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Representation skills students reviewed from the prior knowledge through realistic mathematics education in a linear material program

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Abstract. The ability of mathematical representation in mathematics can be seen from the process of mathematical representation in various dimensions, one of which is the students' initial knowledge of students. This study aims to examine differences in the achievement of mathematical representation between students who get lectures with realistic mathematics education and those who get lectures with conventional reviews in (a) overall; (b) prior knowledge based on high, medium, or low level. Through realistic mathematics education and describe the process of error in students' mathematical representation of students for each indicator. This type of research is a Mixed Method research, and the research design is Concurrent Embedded. Whereas the comparative test of the control and experimental groups with the average difference test. Research subjects consisted of 32 people in semester IV. The results showed differences in mathematical representation ability between students who received lectures with Realistic mathematics education, and those who received lectures with conventional review as a whole, based on students' initial abilities for the upper, middle and lower groups. Most students still have difficulty determining the example used and many errors using inequality marks, difficulty drawing graphics, determining the area of resolution.

1. Introduction

Abstract concepts of mathematics are one of the many obstacles in learning mathematics for students, especially for students whose intellectual development has not reached the stage of formal operations [1,2]. The still low abstraction ability is often an obstacle to learning mathematics, not only experienced by students, and perhaps even by educators in mathematics education, prospective teachers of mathematics [3,4]. The instructor gives some examples of how the theory is used to research [5]. Mathematics has an important role to play in promoting science, technology and communication growth. [6]. Linear programs are one of the topics of the fourth-semester lectures given to students.

A linear program lecture aims at solving optimization problems (maximizing or reducing a goal) to gain an advantage over the desired goal. There are many steps to be taken in achieving the desired optimum value, starting with changing contextual issues into mathematics models in the form of inequality systems and then producing graphs. The optimal value of the initial issue is calculated from the map. With this, the subject of linear programs is related to other mathematical topics such as equation systems and linear inequalities. Students must therefore, have strong representational skills so that the

process of understanding linear program content can be swift. The ability of representation needs to be analyzed because of the ability representation has several very important functions [7,8]. The ability of mathematics representation can help students explain concepts or ideas, and make it easier for students to get solving strategies, and representation is also useful to increase the flexibility of students in answering math problems. The ability of representation is also one of the important and fundamental components for developing students' thinking abilities because in the process of learning mathematics it is necessary to link the material being studied, represent ideas or ideas in various ways to communicate their solutions to others, and form attitudes in mathematics [9,10].

The ability of representation an important and fundamental component for developing student's thinking skills because in the mathematics learning process it is necessary to connect the material being studied, to represent ideas or ideas in different ways to communicate their solutions to others and to form attitudes in mathematics [11–13]. Representation is a configuration of one's thinking as a whole or divided which is connected simultaneously [14]. Teachers use many representations of mathematics education to promote the teaching of mathematical concepts. The ability of representation has several very important functions to be analysed due to the ability representation. The ability to represent mathematics can help students explain concepts or ideas, and make solving strategies easier for students, and representation is also useful in increasing students ' flexibility in responding to math problems [15]. The teacher who in this case is a lecturer must motivate students to represent various ideas in ways that are easier to understand [16]. Students are required to learn conventional forms of representation to facilitate learning mathematics and their communication with others about mathematics ideas. Mathematics representations are depictions, translations, disclosures, reappointments, mining, or modeling, conceptual ideas in mathematics, and relationships including those included in a configuration, construction, or certain situations that are displayed in various forms to obtain clarity of meaning, represent their representations or find solutions to the problems it faces [17]. Representations include forms of spoken language, written symbols, images or physical objects, (b) internal representation (mental representation) cannot be directly observed because it is a mental activity in the brain, including thinking about mathematics ideas.

The level of initial knowledge affects the slow pace of students in mastering matter [18]. Students with high and moderate initial knowledge may not have trouble understanding the material to have better learning achievements in mathematics. But for students the low initial knowledge, there may be many difficulties in understanding the material resulting in a low mathematics representation of students. This is an issue of consideration in the differences in strategies that students use to solve problems.

The fundamental knowledge of students has a significant role because there is a connection between material one with the other material. Students 'initial mathematics knowledge influences students' mathematics abilities. Introduction to mathematics and mastery of mathematical material for mathematical mastery [19,20]. Related to this matter then the purpose of this research is to examine the differences in the achievement of mathematics representation abilities between students who get lectures with realistic Mathematics Approaches and those who get lectures with conventional review in (a) overall; (b) based on prior of knowledge (high, medium, and low) through realistic mathematics education and describing the process of errors in mathematics representation of student students for each indicator.

2. Method

This research is a mixed methods study, and the design used in this study is an experimental design type pre-test-post-test-control group design. The first group is the experimental group as a group that is given the lecture treatment of the realistic approach and the conventional control group. In this mixed method study using a parallel, convergent mixed method strategy, the stages include, (a) collecting qualitative data and quantitative data first, (b) analyzing the data separately, (c) comparing the results of the analysis to find out whether the findings are mutually informing or not [21–23].

The population of this research is students of one of the Mathematics Education Study Programs in Cirebon City. The sample of this study was the fourth-semester students of the 2018-2019 academic

year. This study uses two classes, for each class divided into high, medium and low categories based on the Prior of Knowledge category. The fourth-semester students consist of two classes namely class A and B. Class A the number of students consists of 30 students and class B totaling 32 people. Research instruments in the form of results of tests of mathematics representation ability, and observation and interview guidelines.

Early Mathematics Knowledge a student's ability before the lecture takes place and used for placement of students based on their initial mathematics abilities. Many students in understanding lessons depend on the initial abilities that provide memories for students in finding the information they need and when they need it [24]. Initial knowledge is considered as the accumulation of intelligence possessed at the beginning of the lecture material which can be used where and when correctly. Students in understanding lesson material are influenced by the initial knowledge they have [17]. The formation of initial knowledge is influenced by the quality of lectures experienced by previous students. Knowing the initial ability of students is expected to be able to determine the learning model at the time of the lectures like what is right, while for students, as an evaluation material of the weaknesses and strengths in themselves, so they can better follow the next lecture. Adequate initial knowledge can help students develop their knowledge. This is in line with the opinion that it is important to detect initial abilities as supporting data to develop policies that produce all students [25]. This initial knowledge is a basic reference for continuing the struggle for progressive knowledge. Prior to knowledge for the experimental class and the control class in this study were obtained from the ability of mathematics resilience that has been differentiated into the high, medium, and low levels.

Quantitative data were collected from the results of the experimental class and control class representation ability, then evaluated using Two-ways ANOVA to see the ability to represent mathematics as a whole or based on high, medium and low grades. Qualitative data were obtained for each item from the analysis of the student response description.

3. Result and Discussion

The independent test results sample test gain of the experimental class with the control class indicates that the equal variance assumed value in sig. (2-tailed) is 0,000 (less than 0.05) then H_0 is rejected. That is, there is a difference in the average achievement of mathematics representation ability between students who get lectures with realistic Mathematics Approaches and those who get lectures with conventional studies as a whole.

The differences in the achievement of mathematics representation ability between students who get lectures with realistic Mathematics Approaches and those who get conventional lectures are reviewed based on the lower group there are differences. The independent test results sample test gain value experimental class with the control class shows that the equal variance assumed value on the sig. (2-tailed) is 0.35 (more than 0.05) then H_0 is accepted.'

The ability to achieve mathematics representation skills between students who get lectures with realistic Mathematics Approaches and those who get lectures conventionally reviewed based on the middle group prior to knowledge shows differences. The independent test results sample test gain of the experimental class with the control class indicates that the equal variance assumed value on the sig. (2-tailed) is 0.02 (less than 0.05) then H_0 is rejected.

Test results independent sample t-test the gain value of the experimental class with the control class seen in. Indicates that the equal variance assumed value on the sig. (2-tailed) Is 0, 491 (more than 0.05) then H_0 is accepted. That is, there is no difference in the average achievement of mathematics representation abilities between students who get lectures with realistic Mathematics Approaches, and those who get lectures conventionally are reviewed based on prior knowledge in the upper group. The following are data obtained from the results of the posts about the ability of students' mathematics representation.

3.1 Symbol Representation Indicator

Given a mathematical problem: "An ornamental fish breeder has 20 ponds to maintain koi fish and chef fish. Each pool can accommodate only 24 fish or only 36 koi. The number of fish planned to be maintained is no more than 600 fish. If many ponds containing chef's fish are x, and many ponds contain

koi fish, make a mathematics model". One model of student answers in solving this problem can be seen in Figures 1 and 2.

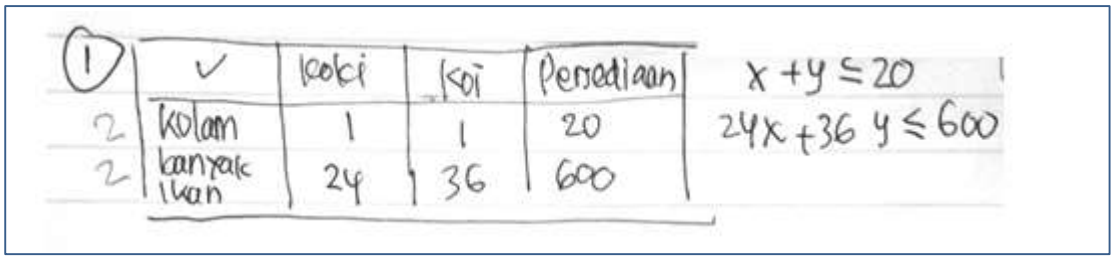

Figure 1. Student's error answer 1st on the symbolic representation indicator.

Based on picture 1 and 2, it can be seen that students are not careful in determining the sign ≤ or ≥ on a system of two- variables inequalities and do not specify the examples for x and y given in the inequality system. Based on this mistake, it causes students not to change realistic problems into mathematics models correctly. The learner is unstructured and not systematic in solving the math problem, which means that only the students do the answer. While sometimes not completed the step of learning, preparation and looking back [8,26].

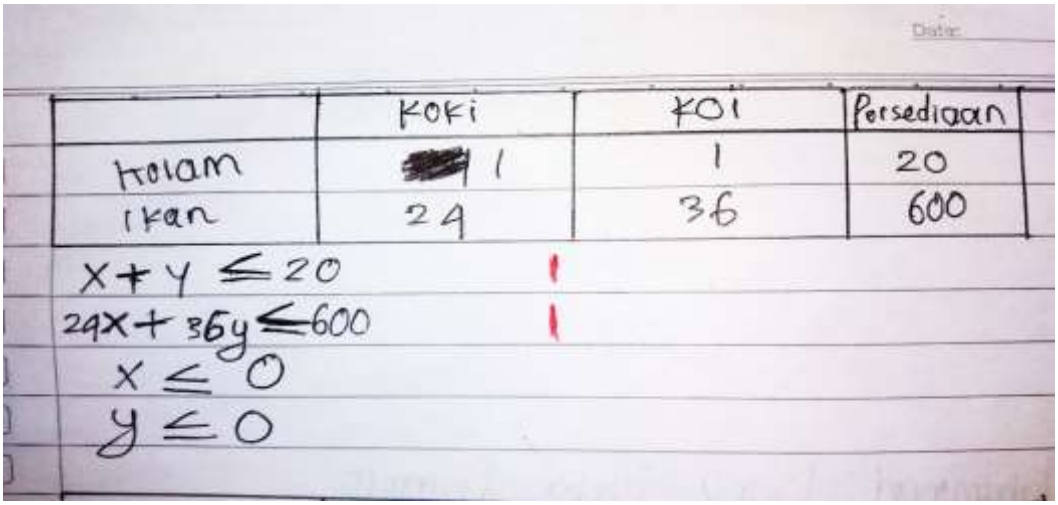

Figure 2. Student's error answer 2nd on the symbol representation indicator

3.2 Graph Representation Indicator

Given a mathematical problem like in picture 3:

A mother has 4 kg of flour and 2,4 kg of butter

Donut:	Bread:
80 gr of flour	50 gr of flour
40 gr butter	60 gr butter

If he has to make at least 10 donuts then make a graph of the inequality system that fits the problem

Figure 3. Second math problem

Some students have been able to understand the indicators of the ability of mathematics representation in graphical representations, resulting in a comprehensive relationship, ut some students

still make mistake in working on the problem related to modeling of mathematics. The large percentage of students answer the questions correctly, namely 83%. Some examples of errors can be seen in the figure 4. and figure 5.

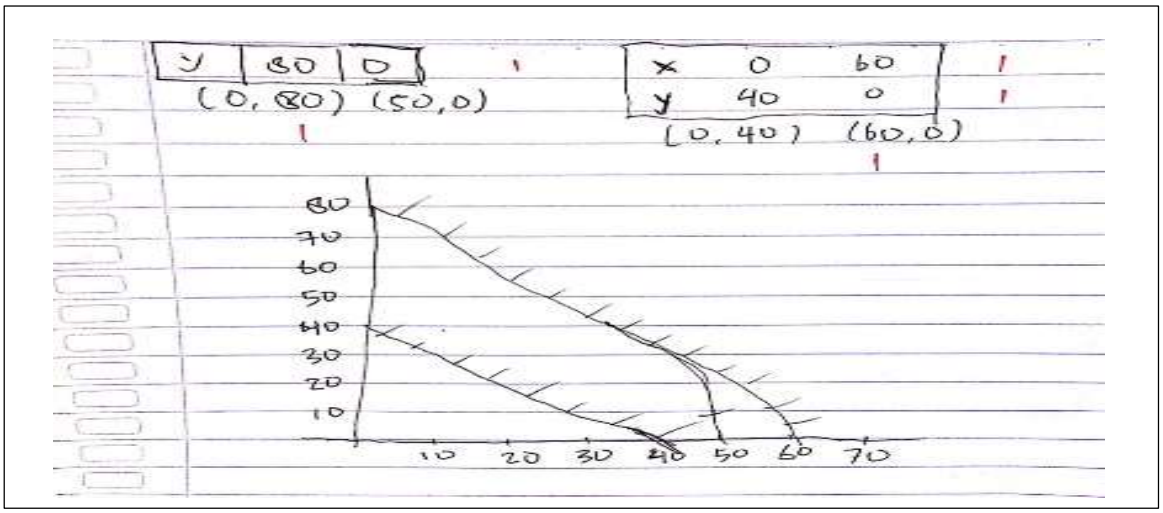

Figure 4. Student's error on graph representation indicator

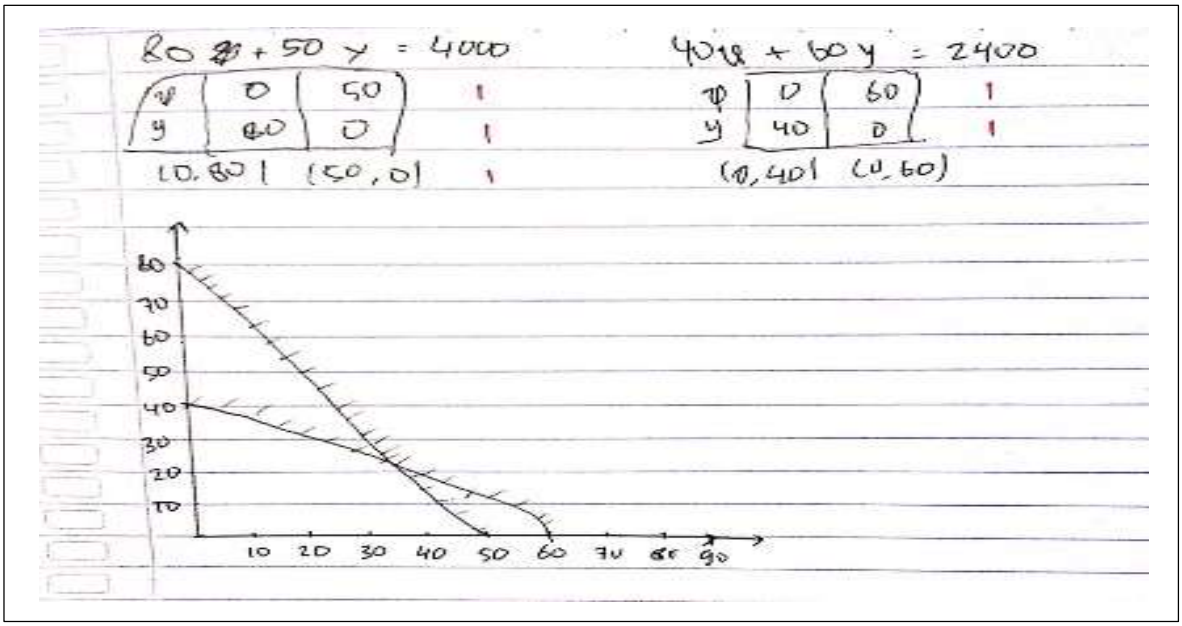

Figure 5. Student's error on graph representation indicator

3.3 Visual Representation Indicator

A tailor will make clothes for model A and model B. Model A requires 1 meter of plain cloth and 1.5 meters of striped fabric. Model B requires 2 meters of plain fabric and 0.5 meters of striped fabric. Plain fabric inventory of 20 meters and 15 meters in stripes. Clothing model A sells for Rp. 70,000.00 and clothing model B sells for Rp.55,000.00. How many models A and model B are there so that the tailor's profits are maximized?

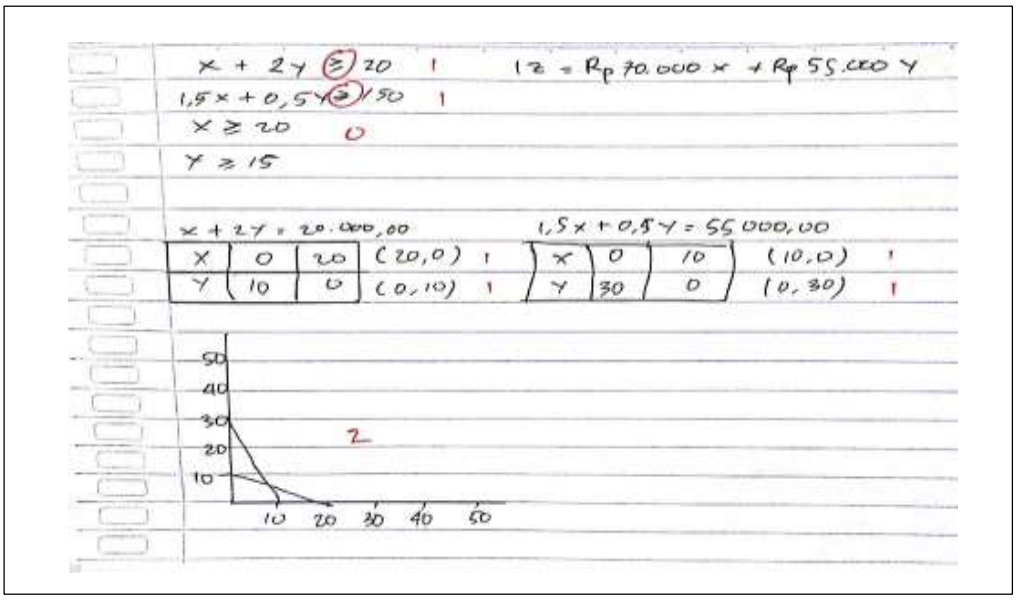

Figure 6. Student's 1st Error on the Symbolic Representation Indicator

Students have been able to understand the indicators of the abilities of mathematics representations such as visual representations, symbol representations, and graph representations. Representation as a crucial element in learning mathematics is not only because they use of symbol systems is very important in mathematics; the syntax and semantics are rich, varied and universal; but also because of epistemological strong reasons that mathematics plays an important part in the conceptualization of the real world. In the case of this problem, students recognize and apply mathematics topics to other topics as well as outside mathematics, but most other students are still mistaken in working on the problem. The large percentage of students answer the questions correctly, namely 79.11%. Errors experienced by students, namely determining the function of constraints and the process of working on students only arrive at drawing graphics, as shown in Figure 5 and 6.

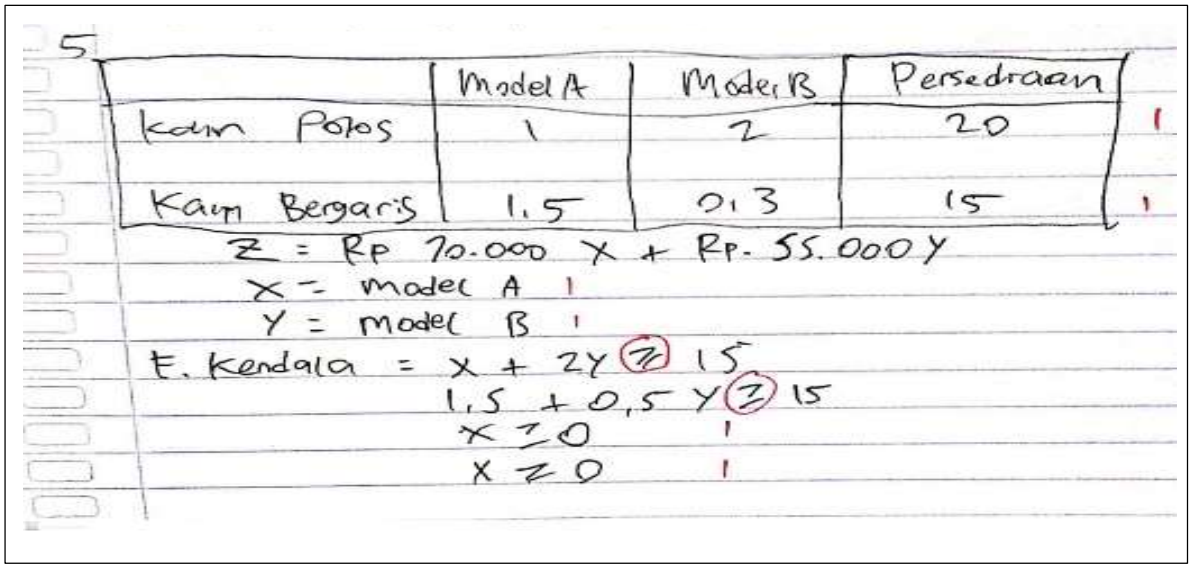

Figure 7. Student 2nd Error on the Symbolic Representation Indicator

Students are less careful in determining the sign " $\leq$ " in making the constraint function. The answer should be the right $x + 2y \leq 20$ and $1.5x + 0.5y \leq 15$, but the student answers $x + 2y \geq 20$ and $1.5x + 0.5y \geq 15$, so it can be concluded that students still have difficulty determining $\leq$ or $\geq$ sign on the problem he is working on. In addition to working on these questions students only arrive at the stage

of drawing graphics, the right thing is that students work on the problem until the stage determines the optimum value.

The results of interviews with several students that the difficulties experienced by students in the linear program material because the material has a lot of relevance to other material while students lack an understanding of the previous material concepts. In terms of making a student mathematics model, it is difficult to determine the example of the variables x and y that are used and are often mistaken or confused in using the inequalities $\leq$ and $\geq$ that correspond to the problems given. The skill of the mathematical representation of students is low because it is difficult for students to bridge representation and switch from one representation to another, especially in the form of words [27,28].

Incompetency in drawing graphs of constraints functions students are less able to determine the intersection of lines so that the resulting graph becomes inappropriate. Some students have difficulty determining the area of completion of the graph from the constraint function. This is the initial obstacle so that to solve the problem of optimum value; students experience some difficulties in the step of drawing a graph then determine the settlement area, this is because students do not understand the concept of a system of two-variable linear equations. Students need to repeat materials to build awareness that can improve performance and skills Students need to repeat materials to build awareness that can improve performance and skills. Knowledge building is an active process, not a passive one [29]. Low representation makes it difficult for students to solve different algebra, geometry, and linear equations because it is difficult for students to change [30]. This is because students are seldom allowed to articulate their ideas during the learning process [31]. Teachers can therefore, avoid this problem by shifting the perceptions of students towards mathematics [32].

4. Conclusion

The results showed differences in mathematical representation ability between students who received lectures with Realistic mathematics education, and those who received lectures with conventional review as a whole, based on students' initial abilities for the upper, middle and lower groups. Most students still have difficulty determining the example used and many errors using inequality marks, difficulty drawing graphics, determining the area of resolution.

Based on the problems described, it can be concluded that the ability of students' mathematics representation is still lacking. Students still have difficulty in relating the relationship of mathematics ideas related to other mathematics topics. These difficulties are caused by several factors, including internal factors of the student and external factors. One of the causes of students' lack of mathematics representation ability is that students are not given a representation of the relevance of topics in mathematics. These difficulties indicate the existence of barriers to student learning in mathematics learning. The use of learning resources is also an important thing, while books owned by students are not varied so that students are only fixated on one reading. The existing books are not understandable, so the discussion raises confusion during learning. Also, students need to be helped to use appropriate learning approaches such as realistic mathematics learning in learning activities to make them easier to understand so that students can have good mathematics representation skills

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