

STUDENT DEDUCTIVE REASONING IN SOLVING PROBLEMS OF ONE-VARIABLE LINEAR EQUATIONS THROUGH PROBLEM-BASED LEARNING

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Article History

Received: 06-02-2021 Revision: 28-03-2021 Accepted: 20-04-2021 Published: 30-04-2021 Abstract. This research aims to determine students' reasoning ability on the subject of the one-variable linear equation system through problem-based learning in class VII of SMP Negeri 11 Seram Barat. The type of research used is qualitative descriptive, with the number of subjects in this study amounting to 1 person. The instruments used are tests and interviews. The data analysis technique used is qualitative descriptive. Based on the data analysis results, the reasoning ability of the subject of class VII SMP Negeri 11 Seram Barat on the material of the linear equation system of one variable obtained the tendency of the subject to have reasoning ability. This is known by how the subject uses the problem, starting with general things that have been known as the truth and then obtaining a more specific conclusion. The subject in his learning has three reasoning indicators used in this study, submitting allegations based on how the subject solves the problem. The subject can give reasons for the arguments presented after the problem in the interview process. It can check the validity of an argument based on the resolution of the problem.

Keywords: Deductive Reasoning, One Variable Linear Equation System, Problem-Based Learning

Abstrak. Tujuan penelitian ini adalah untuk mengetahui kemampuan penalaran siswa pada pokok bahasan sistem persamaan linear satu variabel melalui pembelajaran berbasis masalah kelas VII SMP Negeri 11 Seram Barat. Jenis penelitian yang digunakan adalah deskriptif kualitatif dengan subjek yang dalam penelitian ini berjumlah 1 orang. Instrumen yang digunakan yaitu tes dan wawancara. Teknik analisis data yang digunakan yaitu deskriptif kualitatif. Berdasarkan hasil analisis data diperoleh bahwa kemampuan penalaran subjek kelas VII SMP Negeri 11 Seram Barat pada materi sistem persamaan linear satu variabel diperoleh kecenderungan subjek memiliki kemampuan penalaran. Hal tersebut diketahui dengan cara penyelesaian masalah yang digunakan subjek yang dimulai dari hal-hal yang bersifat umum yang telah diketahui kebenarannya kemudian memperoleh suatu kesimpulan yang lebih khusus. Subjek dalam pembelajarannya memiliki tiga indikator penalaran yang digunakan dalam penelitian ini, mengajukan dugaan yang didasarkan pada cara penyelesaian soal oleh subjek, subjek dapat memberikan alasan terhadap argumen yang disampaikan pada penyelesaian soal dalam proses wawancara, serta subjek dapat memeriksa kesahihan suatu argumen berdasarkan pada penyelesaian soal.

Kata Kunci: Penalaran Deduktif, Sistem Persamaan Linear Satu Variabel, Pembelajaran Berbasis Masalah

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INTRODUCTION

Mathematics is one of the most important basic knowledge for developing educational science and technology that is useful for the nation's development. Mathematics education aims to educate and expand knowledge, human experience and insight. This shows that education is a planned, organized, continuous process that boils down to a specific goal. The quality of a process will determine the outcome of the process (Zulkardi, 2006). Learning mathematics is an activity of understanding the meaning, relationships, and symbols applied in real situations. Mathematics involves observation, investigation, and association with physical and social phenomena. According to Hudoyo, mathematics concerns structured ideas whose relationships are arranged and arranged logically. Thus, mathematics is a science that studies nature, space, and numbers consisting of the results of human thought related to ideas. The process supported by reasoning requires experiments in obtaining facts that are used as the basis for argumentation (Hudoyo, 2001).

There are two visions of mathematics learning: directing mathematics learning to understand the concepts needed to solve problems and other sciences and directing to the wider future. Mathematics provides systematic, critical, careful, objective, and open problem-solving skills. This ability is indispensable in the face of an ever-changing future (Bani, 2011). Learning is a two-way communication process and teaching by the teacher as an educator while learners or students do learning. Learning is intended to shape time and civilization and improve the quality of student life (Raharjo et al., 2018). Learning needs to empower all potential students to master the expected competencies. Empowerment is expected to encourage the achievement of competence and behaviour, especially so that the individual's attitude can become lifelong learning and realize his reasoning power ability (Agustiana et al., 2019).

One of the teachers' complaints lately in junior high school is about students' difficulty in solving non-routine math problems. This is in line with the opinion expressed by Abdurrahman that many people (students) view mathematics as the most difficult field of study. The difficulties experienced by this student, of course, are due to the learning approach used in the learning process, less building the ability to think and problem-solving ability of students and the factor of learning habits, namely students are only accustomed to learning by memorization (Nehru & Syarkowi, 2017). Mathematics learning conducted by teachers places less emphasis on aspects of student thinking (Luo et al., 2020). They are especially using reason in solving various problems students face in the learning process. Teachers in their learning only focus on the aspect of grades students must achieve, namely good learning

outcomes. Reasoning skills in mathematics play an important role because with the ability to reason, and students can analyze and solve various problems faced by these students (Syafrizal et al., 2020)

SMP Negeri 11 Seram Barat is one of the formal institutions with a teaching staff that is thought by the author very well in the field of mathematics because teachers who teach mathematics are very experienced in teaching. However, although the learning process is considered good, there are still many problems found in SMP Negeri 11 Seram Barat in learning mathematics about the material of linear equations of one variable. Namely, students are less able to distinguish variables and constants and have not been able to determine the set of solutions of an equation. Finally, when asked a concept, students do not answer with confidence or instead choose to be silent. Understanding so many problems in mathematics (Isroila et al., 2018), there is a need to develop students' reasoning skills in learning through problem-based learning models so that it is expected to develop students' reasoning skills in the learning process (Syafrizal et al., 2020).

Using problem-based learning in mathematics can increase students' learning spirit and stimulate them to learn and think (Sianturi et al., 2018). Because through problem-based learning, students are faced with problems given by teachers, and students try to solve these problems (Nugroho et al., 2018). Thus, students will try to use their abilities by thinking and acting to solve these problems. This research aims to determine students' reasoning ability on the subject of the one-variable linear equation system through problem-based learning in class VII of SMP Negeri 11 Seram Barat.

METHOD

The type of research used in this study is qualitative descriptive. 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. Taking the subject is based on the highest grades obtained by class VII students after the test. The test results were taken from one student from the total number of students, 26 people who obtained the highest score in the test process to become the research subject. This research is said to be successful if the student who is the subject in this study has reflected the attitude or characteristics of reasoning, namely (1) submitting a conjecture, (2) providing a reason or evidence against the truth of a statement, and (3) checking the validity of an argument.

The instruments used in this study are researchers, tests, and interviews. Researchers are included in research instruments because, in the implementation of research, researchers are

directly involved in the research process. Namely, researchers plunge directly into the field by making observations and interviews. This is in line with Sugiyono's opinion that in qualitative research that becomes the instrument or research tool is the researcher himself (Sugiyono, 2013). The test implementation is used after the student learns the material of a one-variable linear equation system. The test's purpose is to determine the student who has the highest ability based on the student's test results and who will later be selected as a subject in the study. The interview is conducted after the test process is completed and interviews the subject, peers, and teachers to determine the subject's deductive reasoning skills in mathematics learning.

The data analysis technique used in this study is qualitative data analysis, following the concept developed by Miles and Huberman: data reduction, display data, and conclusion drawing. Data reduction is summarizing, selecting the main things, focusing on important things, and simplifying the data obtained from records in the field in the form of observations and interview results. Data presentation is an advanced process of data reduction. Once the data is reduced, it is presented in a brief description and structured, thus allowing the researcher to conclude. Conclusions are processes based on data obtained from data reduction and data presentation. Conclusions are supported by valid data so that the conclusions presented can be accurate (Sugiyono, 2013). For the data obtained in this research process to be valid and appropriate, the validity of the data is carried out using an extension of observations, increasing perseverance, peer examination, and member checking (Sugiyono, 2008).

RESULTS

The ability of reasoning students to solve problems in the material of the linear equation system of one variable then conducted interviews directly with the subject and colleagues. The results of interviews conducted with subjects and peers are as follows.

- R : Can Arfina re-solve problem number 1? Take a look at the number 1 problem. According to Arfina, how to solve it?
- AH : Based on the question, it is known that the number of two natural numbers is the same as 63, which is asked that is (1) if the first number is x, then state the second number also with x, and (2) determine the shape of the equation and determine the two numbers. So you have to make an excuse to solve the problem.

dik : Jumiah dua bilmgan asii - Kgung beruruh dir a) Tika bi langan pertama asir ayara kan Bilangan kedua dalam x 7 H susun persaman dalam x kemudian Tentukan birangan 1407 al Tika bilangan pertama = x Padi bilangon kedua adalah 63-x $\begin{array}{c} \Pr cr Samanya \\ x + (x + i) \\ y \\ \end{array} = 63$ Vilaga Z Kinn gan ke + (x+1) = 62 2x + 1 = 63 63-1 62 31 Indi Vilans an it adalah

Figure 1. Subject Work results on Question Number 1

- R : Try Arfina to explain the answer that Arfina wrote above?
- AH : in the question of number 1, it is known that the sum of two natural numbers is 63, so it is estimated that the number is x. The second number is 63- x. So the equation obtained is x + (x + 1) = 63. Once operated, the value is 31.
- R : Where does Arfina get the equation x + (x + 1) = 63?
- AH : It is known that the first number is x. Thus the second number is x + 1. Since the sum of the two numbers is 63, the equation is obtained if the two numbers are combined.
- R : Where did Arfina get a value of 2 x?
- AH : 2x is obtained from the value of x + x, and the result is 2x.
- R : According to Arfina, is the answer that Arfina got correct?
- AH : Yes, sir, it is known that a number is a natural number. The first number is 31 and belongs to the original number. So the possibility is true.

Based on the results of the interview above from the questions compiled, 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 student's completion also shows that the student is capable of mathematical manipulation.

Based on the results of the work and interviews above, the criteria set based on the characteristics of the subject's reasoning process in question 1 is the reasoning process, namely deductive reasoning that starts from general things. This is adjusted to the subject's steps in solving the problem of a one-variable linear equation system. The process of reasoning the subject starts from the general thing, namely, determining the known value in the problem after that trying to solve the problem.

Thus, it can be noted that the steps used by the subject in answering question number 1 by using statements that have been known to be true can then achieve a new statement whose truth can also be accounted for by the subject. The subject can also explain the problem-solving steps he used, after which he tested the fact he obtained by recasting the truth. The results show that students in solving problem number 1 first convey the allegations of the problem given by the teacher and then give a statement or reason about the problem by connecting facts that have been proven true. After conveying, the student proves the truth about his opinions by solving the questions given by the researcher, then making conclusions from the answers obtained and maintaining the statements or answers obtained in the process of solving the question. This proves that the subject uses his reasoning for the problem-solving a problem or problem.

Based on the results, it can be concluded that the subject solving question number 1 meets four indicators of reasoning ability used in this study. It is submitting conjectures, providing reasons or evidence for the truth of a statement, drawing conclusions from a statement, and checking the validity of an argument. This is based on the results of interviews with the subject directly and the process of solving questions carried out by the subject directly. To better know the subject's reasoning ability in the material of the linear equation system of one variable in the learning process, the researcher interviewed another question, namely question number 2, to be interviewed on the subject as a consideration and evaluation of the subject's reasoning ability.

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Figure 2. Subject Work results on Question Number 2

- R : Try Arfina to explain the answers obtained and how to get those answers?
- AH : In this case, it is known that the length of a rectangle is 6 cm longer than its width. Thus, if written, then the length of the rectangle is 6 + 1. The circumference of the rectangle is 64 cm, and then the rectangular circumference formula is 2p + 2l. Since the length (p) is already known as 6 + 1, then substitute

with its value, it will get its value to 4l + 12. If calculated using the formula of the circumference of the rectangle, it will be obtained the width of the rectangle is 13 cm.

- R : Where did Arfina get the value of 4l + 12?
- AH : 4l + 12. It can be from the description of the formula.
- R : What formula description?
- AH : The circumference formula is 2p + 2l, just because p is equal to 6 + 6, then if replaced, it will get two multiplied by 6 + l and summed by 2l so that if operated, it will get a value of 4l + 12.
- R : Where does the width formula come from?
- AH : In the matter of known circumference is 64 cm, what is asked is the width. To obtain the width, we operate the formula so that the width formula is obtained. Namely, the circumference is subtracted by 12 and divided by 4. So that if the value is entered, we get a width of 13 cm.

Based on the results of the work and interviews above, it can be concluded that the subject in solving the problem can reason. This is adjusted to steps used by the subject in solving the problem of the linear equation system and variables. The process of reasoning the subject starts from the general thing, namely finding the length value of a rectangle in advance based on the comparison results. After that, look for the value of the rectangle width based on the comparison. So that the final result is obtained, thus, it can be noted that the steps used by the subject in answering the question by using statements that have been known to be true can then achieve a new statement whose truth can also be accounted for by the subject. The subject can also explain the problem-solving step used.

Based on the above interviews, the subject showed four indicators of reasoning used in this study. These characteristics shown in this study are (1) the subject can convey a conjecture to a problem or question the teacher gives in the interview process. The following interview excerpts evidence this, (2) can provide reasons and explanations for opinions conveyed by using various facts or truths that have been known and or proven before to obtain a conclusion, and (3) can account for his opinion and explain in more detail about a conclusion he has obtained so that others can accept the validity of the argument or opinion he conveys.

Interview Results with Colleagues

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 VII of SMP Negeri 11 Seram Barat, the criteria for choosing colleagues were obtained by a student who 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. On that basis, a student named Sumarni Rumbia, with the initials SR, was selected as a peer and interviewed the student. The results of interviews conducted with colleagues are as follows.

- R : Arfina, in learning what if at home?
- SR : If at home, he is diligent in studying and playing only on Saturdays or Sundays.
- R : In completing the teacher's task, did he do it?
- SR : He is very happy to solve problems from teachers, especially training questions for the mathematics
- R : How is Arfina in the learning process in the classroom, especially in studying mathematics?
- SR : If in learning, he is often told by the teacher to solve the problem on the board.
- R : Do you think, in solving the problem, Arfina made a guess or prediction of the problem given by the teacher in the class? Can Sumarni give one example!
- SR : For example, like yesterday's study time. When the teacher gave me the training questions to do, I often asked Arfina how to solve them.

Based on the interview results above, it can be known that in the learning process and subject activities at home, someone 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 and expresses predictions or conjectures to the solution of the problem. After which, it solves the problem and concludes the process of solving it 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. 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.

DISCUSSION

The learning process in the classroom is an activity carried out between teachers and students. In its implementation, the use of methods determines the success and failure of the learning process (Nursyahidah et al., 2018). Problem-based learning emphasizes learning in a real-world context, which can help students more quickly understand the material and

remember the various lessons they have learned (Thomassen & Stentoft, 2020). Mathematics learning is a learning process that emphasizes implementing the student's thought process (Hidayah Putri et al., 2019). Because in studying mathematics, the relationship between one material and another is very close. For example, we cannot study material B if we have not mastered material A, and we will also not be able to study material C if we have not mastered material B. Therefore, student thinking activities are necessary to solve various problems in the learning process (Widyatiningtyas et al., 2015).

Efforts to develop students' reasoning skills greatly benefit problem-solving skills in everyday life (Noer & Gunowibowo, 2018). Reasoning ability is one of the goals in every learning activity in school. In addition to learning outcomes and achievements, the reason is one of the essential indicators in learning activities. With reasoning skills, students will be able to develop the abilities and knowledge they have gained to be useful, especially in solving problems within the scope of school learning and everyday life.

This research process was carried out using one subject, where the subject was selected based on the test results obtained by all students of class VII of SMP Negeri 11 Seram Barat. 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 the material problems of the linear equation system of one variable by relying on the indicators of reasoning ability, namely the ability to propose conjectures, the ability to conclude, and the ability to examine the validity of the answers obtained.

Based on the results of the interviews, it was obtained that the subject in solving the question of either the interview test question used for the interview tended to use reasoning skills. This is known based on the results of student work because students solving problems can do it well by solving the problems taught by teachers during the learning process (Wibowo, 2017). The results of interviews with colleagues also support the reasoning ability possessed by the subject. The results of interviews with two people justify the attitude and activities in the learning process. 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, explain it in the interview process, and check the truth of the answers they obtained in the learning process. In detail, the ability of the student's reasoning ability on the indicator of submitting conjecture is 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 (Herdiman, 2017).

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 (Apriani et al., 2019). 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 both on the test questions and on the interview questions used by researchers during the interview process.

CONCLUSION

Based on the results of research and discussion, the author can conclude that the reasoning ability of class VII subjects of SMP Negeri 11 Seram Barat on the material of the linear equation system of one variable obtained the tendency of the subject to have reasoning ability. This is known by solving the problem used by the subject, starting from general things that have been known to the truth and then obtaining a more specific conclusion. The subject in his learning has three reasoning indicators used in this study, submitting allegations based on the way the subject solves the problem, can giving reasons for the arguments presented after the problem in the interview process and can check the validity of an argument based on the solution of the problem he did.

RECOMMENDATIONS

Based on the above conclusions, there are several things that the author can suggest. Namely, (1) it is expected for teachers to be able to develop students' reasoning skills in the learning process, especially in studying mathematics, and (2) this research is still limited to 3 indicators of reasoning ability, so it is expected to other researchers to be able to carry out similar research and in a wider context.

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