Using Motorcycle Reparation in Learning Linear Programming at Vocational School

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Abstract: The objective of this study is to help students understand the concept of linear program materials by using a motorcycle and generate a learning trajectory in linear program learning through motorcycle service activities from the informal stage to the formal stage. This study uses a design research method which consists of three stages, namely preliminary design, teaching experiment and retrospective analysis. This study was carried out in the Public Vocational School 2 in Palembang with the subjects of the study of 32 male students of class XI TSM 1. The results of the study are learning trajectories that can help students understand linear programming. The learning begins with the service of a motorcycle as a starting point, after the students obtain two damages that occurs on two different motorbikes, the students determine the variables and forms of inequality and then proceed to determine the mathematical model and the objective function and the optimum value. Therefore, the use of the context of motorcycle service can help the vocational school's students understand linear programs

1 INTRODUCTION

The objective of the 2013 curriculum is to prepare Indonesian people to have the ability to live as individuals and citizens who are faithful, productive, creative, innovative, and affective and able to contribute to the life of society, nation, state and world civilization. The Public Vocational Secondary High School 2 of Palembang is an educational institution in the field of engineering that has implemented the 2013 curriculum. In accordance with the objectives of the 2013 curriculum, it is expected that after graduating from the vocational school the graduates are able to contribute to everyday life, according the skills to they have acquired during school, one of the departments that can contribute to everyday life and is beneficial to the community is Motorcycle Engineering (ME).

Repainting of motorbike vehicles is one of the subject matters that students learn in community is Motorcycle Engineering (ME). According to Haryono and Sentono (2014) Motorcycle tune-up, namely the effort to return vehicles (motorbikes) to their original conditions according to factory specifications, include: checking motorcycle parts to ensure they are still functioning properly, cleaning the dirty parts so that does not damage the system, adjusts the changing parts to match the specifications, repairs (replaces) damaged / worn components. So, it is clear that motorcycle maintenance is a very important lesson, so that after graduating they can work and can create jobs, such as servicing motorized vehicles, especially motorbikes.

Hell and Dragicevic (2014) Organizations currently in operate a very dynamic environment, and therefore, their ability to continue to adjust strategic plans with new conditions is a must to achieve their strategic goals. Organizations currently in operate a very dynamic environment, and therefore, their ability to continually adjust strategic plans with new conditions is a must to achieve their strategic goals, in this case study, linear programming is used to optimize organizational performance strategies.

A linear program is a mathematical technique as an optimum allocation of resources such as labour, material, capital, energy and so on (Rao. S, 2011; Nurmalia, 2013). Through solving the problem of linear programs students can strive how to get a big profit by pressing the smallest costs.

In addition, the main requirements of community are Motorcycle Engineering (ME) mastering how to take care of, motorbikes so that the condition of prime motorcycle vehicles, they also strive to obtain optimal

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benefits from their work in servicing motorbikes. One strategy that aims to make the learning process work well is to design learning using the Indonesian Realistic Mathematics Education (PMRI) approach. PMRI is one of the learning approaches that will lead students to understand mathematical concepts by constructing themselves through prior knowledge related to their daily lives. By finding the concepts themselves, it is expected that student learning will be meaningful (Putri, 2011). In Vocational School practical lessons are more dominant than theoretical studies so that the PMRI approach to the learning process of mathematics in Vocational Schools will make students better understand the concepts and problem solving of linear programs related to servicing motorcycle vehicles.

Learning linear Programs will be easily understood by students if they use the right context. According to Putri (2011) The importance of using context that is in accordance with the concept in starting learning means that learning should begin with a situation that is known to students, so that it can motivate students to learn and learn mathematics does not seem difficult anymore.

In vocational schools, especially motorcycle engineering majors will indirectly encounter problems involving linear programs. One of the activities that is often carried out by students majoring in motorcycle engineering is servicing motorcycle vehicles. therefore, researchers use the context of motorcycle service as a starting point and innovation in learning Linear Programs.

Based on the background above, this study aims to produce a learning trajectory that can help students understand the material and solve the Linear Program problem.

2 RESEARCH METHOD

This study uses a research design research method that designs linear program material with the PMRI approach to class XI Vocational School using motorbike service as the beginning of learning. The design research method used is type validation studies that aim to prove learning theories (Nieveen, McKenney, & van den Akker, 2006) and develop Local Instructional Theory (LIT). In the implementation of design research there are 3 stages, namely: preparing for the experiment / preliminary design, the experimental design, and retrospective analysis. (Gravemeijer, K., & Van Eerde, D., 2009).

First stage: Preparation for research / preliminary design (preparing for the experiment / preliminary design). In this section the researcher reviews the literature relating to the 2013 curriculum, Linear program learning material, PMRI approach, design research, and conducts interviews with several students to find out students' initial knowledge of linear program material. Furthermore, designing a hypothetical learning trajectory (HLT) in which a series of learning activities is developed in a linear program using the PMRI approach by containing guesses consisting of learning objectives, learning activities and devices that can help the learning process and revised during the teaching experiment

The second stage: experimental design (the design experiment). In this section the researcher conducted two activities, namely pilot experiment (preliminary teaching experiment) and teaching experiment. The pilot experiment was conducted to test HLT which had been designed for students in small groups to collect data and revise the initial HLT to be used at the later stage of the teaching experiment. Students involved in the pilot experiment are as many as 6 students where the researcher will act as a teacher. In the teaching experiment, HLT which has been piloted in the pilot experiment stage and has been revised then tested again in the class which is the subject of research. The mathematics teacher acts as a model teacher (instructor) and the researcher conducts the researcher observed the students' mathematical learning and communication activities. This article is focused on the teaching experiment stage.

The third stage is retrospective analysis. Data obtained from the teaching experiment stage are analysed and the results of this analysis are used to plan activities and develop design activities for subsequent learning. The purpose of retrospective analysis in general is to develop Local Instructional Theory (LIT). At this stage, HLT is compared to actual student learning, the results are used to answer the problem statement. Data collection techniques used during research such as video recordings, observations, interviews, documentation, and field notes were collected and analysed to improve the HLT that had been designed. The data obtained were analyzed retrospectively with HLT as a reference. For data analysis discussed with the supervisor and teacher model to improve reliability and validity in this study in the form of observation, interviews, and documentation carried out qualitatively.

3 RESULTS AND DISCUSSION

The activity that was designed was intended so that students could understand the linear program and be

able to solve the problem. Learning carried out using the context of motorbike vehicle service as a starting point, a series of activities carried out by researchers including, interviews with several students, followed by giving initial tests (pre-test) and afterwards students were given the final test (post-test), when the initial test was still many students have not been able to answer most of the questions given. However, in the final test (post-test) students have been able to solve various problems regarding linear programs. In this activity using Student Activity Sheet (LAS) 1 and Student Activity Sheet 1, each LAS contains 2 activities, while the activities carried out are as follows:

a. Activity 1 (Motorcycle Service Practice)
   The first activity aims to look for damage that occurs on motorbikes, in this activity students carry out the activities of servicing two different motorbikes, by having the same two damage, students carry out activities starting from checking motorbikes, stamping and cranking motors, then looking for problems that cause the motorbike can't live, while servicing motorbikes, students start discussing with each other and asking friends. Researchers as observers look at the work of each group and give direction to the questions they give. Students' strategies in this problem damage in figure 1

Figure 1: Students perform motorcycle service activities.

b. Activity 2
   Activities in activities two are aim to determine the variables and forms of linear inequality, through student thought conjectures, students are expected to be able to replace the damage components into a variable and determine the form of linear inequality by discussing and presenting their answers to the class. The activities in these two activities are student strategies in finding the type of damage and determining the variables in figure 2a and figure 2b. aim

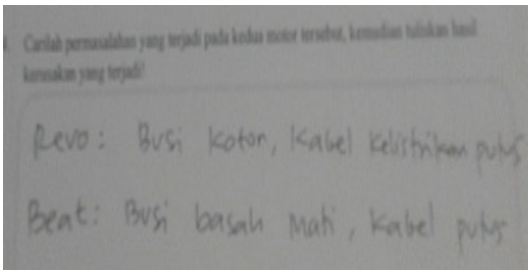

Figure 2a. The components of damage obtained

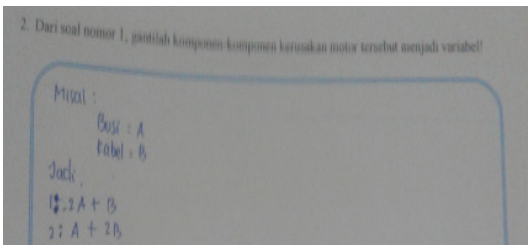

Figure 2b: Turning damage components into variables

c. Activity 3
   In the third activity students are expected to be able to determine the cost of servicing a motorcycle that has been carried out based on the damage that occurs by looking at the table of maintenance costs and prices of sperpat. The aim of this research is that students are expected to be able to make mathematical models and determine objective functions. Student strategies in problem solving in Figure 3.

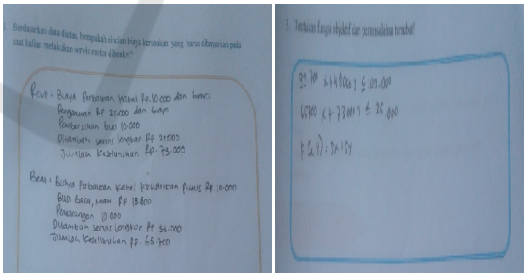

Figure 3: Students can determine the reparation cost and determine mathematical model and the objective functions

d. Activity 4
   The purpose of this activity is that students can determine the optimum value, through student thinking conjectures, students are able to determine the optimum value of an objective function, at the end of learning students are expected to be able to draw conclusions about what they are learning. Students' strategies in determining the optimum value in figure 4.

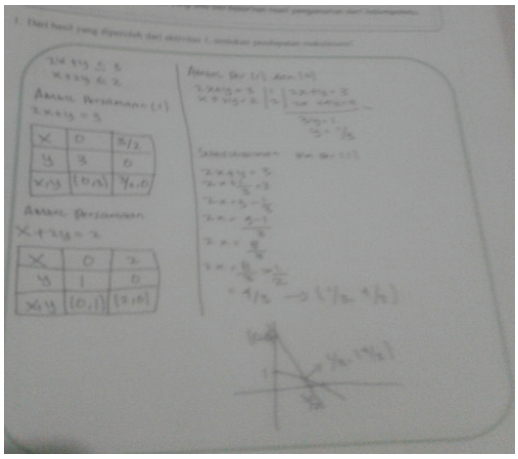

Figure 4: Students can describe the completion area and determine the optimum value

This designed activity aims to enable students to understand linear programs and to solve their problems. A series of activities are carried out by researchers, including interviews with several students, followed by giving initial tests to obtain initial information about student knowledge. After that, it was continued by carrying out cycle 1, namely: pilot experiment. At this stage the researcher becomes a model teacher and 6 students with different abilities participate in learning activities. Initial tests are given to find out students' initial knowledge before the learning process is carried out.

the learning trajectory produced in this study are learning trajectories that students pass through motorbike service in finding linear program algorithms as experience-based activities have helped improve students' understanding of linear program. In classroom learning, students' understanding of linear programs develops from the informal stage to the formal stage.

4 CONCLUSIONS

Based on the results and discussion that has been described, it can be concluded that the PMRI approach has an important role to produce student learning trajectories in linear learning programs to help students find linear program algorithms in class XI. Through activities such as making a mathematical model using motorcycle service, determining objective function and determining optimum value. The learning trajectory produced in this study is the learning trajectories that students pass through motorbike service in finding linear program algorithms as experience-based activities that have helped improve students' understanding of linear programs. In classroom learning, students' understanding of value fragments develops from the informal stage to the formal stage.

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