), mathematical problem-solving ability is the expertise to overcome mathematical difficulties by combining concepts and mathematical rules that have been obtained to achieve the desired goal. In line with Rambe & Afri (2020), problem-solving skills are students' skills in solving complex and non-routine problems. Students can make plans to solve these problems and ultimately ensure that they solve environmental and routine problems.

Gagne (Simatupang & Napitupulu, 2020) said high-level intellectual skills could be developed through problem-solving. Problem-solving is the type of learning that is very high among the eight types proposed by Gagne: signal learning, stimulus-response learning, chaining, verbal association, discrimination learning, concept learning, rule learning, and problem-solving. According to Irawati (2018), higher order thinking skills (HOTS) are about goals that must be possessed so that students can be born as highly educated people who are expected to compete and play an active role in the global arena. Therefore, students at school should master and get used to HOTS thinking to think logically (reasonably) and make decisions independently.

According to Shin Yen in Arifin & Retnawati (2015), the main goal of learning in the 21st century is to develop and improve students' thinking to a higher level. Agree with Widodo (2013), with higher order thinking skills, a student can clearly separate ideas or concepts, solve problems, reason well, form hypotheses, and understand complex problems better. Sumartini (2016) in education, student abilities honed through problems, so that students can enhance the competence they have. In the learning process in the classroom, the teacher needs to provide exercises or HOTS-based questions, although it is only a few items. Therefore, it can be concluded that students' HOTS can grow through stages of problem-solving.

Astuti (2019) state that the HOTS, which was developed from Bloom's taxonomy, includes students' skills or abilities in analyzing (C4), evaluating (C5), and creating (C6). HOTS questions require students to think at a higher cognitive level and can train and inspire students to use HOTS skills. Therefore, by getting used to students solving HOTS-type questions, it is hoped that students will be able to develop into a better generation of the nation.

The characteristics of the HOTS questions according to the Kemendikbudristek 2022 GTK (Teachers and Education Staff) are (1) moving from one concept to another, (2) processing and applying information, (3) finding relationships between much different information, (4) using the information to solving problems (5) ideas and critically reviewing information. Meanwhile, according to Widana in Widhiyani et al. (2019), the characteristics of the HOTS questions include (1) measuring high-level reasoning abilities, (2) based on contextual problems (3) in the form of multiple questions.

In Indonesia, the ability to solve HOTS questions is still lacking in learning mathematics. It is evident from the results of research by Wibowo & Setianingsih (2016) that students cannot yet solve problems that are required to think HOTS. One of the reasons is that students are not used to solving HOTS questions. As a result, many students make mistakes in solving HOTS questions. Therefore, Irmawati et al. (2021) said that mathematics learning should be directed to support the formation of students who can think logically, critically, and creatively.

In line with the research conducted by Puspa et al. (2019), high-ability students are very good at solving HOTS questions at every stage of problem-solving. In contrast, the group of moderately capable students could only understand the questions at all levels of the HOTS questions. Meanwhile, the students with low ability are less able to complete all stages of solving Polya. This study shows differences in the problem-solv ing abilities of HOTS questions based on students' ability levels.

Based on the explanation above, researchers were interested in identifying student errors in solving HOTS questions which were compiled based on Problem Solving Ability indicators using student answer sheets.

2. Method

It is a qualitative research type. This research is descriptive with an inductive approach that emphasizes more on process and meaning. The research subjects were seventh-grade students of Public Junior High School 39 Pekanbaru. Identification of research subjects used a test given to a class of 15 students. The method of taking research subjects was done using the Nonprobability Sampling technique namely by Purposive Sampling.

Research procedures include preliminary studies, design development, implementation, and reporting. This study aimed to determine the student's ability to answer the HOTS questions given by the researcher based on the student's. As well as describing the location of student errors in working on HOTS questions, factors causing student errors in working on questions, and types of student error answers related to social arithmetic material.

The research data collection technique is a test technique. The test technique consists of 2 HOTS questions in the form of descriptions. According to Fatahilah in Putri et al. (2021), the way to find out students' mistakes in solving HOTS questions and to know students' high thinking skills is by giving math problems in the form of stories or descriptions.

The description test refers to the mathematical problem solving ability indicators based on Polya and the scoring rubric of problem-solving questions, which are detailed in table 1 below.

Table 1. Mathematical Problem Solving Ability Indicators

Indicators	Responses
Understanding the Problem	Students recognize what is known to be needed in the problem description.
Making a Solution Plan	Identify the right problem solving strategy to solve the problem.
Executing Planning	Running the right process and getting the right results.
Crosscheking	Checking that the results obtained are in accordance with the provisions and consistent with the question

Mathematical problem solving ability question indicator also requires a scoring guideline used as a reference in processing and analyzing test result data. (Amam, 2017) The scoring rubric is a key element in authentic reviews. This rubric is based on standard reference measurements Modified scoring guidelines from Rosalina (2016).

a. In the indicator understanding the problem, a score of 2 was given if students understood the problem completely. Score 1 was given if students misinterpreted some questions and ignored the question's state. A score of 0 was given if students misinterpreted or were wrong.

b. In the indicator making a solution plan, scores of 4 were given if students followed the steps to plan and led to the right solution. Score 3 was given if students made the plan correctly, but it was incomplete. Score 2 was given if students made the plan correctly but were wrong in the results. Score 1 was given if students made a solution plan that could not be implemented, so it cannot be implemented. Then, a score of 0 was given if there was no plan or made irrelevant plans.

c. In implementing the planning, the score is two if it did the proper process and got the correct result. For example, if a student carried out the correct procedure and might produce the correct answer, but the calculation was wrong, students will get a score of 1. A score of 0 was given if they did not do the calculation.

d. In the indicator of crosschecking, a score of 2 was given if students performed a check to see if the answer was correct. Score 1 was given if the examination was not completed but had not been completed. Score 0 was given if students did not check their answers again.

The test results categorized the students into high, medium, and low ability students. In addition, six students were interviewed to obtain more in-depth information about the problem-solving thinking processes of junior high school students in solving HOTS questions.

3. Result and Discussion

Of the 15 research subjects, in this research solved HOTS-type questions on social arithmetic material with sub materials, namely selling price and buying price. The questions consisted of 2 questions where each question has 3 HOTS levels, namely analyzing level (C4), evaluating level (C5), and creating level (C6). The results of the instrument in the form of student answer sheets to HOTS-type questions and the answer sheets are then analyzed according to the stages of problem-solving presented by Polya, including 1) understanding the problem, (2) determining the plan, 3) implementing the plan and 4) re-examining. According to Annizar et al., (2018) Differences in knowledge, skills, and experience can cause everyone's problem-solving processes and abilities to tend to be different. Student mathematical problem solving ability test results are presented in the following table 2.

Table 2. Student Mathematical Problem Solving Ability Test Results

Students Code	Scores
S-1	5
S-2	12
S-3	20
S-4	13
S-5	14
S-6	18
S-7	18
S-8	13
S-9	12
S-10	14
S-11	12
S-12	17
S-13	5
S-14	14
S-15	5

Mathematical problem solving ability achievement of students who were research subjects in solving HOTS-type questions on social arithmetic material was each divided into three groups of students based on the category of students mathematical problem solving ability. The details are in the following table.

Table 3. Grouping of Students based on Mathematical Problem Solving Ability

Category	Test Score	Total students
High	$x \geq 15$	3
Medium	$5 < x < 15$	8
Low	$x \leq 5$	4

Two students were randomly selected from each category from these groupings, and the subject teachers were consulted about the student's abilities. The following are the details of the research subjects selected in this study to be interviewed to obtain data and identify their problem-solving skills in more detail:

Table 4. The Results of Mathematical Problem-Solving Ability in Solving HOTS Type Questions

No	Group of Students Based on mathematical problem solving ability	Students Scores	Questions Level	Polya Problem Solving Stages							
				Understanding the Problem		Planning Completion		Executing Planning		Crosschecking	
				1	2	1	2	1	2	1	2
1	Low	S-1	Analyze (C4) Evaluate (C5) Create (C6)	TM	TM	TM	TM	KL	KL	TM	KL
		S-13		KL	KL	M	TM	M	KL	TM	KL
2	Medium	S-4		KL	M	KL	M	M	M	TM	TM
		S-8		KL	TM	KL	M	M	M	TM	M
3	High	S-3		M	M	M	M	M	M	M	M
		S-7		M	M	M	M	M	M	KL	KL

Note: M represents that students are able to do the stages, KL represents that students are incomplete in carrying out the stages and TM represents that students are unable to carry out the stages

For the details, the researcher describe the high, medium, and low abilities of each student's mathematical problem solving ability indicator.

Table 5. The percentage of students' abilities in the high, medium, and low categories on each mathematical problem solving ability indicator

Indicator	Category		
	High	Medium	Low
Understanding the Problem	48%	52%	0%
Planning Completion	37%	56%	7%
Executing the Solution	29%	57%	14%
Crosschecking	45%	50%	5%

The analysis of students' mathematical problem solving ability in solving HOTS-type questions on social arithmetic material in each group of students in this study is described as follows:

a. High Ability Student Group

The research subjects in the group of high-ability students consisted of 2 (two) students, S3 and S12. S3 subjects were very able to solve problems in all HOTS levels proposed in the questions, namely the levels of analyzing (C4), evaluating (C5), and creating (C6). Furthermore, judging from the stages of problem-solving and the results of independent interviews with S3, information was obtained that the questions asked were new questions for S3, and S3 felt very challenged and excited about the types of questions given by the researchers and were able to complete the stages correctly and accurately.

S12 subjects can also be said to be capable of solving the HOTS questions. However, S12 was less precise on HOTS question number 2 at the mathematical problem solving ability in re-examining the solutions that had been made so that students were incomplete in concluding the answers made.

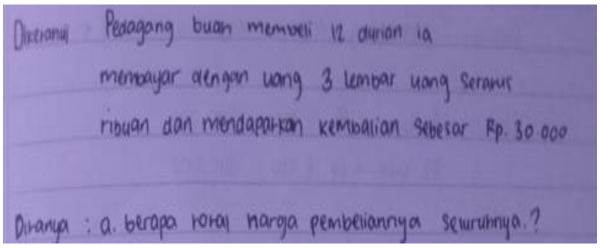

Diketahui: Pedagang buah membeli 12 durian ia membayar dengan uang 3 lembar uang seratus ribuan dan mendapatkan kembalian sebesar Rp. 30.000
Ditanya: a. berapa total harga pembeliannya seluruhnya?

Figure 1. S-3 Student Answer Sheet on Question Number 1

Based on the answer sheets of S-3 students with significant mathematical problem-solving abilities, it can be seen that students can understand the problem and describe the information contained in the problem well.

High-ability students can plan question 1, which refers to the information described at the stage of understanding the problem. The following is one of the student answer sheets for planning a solution.

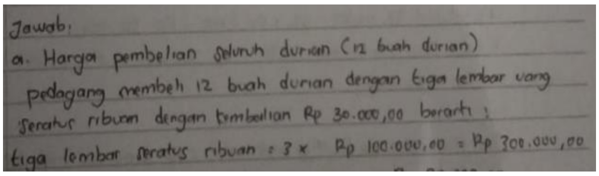

Jawab:
a. Harga pembelian seluruh durian (12 buah durian)
pedagang membeli 12 buah durian dengan tiga lembar uang seratus ribuan dengan kembalian Rp 30.000,00 berarti:
tiga lembar seratus ribuan = 3 x Rp 100.000,00 = Rp 300.000,00

Figure 2. S-12 Student Answer Sheet on Question Number 1

After planning a solution, high-ability students can solve the problem correctly. The following is one of the student answer sheets in completing the completion.

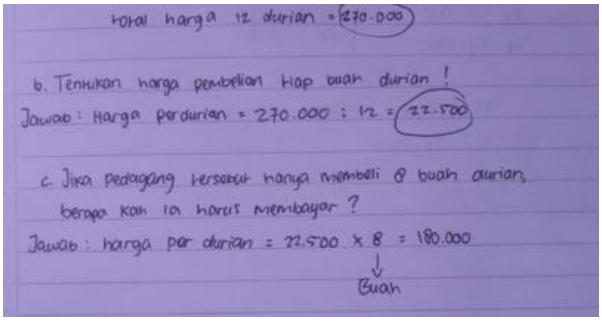
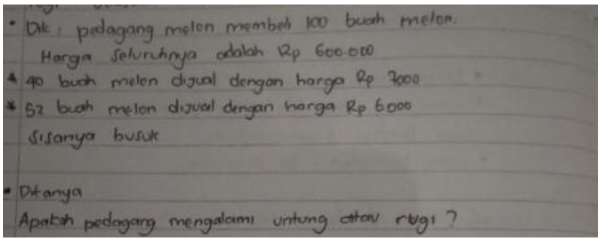

total harga 12 durian = 270.000
b. Tentukan harga pembelian tiap buah durian!
Jawab: Harga perdurian = 270.000 : 12 = 22.500
c. Jika pedagang tersebut hanya membeli 8 buah durian, berapa kah ia harus membayar?
Jawab: harga per durian = 22.500 x 8 = 180.000
Buah

Figure 3. S-12 Student Answer Sheet on Question Number 1

After completing the three stages of problem-solving, high-ability students are less able to re-examine and draw conclusions. When an independent interview was conducted with one of the high-ability students, the student said that it was challenging to write down alternative ways to find the exact answer at the stage of solving the problem. According to Kesumawati in Chotimah (2014), one indicator of the ability to solve mathematical problems is identifying calculation errors, formula errors, being able to check suitability and explaining the correctness or error of answers

b. Medium Ability Student Group

The research subjects in the group of moderately capable students consisted of 2 (two) students, namely S4 and S8. S4 research subjects were able to solve problems in all levels of the HOTS questions given in the levels of analyzing (C4), evaluating (C5), and creating (C6). However, it can be seen from Table. 2 that S4 could not carry out the stages of re-examining the questions given. Also, S4 carried out the stages of understanding problems and planning solutions. S4 can only finish the problem immediately without making a problem-solving plan in advance. The following is one of the answer sheets for students who were able to understand the problem:


Dik : pedagang melon membeli 100 buah melon.
Harga seluruhnya adalah Rp 600.000
40 buah melon dijual dengan harga Rp 7000
52 buah melon dijual dengan harga Rp 6.000
Sisanya busuk

Ditanya
Apakah pedagang mengalami untung atau rugi ?

Figure 4. S-4 Student Answer Sheet on Question Number 2

After S-4 understands the problem, the student immediately solves the problem without writing down the completion plan. The following is the answer sheet for S-4 students in the stage of solving the problem.

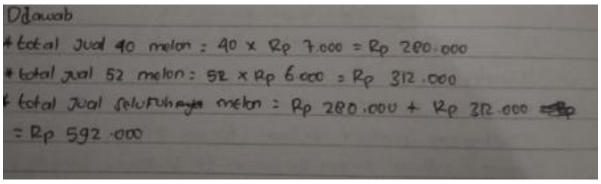

Dijawab
total Jual 40 melon : 40 x Rp 7.000 = Rp 280.000
total jual 52 melon : 52 x Rp 6.000 = Rp 312.000
total Jual seluruhnya melon : Rp 280.000 + Rp 312.000
= Rp 592.000

Figure 5. S-4 Student Answer Sheet on Question Number 2

Based on Table 4, the S8 research subjects could write down what was understood in the question. However, S8 was still incomplete in writing it down on the answer sheet. In question number 1, the medium group students could not write a complete completion plan, so the students were also less able to carry out the plan and look back due to differences in the plans used to solve the HOTS questions. At the stage of re-examining students re-correcting the steps in solving the problem and ending by drawing conclusions. Apriliawan et al. (2013) said students with high and medium mathematical abilities generally do not make mistakes when performing arithmetic operations, while students with low mathematical abilities generally make mistakes when performing arithmetic operations.

c. Low Ability Student Group

Based on Table 4, the group of low-ability students consists of 2 students, namely S-1 and S-13. Low-ability students could not complete the stages of problem-solving on each given question. In the interview session, the S-1 and S-13 admitted that they did not understand the questions' meaning and could not mention what was known and asked from the questions. The research subjects only read the questions without being able to connect the information contained in the questions to carry out the stages of problem-solving. Low-ability students only repeated writing the questions the researcher gave without writing down the information contained in the questions. The following is one of the answer sheets for low-ability students.

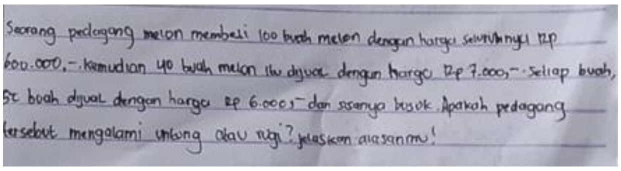

Seorang pedagang melon membeli 100 buah melon dengan harga seluruhnya Rp 600.000,-. Kemudian 40 buah melon itu dijual dengan harga Rp 7.000,- setiap buah, 52 buah dijual dengan harga Rp 6.000,- dan sisanya busuk. Apakah pedagang tersebut mengalami untung atau rugi? Jelaskan alasanmu!

Figure 6. S-1 Student Answer Sheet on Question Number 2

After being interviewed independently, the research subjects in the group of low-ability students stated that the math problems they encountered generally only calculated and used formulas. In addition, subjects were not used when math problems were presented in long story problems. Thus, this shows that there were not many HOTS questions that improved low-level students' thinking skills, so they were not familiar with HOTS-type questions.

4. Conclusion

Based on the research, the researcher concluded that students answered the HOTS questions quite well in social arithmetic material. The HOTS questions given were two graded questions. From the results of this study through tests and interviews with 15 students, there were three students with low mathematical problem solving ability, eight with medium mathematical problem solving ability and four with high mathematical problem solving ability. The results and interviews with students at each mathematical problem solving ability group level show that students experienced different difficulties.

Students with low mathematical problem solving ability could only answer HOTS questions at level C4 (analyze). On the other hand, students with moderate mathematical problem solving ability can answer HOTS questions at levels C4 (analyze) and C5 (evaluate). Meanwhile, students with high mathematical problem solving ability were able to answer all stages in solving mathematical problems, and students could solve problems at levels C4 (analyzing), C5 (evaluating), and C6 (creating).

According to the results of this research, the role of the teacher is vital to familiarize students with solving HOTS questions and creating learning innovations for each category of students so that they can improve their mathematical problem solving ability and work on HOTS-type math problems well.

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