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INTERACTION OF STUDENT-MATERIAL-STUDENT WITHIN REALISTIC MATHEMATICS EDUCATION LEARNING APPROACH IN SOLVING PROPORTION PROBLEM

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Abstract

According to Permendikbud no. 23 of 2016, the learning process in the 2013 curriculum focused on the interaction between students and educators and learning resources in a learning environment. One approach in mathematics learning that uses student interaction during the learning process is realistic mathematics educational approach. One step of realistic mathematics education is the step of solving problems. This research is qualitative-descriptive research with aims to describe the student-material-student interactions during solving problem in mathematics learning using realistic mathematics educational approach on the material of proportion. The subject of student-material-student interactions is a group that consisted of a high-achieving-student, a middle-achieving-student, and a low-achieving student. The data are gathered by using observation (observation paper, video recorder, and sound recorder). The result of this research showed that when solving problem occurs the interaction asking for help, giving help, and discussion of ideas, models, procedures, and problem-solving.

Keywords: student interactions, realistic mathematics education approach, direct proportion, inverse proportion

INTRODUCTION

Currently, education in Indonesia uses the 2013 curriculum. According to Permendikbud no. 23 of 2016, the learning process in the 2013 curriculum focused on the interaction between students and educators and learning resources in a learning environment. Vygotsky stated that heterogeneous small group social interactions can help students utilize their ZPD (Zone of Proximal Development) to a higher understanding (Slavin, 2000).

The use of interaction between students is one of the main things in mathematics learning. So that observation of the interaction between students is important in the learning process. This is parallel to the findings of studies by Webb (1991) and Suradi (2005) which emphasizes the importance of student interaction in the learning process of mathematics to improve student learning achievement. Therefore, there needs to be an effort to develop student interaction in learning mathematics so that it can improve learning achievement.

Interaction is verbal communication in activities asking for help, giving help, and discussion/ negotiation between students or students and their teachers during the learning process to achieve learning goals.

According to Shaw (in Ali and Asrori, 2010) there are three forms of interaction: (1) verbal interactions are interactions that occur when two or more people make contact with each other using articulation tools (the process occurs in the form of conversation with each other), (2) physical interactions are interactions that occur if there are two or more people making contact using body languages (for example: body position, eye contact), and (3) emotional interactions are the form of interaction that occurs when individuals make contact with each other by making outrage of feelings (for example: shedding tears. The form of interaction in this research is verbal interaction that focuses on student conversations concerning subject matter (in assignments) during the problem solving step.

There are several forms of interaction. According to Sardiman (2010), interactions can be in the form of explanations, discussions, questions, or approvals used to solve problems. Webb (1991) stated interactions can take the form of giving help and asking for help. Meanwhile, Atun (2012) consider the form of interaction in realistic mathematics learning in the form of negotiation, explanation, justification, agreeing, disagreeing, and questions. It can be concluded that the form of interaction is the interaction of asking for help, giving help, and discussion/negotiation because the question is a form of interaction asking for help. Then, explanation, justification, agreeing and disagreeing are forms of giving help interactions, and discussion/negotiation. According to Leiken & Zaslavsky (1997), giving help interactions can be done by giving explanations, and without explanation.

Interactions that occur during the learning process to achieve learning goals are called learning interactions

(Suradi, 2005). Learning interaction is one part of student activity in the classroom. One type of learning interaction according to Leikin & Zaslavsky (1997) is interaction in the task. Interaction in the task is an interaction related to the subject matter.

There are two types of interactions in the task (related to the subject matter) that are categorized as active and communicative, namely the interaction of students and students regarding subject matter (student-material-students) and student-teacher interaction related to the subject matter (student-material-teacher). In this study, the interaction focused only on verbal interactions between students when solving problems in realistic mathematics learning.

In student-material-student interactions, the category of student activities related to interaction refers to the categories that have been used by Suradi (2005) in his research and adapted to realistic mathematics learning.

1. Giving help

   Students' interactions are categorized as giving help, if the student give information or expressions verbally to other students relating to the subject matter both requested and unsolicited. The expression given can be accompanied by an explanation or without explanation.
2. Asking for help

   Interaction of students categorized as asking for help, if the student ask questions verbally about teaching material or students express statements or questions to seek help from other students to solve problems. Asking for help can be accompanied by an explanation request or without explanation.
3. Discussion / Negotiation

   Interaction of students categorized as discussion if two or more students together discuss how to solve the problem, including together to determine the answer if there is a difference of opinion. While negotiation is the expression of students if there are differences of opinion or answers.

One of approach in mathematics learning that uses student interaction during the learning process is learning with a realistic mathematical approach which is then referred to as realistic mathematics learning. Realistic mathematics learning is learning adopted from Realistic Mathematics Education (RME). RME is a mathematical learning theory that has been developed in the Netherlands since 1970 (Van den Heuvel-Panhuizen, 2003). Gravemeijer (2008) stated three principles realistic mathematics approaches, (1) guided reinvention through progressive mathematizing, (2) didactical phenomenology, dan (3) self developed models. The three principles expressed by Gravemeijer (2008) are operationalized into five characteristics of mathematics learning with realistic mathematical approaches, (1) use of real world context, (2) use of models, (3) student contribution, (4) interactivity, and (5) intertwining.

Based on characteristics of realistic mathematical approach, there are 4 steps of realistic mathematics learning adapted from Murniyati (2017), understanding problems, solving problems, comparing and discussing answers, and drawing a conclusion. The step of solving problems is one step that will cause a lot of interactions in learning. This is based on the result of a study onducted by Auladina (2017) which states that students ask each other or discuss to solve a problem during the step of solving problems in mathematics learning in the classroom.

One of mathematical material that has many applications in daily life is material of proportion, so, many realistic problems can be used in learning material of proportion. However, contrary to the many proportion problems in everyday life, there are many students who have difficulty in solving proportion problems especially related to the direct proportion and inverse proportion that shown in Raharjanti (2016), and Supriyanto (2017).

Student interaction that has not been directed in the learning process is one of reason students don't understand a material. Student interaction is one of the determinants of students' success in learning with a realistic mathematical approach, but not many research have discussed how student-material-student interactions in learning with realistic mathematical approaches, such as how students asking for help, how students help to other students and how students discuss or negotiate with other students. So, this research is intended to describe student-material-student interactions when solving proportion problems in realistic mathematics learning.

Based on the description above, the aim of the research are describing the interaction of student-material-student within realistic mathematics education learning approach in solving proportion problem.

METHOD

This research is qualitative-descriptive research with aims to describe the interaction of student-material-student within realistic mathematics education learning approach in solving proportion problem. Data collection was conducted at SMP Labschool UNESA, Surabaya in class VII-B.

The subject of student-material-student interactions is a group that consisted of a high-achieving-student, a middle-achieving-student, and a low-achieving-student. The data are gathered by using observation (observation paper, video recorder, and sound recorder).

Data analysis based on observations on video recordings, sound recordings, and observation paper. From the results of the observations, will be described the verbal

expressions of the students when interacting during solving problems in realistic mathematics learning in the proportion materials. In describing student-material-student interactions the label "T" is used for high-achieving-student, "S" for students with middle-achieving-student, "R" for low-achieving-student.

FINDING AND RESULT

Interaction of student-material-student are students interact with other students related to material of direct proportion and inverse proportion in learning with realistic mathematical approaches. Observation of student interactions is done at the solving problem step.

1. Material of direct proportion

The student-material-student interaction in the categories of "asking for help" in solving direct proportion problem appears within the activity of students asking for an explanation of the model used to solve problems related to the value of one unknown magnitude. Moreover, students asking about ideas to solve problems related to the value of one unknown magnitude and related to the graphic form of direct proportion, and then, students ask for an explanation of problem-solving from other students related to the value of one of the unknown magnitude, a comparison of two magnitudes, a graphic form, and an equation of direct proportion. The last, students asking for clarification or ask questions related to solving problems regarding the value of one unknown magnitude, relationship of two magnitudes, comparison of two magnitudes, graphic form, and an equation of direct proportion. Asking for help interaction is done by all students both S, R, and T students. Interactions "asking for help" in solving direct proportion problems are mostly done by students with low-achieving-student. The dominant form of "asking for help" is a question related to problem solving or asking for clarification of the solution obtained.

The student-material-student interaction in the categories of "giving help" in solving direct proportion problem appears within the activity of students expressing words or sentences to explain the model that used to solve problems related to the value of one unknown magnitude to other students. Moreover, students expressing words or sentences to explain steps or procedures to complete problems related to the value of one of the unknown magnitude, the relationship of two magnitudes, the comparison of two magnitudes, the form of graphics, and an equation of direct proportion to other students. The last, students expressing words or sentences in the form of short answers without explanation when solving problems related to the value of one unknown magnitude, the relationship of two magnitudes, a comparison of two magnitudes, graphical form, and an equation of direct proportion. Giving help interactions is only done by T students, S students, and S_{11} students from other groups. Giving help interactions when solving problems is mostly done by students with high-achieving-student. The dominant form of "giving help" is giving short answers without explanation.

The student-material-student interaction in the categories of "discussion/negotiation" in solving direct proportion problem appears within the activity of students discussing/negotiating procedures and problem solving related to the value of one unknown magnitude, comparison of two magnitudes, graphic forms, and an equation of direct proportion with other students. Moreover, students discussing the model used to solve problems regarding the value of one of the unknown magnitude with other students. Discussion / negotiation interactions are carried out by all group members namely T, S, and R students. The dominant form of "discussion/negotiation" is a discussion of the procedure for solving problems.

Based on the results of observations of student-material-student interactions during solving direct proportion problems, all students interacted in the category of "asking for help" and "discussion", but only low-achieving-student who didn't interact in the category of "giving help". In addition, there are "giving help" interactions by high-achieving-student students in other groups in solving problems in one number. Student-material-student interactions during completing direct proportion problems are presented in the figure below.

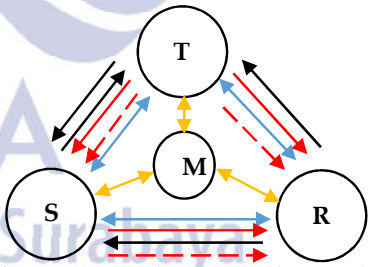

Figure 1 Student-material-student interactions when solving direct proportion problems in group discussions

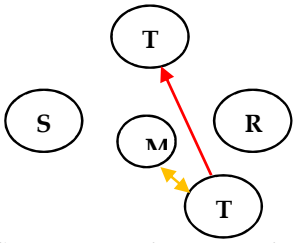

Figure 2 Student-material-student interactions when solving direct proportion problems in class discussions

Note of the meaning of arrow:
- : Asking for help
- : Giving help with explanation
- : Giving help without explanation
- : Discussion/negotiation
- : Interaction related to the material

2. Material of inverse proportion

The student-material-student interaction in the categories of "asking for help" in solving inverse proportion problem appears within the activity of students asking for an explanation of the model that used to solve problems related to the value of one unknown magnitude. Moreover, students asking about ideas to solve problems related to the value of one unknown magnitude. And then, students asking for an explanation of problem solving from other students related to the value of one of the unknown magnitude, a relationship of two magnitudes, a graphic form, and an equation of inverse proportion. The last, students asking for clarification or ask questions related to solving problems regarding the value of one unknown magnitude, relationship of two magnitudes, comparison of two magnitudes, graphic form of inverse proportion. Interaction asking for help is done by all students both S, R, and T students. Interactions asking for help in solving inverse proportion problems are mostly done by middle-achieving-student. The dominant form of "asking for help" is a question related to problem solving or asking for clarification of the solution obtained.

The student-material-student interaction in the categories of "giving help" in solving inverse proportion problem appears within the activity of students expressing words or sentences to explain the model that used to solve problems related to the the value of one unknown magnitude to other students. Moreover, students expressing words or sentences to explain steps or procedures to complete problems related to the value of one of the unknown magnitude, the relationship of two magnitudes, the comparison of two magnitudes, the form of graphics, and an equation of inverse proportion to other students. The last, students express words or sentences in the form of short answers without explanation when solving problems related to the value of one unknown magnitude, the relationship of two magnitudes, and graphical form of inverse proportion. Giving help interactions is only done by T students and S_{11} students from other groups. Giving help interactions in solving inverse proportion problems are mostly done by high-achieving-student. The dominant form of "giving help" is giving short answers without explanation.

The student-material-student interaction in the categories of "discussion/negotiation" in solving inverse proportion problem appears within the activity of students discussing/negotiating procedures and problem solving related to the graphic forms of inverse proportion with other students. Discussion/negotiation interactions are carried out by all group members namely T, S, and R students. The dominant form of "discussion/negotiation" is a discussion of the procedure for solving problems.

Based on the results of observations of student-material-student interactions in solving inverse proportion problem, R students and S students interacted in the categroy of "asking for help". In addition, T students also interacted in the catogy of "asking for help" from high-achieving-student in other groups. Then, giving help interactions is only done by T students in groups which are also observed and carried out by –high-achieving-student students in other groups. Student-material-student interactions during completing a inverse proportion problems are presented in the figure below.

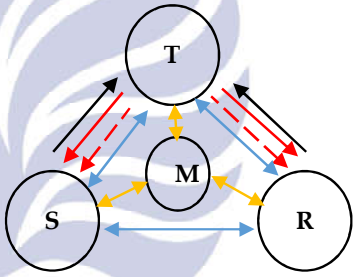

Figure 3 Student-material-student interactions when solving inverse proportion problems in group discussions

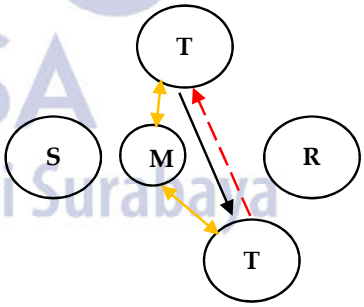

Figure 4 Student-material-student interactions when solving inverse proportion problems in class discussions

Note of the meaning of arrow:
- : Asking for help
- : Giving help with explanation
- : Giving help without explanation
- : Discussion/negotiation
- : Interaction related to the material

During solving the problem of direct proportion and inverse proportion in realistic mathematics learning, the student-material-student interactions that occurs are student interactions in the category of “asking for help”, “giving help”, and “discussion/negotiation” in group discussions and interaction categories asking for help and giving help in class discussions.

Students' interactions in solving problems are mostly done when students solving problem number 1 that related to completing the table of magnitude in the direct proportion and inverse proportion. This problem has many solutions and strategies to complete the empty table, and the problem can be imagined by students because it is related to the problem about the number and price of books and the speed and distance that is so close to the lives of students. This is parallel to the findings of studies by Chapman (2004) and Retnowati (2009) which states that open problems and can be imagined by students provide opportunities for students to interact with other students.

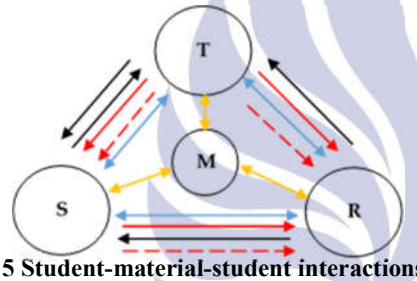

Figure 5 Student-material-student interactions when solving problems in group discussions

From Figure 5, the asking for help interactions that occurs during solving proportion problems in a group discussion is asking for an explanation of the ideas, models, procedures, and problem solving and asking for clarification or asking questions related to procedures and problem solving. Meanwhile, the most dominant asking for help interactions is asking for clarification or asking questions related to procedures and problem solving.

In the category of asking for help interactions asking, dominant is done by R students. R students do asking for help from T students to ask questions about solving problems and ask for clarification, such as verbal expressions "80?" to confirm answers. and ask for an explanation of the idea of solving a problem such as an oral expression “... ini diisi gimana?” and ask for an explanation of the model and procedure for solving problems such as verbal expressions “maksudnya gimana sih? Gamudeng aku”. In the verbal expressions “gamudeng aku”, according to Webb (1991) is an expression of incomprehension which shows that students ask for help in the form of explanation. However, several times, student R also asking for help form student S in the same form. This is parallel to the findings of studies by Suradi (2005) which states that low-achieving-student tend to ask for help in clarifying problem solving to high-achieving-student and middle- achieving-student. In addition to student R, student S also ask for help only to students T in the form of requests for explanations of ideas and procedures to solve problems and questions related to solve problems and asking for clarification. Typical of verbal expressions when students do asking for help interactions when solving problems are “gimana yang ini?”, “habis gitu, ini gimana?”. Webb (1991) stated student questions that contain the question "how" shows that students do asking for help with explanation. In addition, other students' typical of verbal expressions such “iya ta?”, ”ini ... ya?”, according to Webb (1991) questions in the form of yes or no question shows that students want to confirm answers that only require short answers without explanation.

So, T students is the most dominant student in the giving help interactions when asked for help or not asked for help, to help R and S students. T students do giving help with explanations such as the verbal expression “Ini jarak kota A dan kota B itu 120 km. Berarti mencari waktu itu 120 dibagi 40”, and giving help without explanation, such as the verbal expression " 2 banding 5 ". This is parallel to the findings of studies by Webb (1991) that students giving help with explanation and without explanation. In addition, S students also do giving help R students in the form of giving clarification without explanation. Typical of verbal expressions when students do giving help interactions when solving problems are “ini itu....”, “kalau sudah, lanjut ....”, and “itu yang ditanyain kan..., berarti ....” followed by an explanation. According to Webb (1991) student questions that contain the question "how" shows that students ask for help with explanation. In addition, other students' typical of verbal expressions are "iya", "600", and "bagi 5" which are expressions to giving help in the form of short answers without explanation. Webb (1991) stated when giving help is not followed by explanation, it means that students don’t elaborate how to get the right answer so that the giving help is only a short answer.

Meanwhile, interactions in the discussion/negotiation category when solving problem are carried out by all group members are R, S, and T students. Discussion/ negotiation interactions occur in the form of discussions about the procedures used. However, in some discussions, T and S students are more active in giving opinions, while R students only participate as little as possible because R students don’t understand the problem. This is parallel to the findings of studies by Atun (2012) that high-achieving-student who are dominating in the discussion solved the problem. Typical of verbal expressions when students starting a discussion are questions such as "loh? kok 5000?” or verbal expressions such as " eh ini lo gakbisa ".

According to Hall (2014) in the discussions, students can express opinions and consent or disagree.

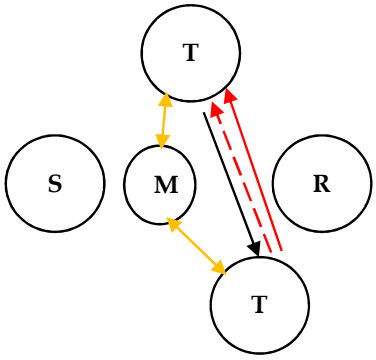

Figure 6 Student-material-student interactions when solving problems in class discussions

From Figure 6, the asking for help interactions occurs during solving problems in class discussions is carried out by T students to high-achieving-student in other groups to ask for an explanation of problem-solving. High-achieving-student s in other groups do giving help with explanations about the procedures and problem solving that are asked by T students.

Student-material-student interactions when solving problems in realistic mathematics learning in material of direct proportion and inverse proportion in group discussions and class discussions each has a different interactions. Interactions in the category of asking for help, giving help, and discussion/negotiation occurs more during direct proportion materials. This happens because the student worksheets used in direct proportions and inverse proportion have the same form. Thus, more student interaction occurs when accepting the first realistic mathematics learning worksheets on direct proportion materials. So that variant of the student worksheets influences student interaction.

CONCLUSION

Based on the results of the study on student-material-student interactions when solving problems in mathematics learning with realistic mathematical approaches material of proportion that has been processed and analyzed, it can be concluded as follows.

a. Interactions of "asking for help" appears within the activity of asking about ideas to solve problems, ask for explanations of models and procedures to solve problems, and asks for clarification or ask questions related to procedures and solving problems related the value of one magnitude, relationship of two magnitudes, comparison of two magnitudes, graphic form of direct and inverse proportion, and an equation of direct and inverse proportion in group and class discussions conducted by students with low, middle, and high-achieving-students.
b. Interaction of "giving help" appears within the activity of giving explanations of the models and procedures used to solve problems and give short answers without explanation of problems related to the value of one magnitude, relationship of two magnitudes, comparison of two magnitudes, graphic form of direct and inverse proportion, and an equation of direct and inverse proportion in group and class discussions conducted by moderate and high-achieving-students.
c. Interactions of "discussion/negotiation" appears within the activity of discussing about procedures and problem solving related the value of one magnitude, a comparison of two magnitudes, and graphic form of direct and inverse proportion in group discussions conducted by students with low, medium, and high-achieving-students.

SUGGESTION

Based on the results of the research and conclusions regarding the interaction of student-material-students when solving problems in mathematics learning with realistic mathematical approaches to proportion material, researchers can provide some suggestions outlined as follows.

a. For researchers that conducting similar research, researchers should consider the interview method in addition to the observation method for data collection. Interviews can help explain the factors that influence student-material-student interaction in solving problem step of realistic mathematics learning. Because, in this study can't reveal factors that influence deeper interactions.
b. For researchers who carry out similar research, researchers should consider using 1 other observer in writing student expressions. It happens because researchers feel overwhelmed in writing down student-material-student interactions that occur during solving problems on the observation sheet so that there are some phrases that are missed.

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