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Student Difficulties in Solving Open-Ended Model Mathematics Problems

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Abstrak

Penelitian ini merupakan penelitian deskriptif kualitatif yang bertujuan untuk mengetahui faktor-faktor apa saja yang mempengaruhi kesulitan siswa dalam menyelesaikan soal non-rutin, dalam hal ini peneliti menggunakan soal *open-ended* yang sudah dikembangkan sebelumnya oleh peneliti, sehingga sudah valid, praktis, dan memiliki efek potensial. Peneliti mengangkat tema ini karena soal non-rutin dapat melatih kemampuan matematika siswa. Prosedur penelitian yang dilakukan dalam penelitian ini meliputi 3 tahap yaitu persiapan, pelaksanaan, dan analisis data. Subjek penelitian adalah siswa kelas VIII pada salah satu SMP di Belitang yang berjumlah 31 siswa. Pengumpulan data dilakukan dengan observasi, wawancara, dan tes. Data proses pembelajaran dikumpulkan dengan observasi, sementara wawancara digunakan untuk mengetahui lebih mendalam dan secara langsung mengenai kesulitan siswa dalam menyelesaikan soal non-rutin. Kemudian tes digunakan untuk mengetahui kemampuan siswa dalam menyelesaikan soal-soal non rutin. Data dianalisis menggunakan analisis deskriptif kualitatif. Berdasarkan data observasi dan wawancara didapatkan bahwa ada beberapa faktor siswa mengalami kesulitan dalam menyelesaikan soal non-rutin, diantaranya adalah siswa belum pernah mengerjakan soal non-rutin pada saat proses pembelajaran di kelas, dan juga buku yang digunakan oleh guru hanya berisi soal-soal rutin. Relevan dengan hal diatas, hasil yang didapat melalui tes adalah kemampuan siswa dalam menyelesaikan soal-soal non-rutin masih kurang baik, yaitu sebanyak 58,07% siswa mendapatkan nilai yang kurang baik, 19,35% mendapatkan nilai cukup baik, dan hanya 22,58% siswa yang mendapatkan nilai baik. Dengan adanya peneloitian ini diharapkan kedepannya para guru banyak memberikan soal-soal non-rutin di kelas, sehingga kemampuan matematika siswa dapat terlatih dengan baik.

Kata kunci: Kesulitan siswa, penyelesaian soal, soal matematika, soal non-rutin, model *open-ended*.

Abstract

This descriptive-qualitative study aims to discover factors that influence students' difficulties in solving non-routine problems. The researchers employed open-ended questions that had previously been developed by researchers, ensuring that they were valid, practical, and had potential effects. The researchers brought up this topic because non-routine questions can help students improve their mathematical skills. The study's approach consisted of three stages: preparation, implementation, and data analysis. The research subjects were 31 eighth-grade students from one of Belitang's junior high schools. Data was gathered through observation, interviews, and testing. Observation was utilized to collect data on the learning process, while interviews were used to understand more profoundly and directly about students' difficulties in addressing non-routine tasks. The test was then administered to assess students' ability to solve non-routine tasks. The data was evaluated qualitatively using descriptive analysis. Based on observation and

interview data, several factors contributed to students' difficulty in solving non-routine problems, including the fact that students had never worked on non-routine problems during the learning process in class, and the teacher's book only contained routine problems. In relation to the foregoing, the exam results show that students' ability to solve non-routine problems remains poor, with as many as 58.07% receiving poor grades, 19.35% receiving moderate grades, and only 22.58% receiving good grades. With this research, it is envisaged that teachers will assign numerous non-routine tasks in class in the future, allowing students' mathematical abilities to be thoroughly developed.

Keywords: Students' difficulty, problem-solving, mathematical questions, non-routine questions, open-ended model.

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INTRODUCTION

The competence to answer non-routine problems is critical for students because non-routine problems are the best form of problem to develop problem-solving skills, mathematical reasoning, and the ability to apply problem-solving skills in real-life circumstances (Yazgan, 2016). According to the international research institution TIMSS (Trends in International Mathematics and Science Study), Indonesia was rated 46 out of 51 participating countries in 2015, with 397 points less than the standard score of 500. According to these findings, Indonesia is in the low category (low benchmark) for mathematics achievement, with children only knowing basic mathematical skills such as mathematical arithmetic procedures (Mullis et al., 2016).

The ability to address non-routine problems is so crucial that it is one of the classroom learning objectives in the 2013 curriculum. According to Permendikbud number 24 of 2016, the core skills of learning mathematics are processing, reasoning, and presenting in the concrete and abstract domains related to the independent development of what they learn at school, as well as the ability to use methods based on scientific principles. It demonstrates that after students comprehend ideas and procedures from working on routine problems in class, they must be able to expand their skills by processing reasoning concepts and procedures that are frequently learnt in class in to deal with non-routine problems. It is done in the belief that Indonesian students will be able to face non-routine problems. Nevertheless, students in Indonesia have failed to meet these expectations.

According to the findings of the 2015 PISA research (NCTM, 2000) Indonesian students are at the lowest level of accomplishment in mathematics among the six levels in the PISA edition, with nearly 80% of Indonesian students performing below level 2. At this level, students can only answer questions in familiar contexts where all relevant information is

presented and the question is clearly defined. Students can identify information and use routine procedures based on direct instructions, but they still make many mistakes in non-routine problems. There are five fundamental abilities in mathematics: problem-solving, reasoning, communication, connection, and representation (NCTM, 2000). It demonstrates that Indonesian students can only solve training issues or conventional routine problems, however they have low ability to solve non-routine problems. Because tackling non-routine problems is more difficult than solving routine problems, techniques for problem-solving may not arise instantly and demand a high level of imagination and originality from the solver (Putri, 2018).

That believe students' problem-solving skills have not been maximized (Fauziah & Sukasno, 2015). Rahmadani states that (Rahmani & Widyasari, 2018) students' problem-solving skills are low, and she used tangram media to improve their problem-solving skills. Tests or unusual problems in the form of mathematical problems are required to assess students' mathematical solving ability. Routine problems can be solved by methods that are familiar to students by replicating previous learning methods in a step-by-step manner, whereas non-routine problems cannot be predicted by trained approaches or procedures that are explicitly shown in the task, instructions on the task, or examples on the task (Woodward et al., 2012).

Therefore, the researchers were interested to investigate students' difficulties in solving non-routine problems in order to identify the factors influencing students' difficulties. This study's findings can be used as input and empirical considerations in the mathematics learning process, with the goal of improving students' mathematical abilities.

METHODS

The researchers employed the descriptive qualitative research method . The validity of qualitative research data, according to Sugiyono (Sugiono, 2017), is the degree of trust in the research data and the data's results can be justified. In qualitative research, data validity checks include credibility tests, transferability tests, dependability tests, and finally objectivity tests (confirmability). According to Moleong (Moleong, 2014), triangulation is a method of determining the validity of data by comparing research data with outside data.

Data analysis techniques are activities in qualitative data analysis that are carried out interactively and continuously until completion, so that the data is saturated (Sugiono, 2017). Data analysis activities include: 1. Reduction of field data, such as field notes and observations, which are meticulously recorded. 2. Data Display (Data Presentation) tt can come in the form of tables, graphs, pie charts, pictograms, and so on. The data is sorted and displayed in a relational pattern through data presentation, making it easier to comprehend. 3 Conclusion Drawing / Verification is a conclusion drawing or verification. The preliminary conclusions are still tentative and will alter if no compelling evidence supporting the next round of data collection is discovered. Findings in qualitative research, according to Sugiyono (Sugiono, 2017), are previously unknown results. Findings can be in the form of a description or description of an object that was before dim or dark so that after research it becomes evident, it can be a casual or interactive relationship, hypothesis or theory.

RESEARCH RESULT

The instruments employed were observation sheets, non-routine question tests, and interview guidelines. The researcher then employed open-ended type non-routine questions with material adapted to the material previously learned at school, in this case two and three dimensional figures. The questions given have also previously gone through the validation stage from one expert or mathematics education expert, Mewa Zabeta, M.Pd, who is a lecturer at STKIP Muhammadiyah OKU Timur and Mrs. Titin Riyanti, M.Pd who is a mathematics education teacher at the senior high school for the language aspect. After several stages of revision both in terms of language or sentences and the form of images, the questions were declared feasible and suitable to be given to the eighth-grade students.

One class at SMP Negeri 2 Belitang participated in this study. The research subject was class 8.1, which had a higher average ability than the other classes. The subject was considered because the questions were classified as difficult and designed for students with a better understanding of mathematics. Each student received the same problems, which were five non-routine essay questions. This distribution was designed to determine the extent to which students' routine and non-routine problem-solving skills differed. According to these findings, 58.07% of students received poor grades, 19.35% received moderate grades, and only 22.58% received good grades. The students did not write systematic steps in their answers. The finding is shown in the Table 1.

Table 1. Recapitulation of Test Results for Non-routine Questions

No	Score	Students	Percentage (%)
1	0 – 25	0	0
2	26 – 50	18	58,07
3	51 – 75	6	19,35
4	76 – 100	7	22,58
	Total	31	100

Furthermore, at the interview stage, the interview guideline instrument was used to delve deeper into students' mathematical problem-solving abilities. The interview guidelines included several questions that were tailored to the indicators of problem-solving ability. This study's interview guidelines were developed using indicators of mathematical problem-solving ability. An expert in the field of mathematics education validated the interview guidelines. The interview guidelines that had been designed were improved during the validation process. The interview guidelines, according to the validator, must be adjusted to the indicators of mathematical problem-solving ability and the rating scale. The interview guidelines were revised after receiving feedback from the validator. The validator declared the revised interview guidelines valid and approved their use in the study.

DISCUSSION

During the first stage, known as research preparation, researchers prepared a variety of instruments such as observation instruments, tests, and interviews. During the observation, the researcher directly observed the teacher's learning process in the classroom when the mathematics subject took place. The researchers found that the teacher of mathematics subject tended to use the usual type of problems or routine problems commonly found in the student worksheet. The researchers also discovered that questions asked to the students were familiar and tended to be monotonous, such as questions on two-dimensional figures, where the questions given already have side lengths and widths so that students only need to find answers only by entering formulas and solving problems in a structured manner without having to think critically like open-ended questions. Furthermore, researchers observed the textbooks used by subject teachers to teach in class, which had monotonous questions..

Next, during the research implementation, before the researcher administered the test questions, the researcher first observed the learning process in the classroom, the books used by the subject teacher to teach in class, and students working on non-routine problems. Then,

during the test, the researcher asked students five non-routine questions and allowed them considerable time to answer them. In between students working on problems, the observer who accompanied the researcher took some notes for the findings. It was discovered that some students were confused and asked each other about the questions. The students also asked the observer how to determine the value of each side or the length, width, and height of the building that would be sought for the area and volume. The Figure 1 student activities for problem-solving in the classroom.

Figure 1. The Students Work on Non-routine Problems

According to the results of the second activity, when researchers addressed mistakes done by students in the classroom, 58.07% of students received poor grades, 19.35% received quite good grades, and just 22.58% received good grades. Hence it can be inferred that students at SMP Negeri 2 Belitang were even less acclimated to and did not grasp questions in non-routine form, as evidenced by the low scores and observations collected while monitoring students working on these problems. The Figure 2 is a summary of student test results.

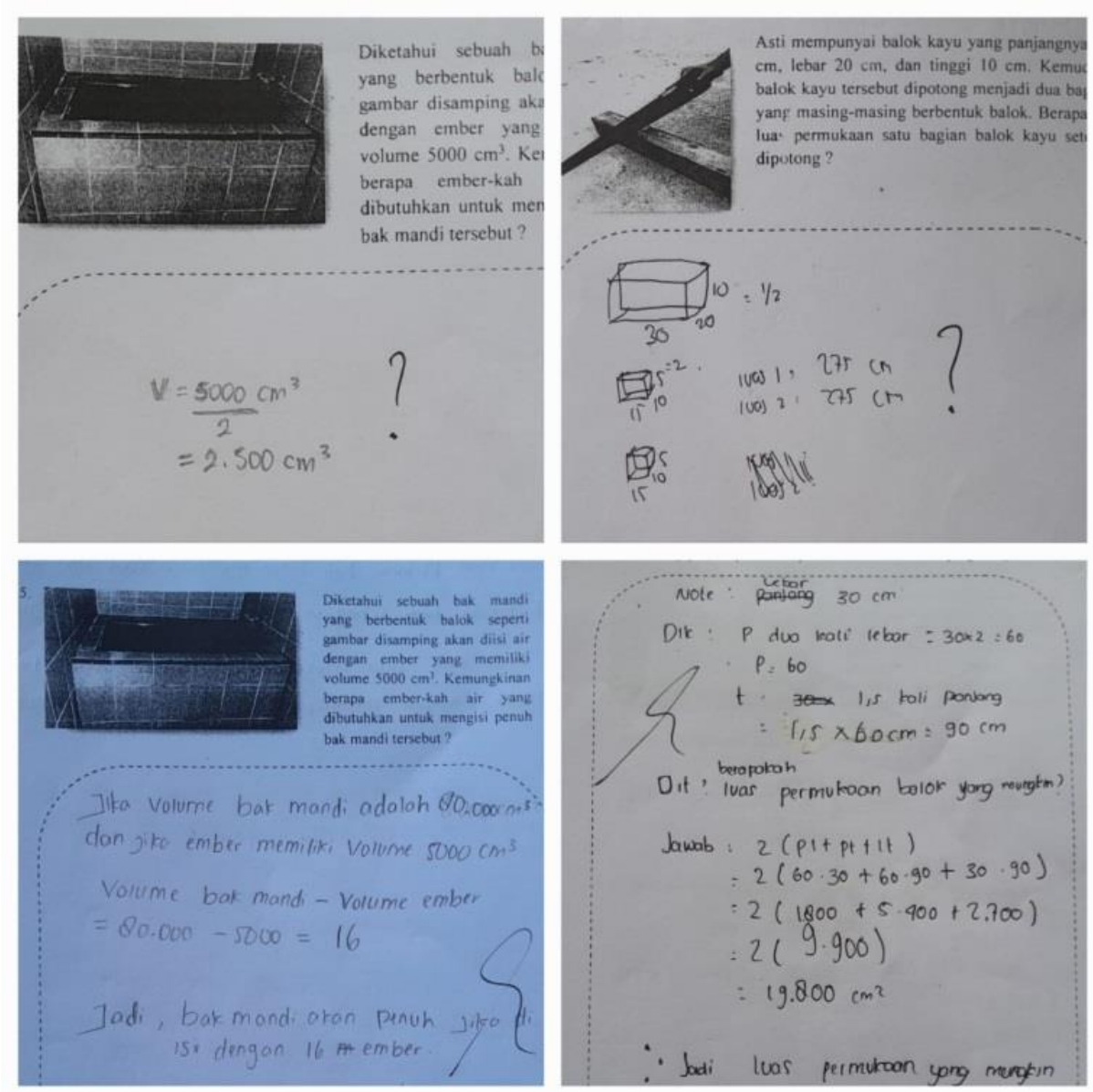

Figure 2. The Samples of Students' Answers

Finally, researchers conducted interviews with various students from the class who were sampled, specifically individuals with high, moderate, and poor abilities. Researchers chose based on the results of student answers, where one student received the highest score of 90, and based on the results of the interview, this student was capable of solving the problem because the student participated in extra learning outside of school. The parents of this student also supported the improvement of their children's abilities in the field of mathematics. Therefore, the students was accustomed to working on non-routine problems.

P : You got a score of 90, I want to ask the question is classified as easy or not?
S1 : The question is about the bathroom tub, I happened to have gotten a problem like that from my private tutor at home. Problems like that are usually given by my teacher during tutoring, sir.
P : For the types of problems, what are they?
S1 : Quite a lot sir, such as story problems and problems in the form of two and three dimensions figures.

Furthermore, researchers interviewed two students who received medium scores, 70 and 65, and asked them how they attempted and altered the numbers or values in the question so that they might be used to solve the problem.

P : Then for question number 2, why is the width of the wooden beam 30cm in your answer?
S2 : At first I was confused too, sir, because the question had no numbers. But after I tried to input some numbers, I was finally able to do it.
P : Yesterday we did a math problem, your score was among the lowest scores, what was the problem, and can you explain it to me?
S3 : The problem was difficult sir, I have never found a problem like that. There was no description of the value on several sides of the figures so I couldn't work on it.
P : At school, have you never been given a problem like this?
S3 : Yes sir, it was my first

Furthermore, the researcher interviewed three students who received low scores of 30, 20, and 10. According to the findings of these three students' interviews, they were highly unfamiliar with and have never faced situations of this type where several aspects of the problem were absent, making it difficult for them to solve the problem. The following are excerpts from interviews conducted with a number of students.

P : Gimana dengan soal yang kemarin yang kamu kerjakan?
S4 : Tadi saya baca soalnya pelan-pelan pak, karena saya belum pernah mengerjakan soal yang seperti ini. Jadi harus santai pak ngerjakannya. Hehe
P : setelah kamu baca gimana kira-kira bisa menyelesaikannya?
S4 : saya masih belom paham pak, karena yang diketahuinya gak jelas, yang digambar juga gak ada keterangan panjang, tinggi dan lebarnya.
P : kalo di sekolah apakah pernah ngerjakan soal yang seperti ini?
S4 : Belom pernah pak, baru pertama kali.

Based on the explanation above and the observation data, it can be determined that the teacher was extremely proficient in carrying out classroom learning, which includes, among

other things, introductory activities, core activities, and closing activities. Students were also extremely involved in the learning process in class, as seen by several students who asked the teacher questions about the content delivered and took notes on what the teacher said. The teacher, on the other hand, never assigned non-routine problems in class. The teacher only delivered problems from the textbook and rarely from the internet. All fthe problems were all standard problems. Several information was obtained from the results of interviews that became the reason for students' difficulties in solving non-routine problems. The students felt confused about how to work on non-routine problems because there were problems without numbers, and there were also problems that only displayed numbers as a reference in working on these problems. Therefore, they were afraid of being "wrong" when working on these problems. Furthermore, based on the interview results, it was discovered that the mathematics teacher had never offered non-routine problems and exclusively delivered regular problems in the mathematics textbook.

Students' problem-solving skills must be enhanced in order to prepare young people to confront the Asean Economic Community (AEC) (Cahyani & Setyawati, 2016). Problem-solving is an important skill because (Kouvela et al., 2017) argues that problem-solving can be used to promote mathematical thinking as a tool for everyday life. According to (Swastika, 2019) teachers should provide students with greater practice in portraying problems. Because representation is a critical component of problem-solving. According to this argument, good problem-solving abilities are highly important for students, students, professors, lecturers, and society to have, because problem-solving skills play a vital role in a person's attitude.

The explanation above reveals that there are several reasons why students have difficulty solving non-routine problems, including the fact that students have never worked on non-routine problems during the learning process in class, so students are unfamiliar with clear non-routine problems, and that the books used by teachers only contain routine problems.

CONCLUSION

According to the results and discussion above, there are several factors that cause students to struggle with non-routine problems, including the fact that students have never worked on non-routine problems during the learning process in class, and the teacher's book only contains routine problems. Therefore, students are not used to working on non-routine problems. The exam results show that students' ability to solve non-routine problems remains inadequate, with as many as 58.07% receiving poor grades, 19.35% receiving

moderate grades, and only 22.58% receiving good grades. The ability to answer non-routine problems is critical for students since non-routine problems are the best sort of problem to build problem-solving abilities and mathematical reasoning, as well as the capacity to apply problem-solving skills in real-life circumstances (Yazgan, 2016).

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