

STUDENTS' REASONING ABILITY TO SOLVE PROBLEMS IN STATISTICAL MATERIALS WITH A REALISTIC MATHEMATICS EDUCATION

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Abstract. This research aims to determine students' reasoning ability in solving problems in statistical materials with a Realistic Mathematics Education. This type of research is qualitative and descriptive with the number of subjects used, namely one person. The selected subjects are students who get the highest scores from conducting tests carried out on 37 students. The instruments used are tests and interviews. Tests are used to select subjects, and interviews are conducted to determine the student's reasoning ability in solving problems on the opportunity material. The data analysis technique is qualitative data analysis, namely using the data collection stage, data presentation, and conclusion drawing. Based on the results of data analysis conducted on subjects, peers, and subject teachers, it was obtained that the subject in learning and in the process of solving questions during the interview process used reasoning skills. In this study, the subject met the indicators of reasoning ability used, namely the ability to submit conjectures, compile evidence, provide reasons for solving problems carried out, conclude, and check the correctness of the answer.

Keywords: Reasoning Skills, Statistics, Realistic Mathematical Education

Abstrak. Penelitian ini bertujuan untuk mengetahui kemampuan penalaran siswa dalam menyelesaikan soal pada materi statistik dengan Pendekatan Matematika Realistik Kelas IX SMP Negeri 209 Jakarta. Jenis penelitian ini yakni deskriptif kualitatif dengan jumlah subjek yang digunakan yakni 1 orang. Subjek yang dipilih yakni siswa yang memperoleh nilai tertinggi dari proses pelaksanaan tes yang dilaksanakan pada 37 orang siswa. Instrumen yang digunakan yakni tes dan wawancara. Tes digunakan untuk memilih subjek dan wawancara dilakukan untuk mengetahui kemampuan penalaran siswa dalam menyelesaikan soal pada materi peluang. Teknik analisis data yang digunakan yakni menggunakan analisis data kualitatif yakni menggunakan tahap pengumpulan data, penyajian data dan penarikan kesimpulan. Berdasarkan hasil analisis data yang dilakukan pada subjek, teman sejawat, dan guru mata pelajaran diperoleh bahwa subjek dalam pembelajaran maupun dalam proses penyelesaian soal pada saat proses wawancara menggunakan kemampuan penalaran. Dalam penelitian ini subjek memenuhi indikator kemampuan penalaran yang digunakan dalam penelitian ini yaitu kemampuan mengajukan dugaan, kemampuan menyusun bukti, memberikan alasan terhadap penyelesaian soal yang dilakukan, kemampuan menarik suatu kesimpulan, serta kemampuan memeriksa kebenaran jawaban tersebut.

Kata Kunci: Kemampuan Penalaran, Statistika, Pendekatan Matematika Realistik

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INTRODUCTION

Education is a means to improve yourself towards a better future life; without education can be imagined what this life will be like. So it is natural that education in a country is a top priority (Jatisunda, 2017). Education is an interaction between educators and learners to achieve educational goals in a particular environment (Sukmadinata, 2011). Education as a development capital is required to play an active role in improving and developing the quality of human resources. Especially with globalization, the younger generation must be prepared for various changes in circumstances. One that must be improved is the ability in mathematics because mathematics is essential in human life and is needed as a tool in the development of technology and industry. Mathematics has a considerable role in providing a variety of thinking and problem-solving skills in everyday life (Mawaddah & Anisah, 2015).

In the 21st century, the national education system faces complex challenges in preparing the quality of human resources that can compete in the global era. Issues that are still a hot topic in the issue of the quality of education today are students' learning achievements and reasoning ability in a particular field of science. This is seen in the learning outcomes of learners who are always very concerned. Realizing this, the government, together with education experts, strive to improve the quality of education, including through seminars, workshops, and training (Al-Otaibi, 2017).

Learning is a series of activities of the body-soul to obtain a change in behavior as a result of the individual's experience in interaction with his environment that concerns cognitive, affective, and psychomotor (Djamarah, 2011). The teaching and learning process in schools should run well because it will give birth to reliable and quality human resources (Noer & Gunowibowo, 2018). However, due to the lack of variations in the teaching and learning process, many students feel saturated, and even the learning process tends to be monotonous. Therefore, it takes teacher creativity to use various variations in the learning process. In the content standards for elementary and secondary education units of mathematics subjects, it has been mentioned that mathematics subjects need to be given to all learners starting from elementary school to equip learners with logical, analytical, systematic, critical, and creative thinking skills, as well as the ability to cooperate (Kemdikbud, 2006).

Students' reasoning abilities vary depending on cognitive knowledge, motorist skills, intellectual prowess, verbal information, and attitudes (Saleh et al., 2018). Some things that affect it include learning methods, learning facilities, learning environment, and so on. This ultimately impacts student learning outcomes, and teacher learning activities are responsible for the learning outcomes achieved by students both individually and classically (Bhat, 2019).

The current reality shows that mathematics is becoming one of the subjects that many students avoid. Many students find learning math difficult. Students tend to learn passively, so the level of student reasoning ability is shallow in solving problems in the learning process in the classroom. This fact may be due to the abstract nature of mathematics. It may also be because, during this time, students only tend to be taught to memorize mathematical concepts and principles without being accompanied by a good understanding (Luo et al., 2020).

These concerning conditions must continue to be sought to be improved, and the condition is not only caused by difficulties that are sourced from the students themselves, but some are sourced from outside the student, such as the way the lesson is presented, or the learning atmosphere is carried out (Tambunan, 2018). Teachers are less motivated to change their teaching patterns. Therefore, it is necessary to renew or improve learning because learning activities are important factors that need attention. Teachers must think and carefully plan to improve student learning outcomes, for example, by choosing the right approach and learning method according to the material to be taught. One of the efforts that can be made is to implement the Realistic Mathematics Education (RME), which in Indonesian means Realistic Mathematics Education. Operationally and subsequently used in this paper is commonly called Realistic Mathematics Education (Fauziah et al., 2018; Özdemir, 2017). This approach demands the activeness of students in the learning process. With RME, students learn mathematical ideas and concepts through contextual problems related to the student's environment (Fitri & Prahmana, 2020; Hadi, 2003). Furthermore, gradually students are guided to master mathematical concepts.

The process of learning mathematics is a learning process that requires a thought process in the process of solving problems (Kartono & Shora, 2020). Because in its implementation, a student will connect one concept with another to solve problems that occur in the learning process or try to prove his arguments scientifically. Mathematical materials and mathematical reasoning are two things that cannot be separated. Namely, mathematical materials are understood through reasoning, and reasoning is understood and trained through learning mathematical materials (Depdiknas, 2002). Student reasoning skills are an activity or thought process that is very important in mathematics learning. Reasoning is a process of thinking activity to draw conclusions or make a new statement that is true based on several statements whose truth has been proven or assumed before. With the ability to reason, students can solve various problems in the learning process and in everyday life (Putri et al., 2020).

Statistical material is one of the essential materials in mathematics learning and is taught to grade IX Junior High School students. The material was chosen with consideration based

on a small discussion with several SMP Negeri 209 Jakarta mathematics teachers. Many students have difficulty understanding this material. In addition, the statistical subject matter is closely related to the problems of daily life that students may experience or observe, making it easier to choose contextual problems to be used as the first step in RME learning that allows students to build their own understanding/concepts/ principles/mathematical procedures related to this material (Putri et al., 2019).

METHOD

The type of research used in this research is qualitative descriptive, which is research that aims to obtain data and describe students' reasoning ability to solve problems in learning using the Realistic Mathematics Education. The research subject in this process is a class IX SMP Negeri 209 Jakarta student. The process of determining the subject using purposive sampling is the process of determining the subject using certain goals or criteria, namely student test results (Sugiyono, 2008). Taking the subject is based on the highest grades obtained by class IX students after carrying out the test. The selected subjects amounted to 1 person out of a total of 37 people. Where the subject is selected based on the test results, the student who obtains the highest score is selected as the research subject.

Indicators of students' reasoning ability in this study are (1) the ability to submit conjectures, (2) the ability to compile evidence and provide reasons for a solution, (3) the ability to conclude from statements, and (4) the ability to check the validity of an argument. The instruments used in this study are (1) researchers; Researchers are the main instrument in this research process. Because in the implementation of research, researchers are directly involved in the focus of research, and the research procedures used in this study are not yet certain. So that researchers must be directly involved in the research process, (2) tests; tests are conducted after students learn using the Realistic Mathematical Education, and (3) interviews; The interview used in this study is direct. According to Arifin & Retnawati (2017), a live interview is conducted directly between an interviewer or teacher and an interviewee or learner without going through an intermediary. The interview process is carried out after the student has taken the test. The interview used is an unstructured interview by following the progress of the answers conveyed by the subject. To obtain the validity of the data, the interview process is carried out with the research subject, peers, and teachers of the subject. The data analysis technique used in this study is qualitative data analysis, following the concept developed by Miles and Huberman, namely data reduction, display data, and conclusion drawing (Miles & Huberman, 1994).

RESULTS

Students' reasoning ability in solving problems in statistical materials is conducted through interviews directly with the subject, peers, and peers. The results of interviews conducted with subjects, peers, and teachers of mathematics subjects are as follows.

Interview Results with The Subject

Interviews with the research subjects were conducted after determining the subjects in this study. The process of determining the subject was carried out by carrying out tests on all students of class IX of SMP Negeri 209 Jakarta. From the test results obtained by female students who obtained the highest grades in their class, namely students with the initials HS. The results of the interview with the subject of HS are as follows.

R : In answering the question at the interview, did HS do it himself?

HS : Yes, I did it myself.

R : I now have a test question and asked HS to solve it. Can HS solve this problem? Try Hardiana to pay attention to the number 1. According to Hardiana, how to solve it?

HS : The number 1 problem is the car journey in one year, 14,250 km, consuming 1,500 liters of gasoline. Meanwhile, those who were asked about the average car distance, with a distance of 1,425 km. How much gasoline is needed? To solve, it is divided by 14,250 km by 1,500 liters.

R : Try HS solve problem number 1 first part

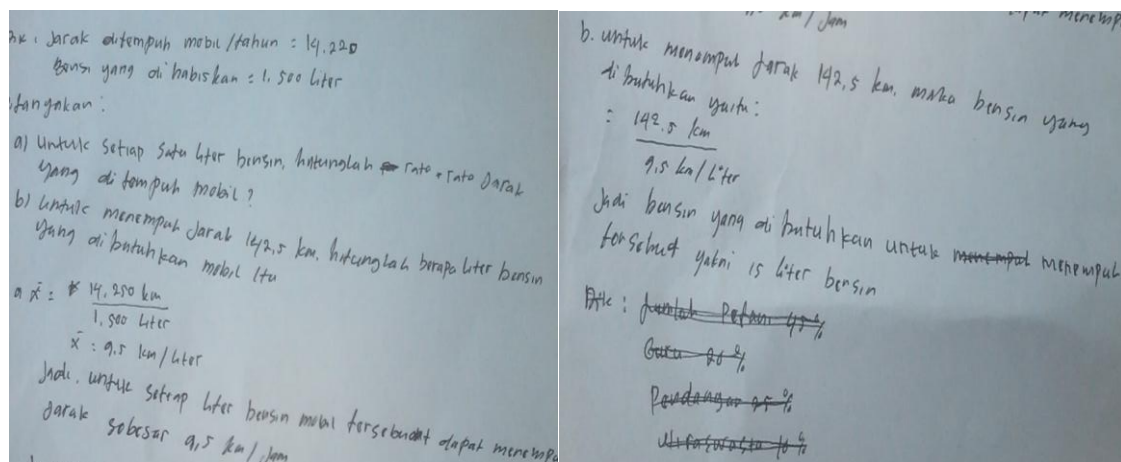


Figure 1. The results of students' work in solving question number 1

R : Hardiana tried to explain how to get the answer above?

HS : First, determine what is known and asked. Next, determine the average distance then 14,250 divided by 1,500 then. The average distance is 9.5 km / h

R : Why is it that HS divides 14,250 km by 1,500 liters?

HS : Because if multiplied, the value gets bigger. The question asked the average distance traveled for each liter of gasoline.

R : Does the answer that Hardiana got correct according to HS?

- HS : Not sure yet, but I think the solution is so.
 R : What about question number 2? According to HS, how to solve the problem?
 HS : In solving problem number 2, it is known that the number of residents in an area is farmers 45%, teachers 20%, traders 25%, and self-employed 10%. Asked how the pie chart and if the population is 200 people determine the number of inhabitants according to livelihood. To solve the first problem means that the circle image must use a ruler and longitude.
 R : Regarding number 2, what is the second part?
 HS: Multiplied. Suppose the farmer has 45% weight to determine the number of $\frac{45}{100} \times 200$.

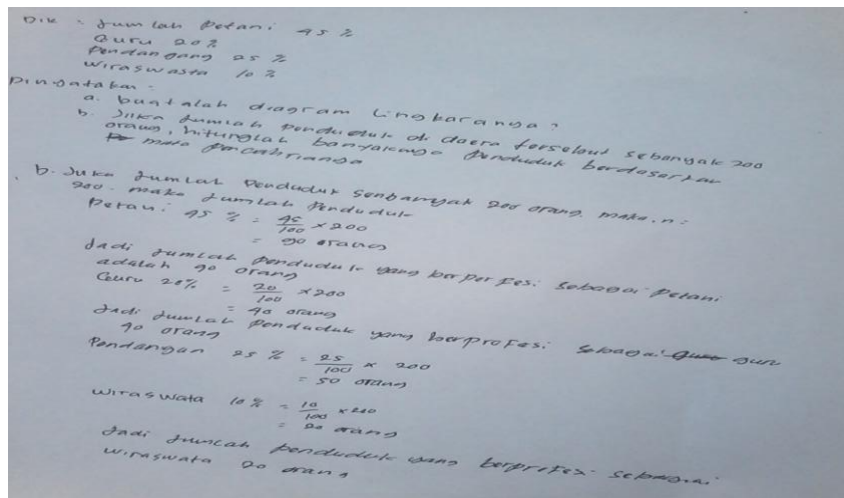


Figure 2. The results of the subject's work on interview question number 2

- R : Why in settlement of question number 2 part two, multiplied by 200.
 HS : In the matter of a known population of 200 people, to find the number of farmers, it is multiplied by 200.
 R : From which HS gets 45% to $\frac{45}{100}$
 HS : Because the form is percent, it can be changed to $\frac{45}{100}$.

Based on the interview results above from the questions compiled by one of the groups, it can be seen that students have been able to express their ideas. Students understand the type of questions they must compile and can choose the right statement to describe the problem's meaning. It can be seen from the example of the problem above that students write down mathematical notation and include sufficient information about the notation. The completion made by students to the above questions shows that students have been able to solve the problem in severance and correct manner. The completion of the student also shows that the student is capable of mathematical manipulation. It can be said that from the results of the interview, students have mastered the first indicator of mathematical reasoning skills, namely presenting conjecture, the ability to compile evidence and provide reasons for solving the

problem, concluding the problem completion process, and checking the validity or truth of the problem completion process.

Peer Interview Results

Interviews with peers were conducted directly by researchers with peers of the study subjects. Peers are chosen for various considerations, namely the person closest to the subject, in terms of the association at school and home. This is done with the aim so that the results of the interview obtained later can be completely valid and related to students' reasoning ability in the learning process.

After collecting data through the subject teacher and one of the students in class IX of SMP Negeri 209 Jakarta, the criteria for choosing colleagues were obtained by a student who in the classroom sat side by side with the research subject. In addition, it is also known that the selected colleagues are the subject's elementary school friends and live close to the house. The basic bag is a student named Raoda Rumbia, with the initials RR selected as a peer, then interviewed the student. The results of interviews conducted with colleagues are as follows.

R : What do you think the HS in the person's house is like?

RR : HS, if at home, he is a person who rarely goes out of the house. If you play, only inside the house.

R : When in learning HS, how?

RR : If at home, he is diligent in studying. Suppose he plays only Saturday or Sunday and has completed the task.

R : In completing the teacher's task, how does HS do it?

RR : HS is eager to complete tasks, especially mathematics and physics.

R : How does he solve problems from teachers, especially on open-ended questions.

RR : In solving the problem, HS first writes the keywords in the question. Next, it is inserted into the formula.

R : In classroom learning, especially in learning mathematics, HS how?

RR : If in ordinary learning, HS is always asked to solve difficult exercise problems in front of the class.

Based on the interview results above, it can be known that in the learning process and subject activities at home, someone who is diligent in learning. In addition, in solving problems and problems given by teachers in the classroom, the subject is a student whose solution reflects reasoning ability. This can be seen from the testimony of colleagues that the subject in solving the training questions given by the teacher first formulates the questions into simpler steps, expresses predictions or conjectures to the solution of the problem, after which it solves the problem and draws a conclusion from the process of solving the problem and checking the truth of the answer.

If viewed from the steps of solving the problem, according to interviews with colleagues, the subject in the learning process meets the reasoning ability indicators used in this study. So it can be said that the results of the interview with the subject are in line with the results of interviews conducted with colleagues. Namely, the subject in learning and solving problems has reasoning skills.

Interview Results With Math Teachers

The interview process with the subject teacher is carried out to obtain information about students' reasoning abilities in the learning process, especially in learning mathematics. The results of interviews with teachers of mathematics subjects are as follows.

- R : According to the father, as a math teacher who teaches in the classroom, How is HS in classroom learning?
- G : HS is one of my proud students. Because people are calm in learning, and have an excellent mindset in solving training problems.
- R : What kind of mindset what the father means?
- G : The ability to think. HS can think that other friends do not have.
- R : Can you be more clear?
- G : He has a different mindset in solving the training problems that I give. Suppose I ask a class training question, and he often raises his hand and comes forward to solve the problem I give. The process of solving the problem is excellent, were in solving the problem first by writing things of a general nature that has been known in the matter. After that, he began to estimate what the answer would be and solved the problem.
- R : Is it in solving the questions given by the father in the learning process and HS solving the problem? Did you ever ask him where he got the answer to that question?
- G : Yes, this is what I often do. I most often apply peer tutor learning. Because I think that in addition to receiving material submissions from me, learning between their fellow people will help students' understanding of the material learned. So usually, after students have solved the problem, I ask them to explain again where the answer came from, and Hadrian is one of the students who often do this.
- R : Is it that after he has solved the problem, he can again prove the answer he got?
- G : Yes, he can prove his answer, and the test results are correct.
- R : Is it that in addition to solving problems, HS can make conclusions in each learning process?
- G : I usually, after the learning process, often do a brief evaluation while making conclusions with students, and usually HS, who often give conclusions to the answer.

Based on the results of the above interviews conducted with teachers of mathematics subjects, it can be known that subjects in the daily mathematics learning process, especially in solving mathematical problems, have reasoning skills. This is reflected in the steps of solving the problem carried out by the subject in the learning process. In solving these

questions, usually, the subject uses general steps until it reaches special stages. Before solving the problem, the subject predicts the answer to the problem's solution. Also, research can solve the problem well and account for it so that it can make a good conclusion.

If viewed from the steps of solving the problem, it can be concluded that the subject in solving the problem in the mathematics learning process uses reasoning skills in the problem-solving process and meets the four indicators of reasoning ability used in this study based on the results of the interview with the teacher, namely the subject can submit a guess, give reasons for the answers obtained, check the truth of the answers, and conclude.

DISCUSSION

Efforts to develop students' reasoning skills greatly benefit problem-solving skills in everyday life. Reasoning ability is one of the goals in every learning activity in school. In addition to learning outcomes, the achievement of reasoning learning is one of the important indicators in learning activities (Ardiyani & Gunarhadi, 2018). With reasoning skills, students can develop the abilities and knowledge they have gained to be useful, especially in solving problems both within the scope of school learning and in everyday life (Syafrizal et al., 2020).

This research process was carried out using one subject; the subject was selected based on the test results obtained by all students of class IX of SMP Negeri 209 Jakarta. In collecting data, interviews are conducted on the subject, where the interview focuses on the results of students' work on the test questions used. Questions are developed based on the answers submitted by the subject at the time of the interview, so this research does not use interview guidelines. The goal is to find out the extent of students' reasoning ability to solve statistical material problems by relying on indicators of reasoning ability, namely the ability to submit conjectures, the ability to compile evidence, the ability to conclude, and the ability to check the validity of the answers obtained.

Based on the results of interviews conducted, it was obtained that the subject in solving the question of either the interview test question used for the interview tended to or used reasoning skills. This is known based on the results of student work because students solving problems can do it well by the steps of solving the problems taught by teachers during the learning process. The results of interviews with colleagues also support the reasoning ability possessed by the subject. The interview results from the two people justify the attitude and activity of the subject in the learning process, including the ability to submit a conjecture or predict an answer to the solution of a problem. Students can compile evidence for the answers

obtained in solving well and explain it in the interview process. The subject can conclude and check the truth of the answers he obtained in the learning process (Hartatiana et al., 2017).

Educators should consider reasoning skills in every learning process and, more specifically, in mathematics learning. As stated in the content standards for elementary and secondary education units of mathematics subjects, namely the Regulation of the Minister of National Education Number 22 of 2006 dated May 23, 2006, concerning content standards, it is stated that mathematics subjects need to be given to all students starting from elementary school to equip students with the ability to think logically, reason, analytically, systematically, critically, and creative, as well as the ability to work together. In detail, the ability of creative thinking skills of students on the indicator of submitting conjectures owned by the subject. This can be known from the results of student work on test questions and interview questions. The subject in solving the problem can first explain the steps of solving the problem and predict how to solve the problem so that later obtain the truth in the process of solving the problem (Luo et al., 2020).

Indicators compile evidence and provide reasons for solving problems owned by the subject because in the process of learning and solving questions in the interview, the subject can solve problems by using a different point of view from his friends. The subject in solving the problem not only solves it but can explain how the process is solved and provide evidence against the problem that he has completed. The subject in the explanation process can explain well the answers he wrote on the test questions and the interview questions used by researchers during the interview process (Saleh et al., 2018).

The subject owns the indicator of concluding in the interview process after explaining the answers obtained in solving the subject test question. He can also conclude his answer (Hartatiana et al., 2017). In addition, the subject can check the truth of the answers obtained in the interview process to the completion of the test question by substituting the answers obtained into the questions to get the same answer as the test question (Kartono & Shora, 2020).

CONCLUSION

Based on the results of research conducted on students of class IX SMP Negeri 209 Jakarta where the research process was carried out to analyze students' reasoning ability in solving statistical material problems and the subjects used were one person selected from the test results that obtained the highest scores, the results obtained were subjects after the interview directly met four indicators of reasoning ability, namely the ability to submit

conjectures, the ability to compile evidence, provide reasons for solving the problem, the ability to conclude, and the ability to check the truth of the answer.

RECOMMENDATIONS

Based on the above conclusions, there are several things that the author wants to suggest, namely (1) it is expected to all teachers, especially mathematics teachers, to be able to develop students' reasoning skills in learning in addition to learning outcomes, (2) in students in order to continue their reasoning skills both in the learning process and in everyday life, and (3) This research is only limited to statistics, so it is expected in other researchers, who will carry out similar research to be able to continue or improve this research.

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