LEARNING MATERIAL ON THE LINEAR EQUATION SYSTEM WITH TWO VARIABLES (SPLDV) BY USING THE CONTEXT OF TRAIN TICKET RECEIPTS ON VIII GRADE STUDENTS

Desy Amelia, Ratu Ilma Indra Putri, Somakim
Master Program in Mathematics Education, Sriwijaya University, Palembang
desyamelia16@gmail.com

Abstract

This research aims to produce learning trajectory that can help students in learning material on the linear equation system with two variables (SPLDV). In this research, the method used design research. First stage, preparing for experiment. Second stage is the design experiment. The last stage is retrospective analysis. The learning approach used Indonesian Realistic Mathematics Education (PMRI). Subjects in this study were students of class VIII SMP Negeri 7 Palembang. In collecting the data, the researcher used observation, interview, video recording in classroom learning activities, collection of student work and collection of student test results. Hypothetical Learning Trajectory (HLT) is designed to compare with Actual Learning Trajectory (ALT) to analyze whether there is any difference between both of them. A retrospective analysis of SPLDV material learning shows that using the context of a train ticket receiptscan assist students in understanding SPLDV materials.

Keywords: Train ticket receipts, PMRI, SPLDV

INTRODUCTION

The material on the linear equation system with two variables (SPLDV is one of the important material in mathematics learning. As revealed by Slavin, the SPLDV material is very important because it is directly related to everyday real life [9]. SPLDV is a system or unity of several linear equations of two similar variables. The linear equation of two similar variables referred to here is the equations of two variables that contain the same variable.

Based on the Graduates Competency Standards (SKL) that must be achieved by students for junior high school mathematics subjects based on Minister of Education Regulation No. 23 of 2006 systems of linear equations and their solutions, and use them in problem solving namely the settlement of story problems related to everyday life [6]. From the results of several TIMSS studies (Trends International Mathematics and Science Study) and PISA (Programme for International Student Assessment) shows the level of ability of students in mathematics is low, one of which is the error factor experienced by students is the difficulty of students in solving story problems [8]. The story questions are used as learning in the SPLDV material.

According to some experts who discussed the difficulties in the SPLDV material experienced by students and the causes, among others, students had difficulty building

knowledge about how to compile the questions so that they could be solved (Slavin, 2009; Cikla, 2004; Neria & Amit 2004) [9,3,5] It is caused by available textbooks that tend to only present routine questions that do not stimulate students to think (Bransford & Stein, 1993; Marinez, 1998, Mayer & Wittrock 1996) [1]. Furthermore, according to Kaput (in Van de Walle, 2008) states that students are difficult in mathematical modeling which is a process thatstarts from real phenomena and attempts to break the phenomenon [11]. The problems that occur in the SPLDV material can be overcome by providing innovative SPLDV material through exploration activities. For example the exploration of "bills and dollars" proposed by Slavin [9] where students learn SPLDV material through buying and selling transactions involving dollars, bills. Thomas & Tall exploration of fruit salad algebra or called explored in the two a balance scale that changes the forms of equilibrium, which is an analogy of the form of equations [10]. According to Anibal (1995) with the exploration activities through the calculation of the numeric value by constructing numerical functions and mathematical objects to guide the mind in solving problem [2]. It can be concluded that exploration activities carried out by experts through real problems that are manipulated by tools or figures, then students express into everyday language, then declare into the language of mathematics and conclude back into their own language. Exploration learning is in line with what is required in the Education Unit Level Curriculum (KTSP) where students can work collaboratively in scientific, realistic thinking classes, find their own concepts from everyday experience and carry out competency-based assessments and teachers as facilitators who help students in the learning process are not the only source of student learning.

To support the implementation of learning that prioritizes students as active learning centers to construct their knowledge, an appropriate learning approach is needed. For this reason, the PMRI approach will be used as the basis for the implementation of learning. Furthermore (Tatang Yuli Eko, 2016) examines PMRI teaching mathematics material, it can develop reasoning, creativity and student personality. So it can be said that the implementation of mathematics learning using PMRI approach can bring students' real life exploration activities and mathematics as a form of human activity, not just objects which must be transferred from teacher to student [12].

PMRI, where mathematics learning is human activity and mathematics must be connected significantly to the context of students' daily lives [13]. Context is used close to the student's daily life and can be imagined by students so that learning can be more meaningful (Van den Heuvel-Panhuizen, 2003). This study aims to analyze the learning trajectory of students in learning material systems of two-variable linear equations using the context of train ticket receipts. Train ticket receipt is used as a tool to help students understand the material of the two-variable linear equation system. In this study, researchers used train ticket receipts taken from the results of exchanging passenger booking codes at the station and displayed on student activity sheets.

METHODS

The research involved 40 students from class VIII in 1. SMP Negeri 7 Palembang and a teacher who acted as a model teacher. And design research is used as a method in this study with the aim of writing learning theories and developing Local Instructional

Theory (LIT) in collaboration with researchers and teachers to improve the quality of learning (Gravemejer & Cobb, 2006). Gravemeijer & Cobb (2006) define three stages in design research, including: (1) preparing for the experiment, (2) the design experiment dan (3) retrospective analysis. The first stage, Preparing for The Experiment (preparing for the research). At this stage, the researcher conducted a literature study through gathering information in the form of reviewing SPLDV material in mathematics text books, adjusting to the PMRI approach literature and research design as the basis for formulating the students' initial strategy in learning system of two variable linear equations. Thus, the researcher conducted a discussion with the class teacher regarding the state of the class, the research equipment, adjusting the schedule and the method of conducting the study with the teacher who would become the model teacher. In addition, the researcher also examines students 'initial abilities by conducting follow-up interviews with teachers regarding the extent of students' understanding with the material of the learning preconditions. The results of this stage are used by researchers as material in designing student activities and outlined in the hypothetical learning trajectory (HLT). The researcher made a HLT design by sorting the strategy estimates that will be used by students and predicting the answers that will appear. HLT is used to see the connection between the initial allegations that have been made and the data obtained in the field. These allegations are dynamic so they can be adapted to students' reactions during the learning process. After that, the researcher conducted a discussion with the class teacher regarding the state of the class, the research equipment, adjusting the schedule and the method of conducting the study with the teacher who would become the model teacher. While the researcher also examines students 'initial abilities by conducting follow-up interviews with teachers regarding the extent of students' understanding with the material of the learning preconditions. The results of this stage are used by researchers as material in designing student activities and outlined in the hypothetical learning trajectory (HLT). The researcher made a HLT design by sorting the strategy estimates that will be used by students and predicting the answers that will appear. HLT is used to see the connection between the initial allegations that have been made and the data obtained in the field. The second stage is The Design Experiment which has two cycle here are Preliminary Teaching Experiment dan the other is Teaching Experi

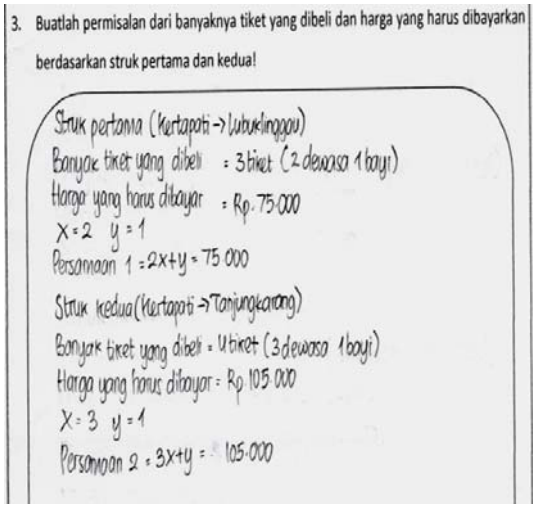
In the first cycle phase, the researcher acts as a model teacher. There are 6 students from class VIII.5 who are selected based on their level of ability, namely 2 high-ability students, 2 moderate-capable students and 2 low-ability students. Results from the first cycle are used to revise the initial HLT version for one class participating in the second cycle. In the second cycle, 40 students from SMP Negeri 7 Palembang, students were given learning by the teacher of mathematics in the classroom who acted as the model teacher while the researcher observed and analyzed each student's learning activities during the learning process. The third stage is retrospective analysis. The data obtained from the second cycle is the teaching experiment stage which is analyzed to develop the design of learning activities. HLT is compared to the actual student learning activities or actual learning trajectory to answer the formulation of research problems. The purpose of retrospective analysis in general is to develop local instructional theory. Therefore, feedback from teachers is very useful to inform researchers about the different ways of teaching that can theoretically be adapted to various types of conditions in the classroom. Thus a better learning design is obtained. Data collection was carried out

through photo learning activities, the results of video recordings of teacher and student interviews, the results of video recordings of learning activities, the results of the pre-test and post-test results, and the results of students' work on the Student Activity Sheet and observation sheets. HLT that has been designed is then compared with the actual learning trajectory of students during the implementation of learning to be conducted retrospective analysis, students learn or not from the activities that have been designed. Data analysis is carried out by researchers and mentors to increase validity and reliability. Validity is useful for looking at the quality of a set of data that affects the conclusion of the study. Reliability is described through a clear description of the data collected so that conclusions can be conclude.

RESULTS AND DISCUSSION

This learning is designed to produce the SPLDV learning path using the PMRI approach and find out the role of train ticket receipts in helping students understand SPLDV material. The following are the results of the teaching experiment in the second cycle involving 40 students. The first activity, aims to enable students to identify problems related to SPLDV.

The initial stage is context exploration. Initially students are given the opportunity to get to know the use of train ticket receipts in everyday life. Students fill in the questions under the picture of ticket sales activities and the ticket receipt by the seller to the buyer. Students are asked to view and observe figures from the train ticket receipt with the situation related to the purchase. From the results of the students' answers indicate that students can mention information obtained from the train ticket receipt. Students are able to identify by carefully observing the information in photo, stories and each train ticket receipt. After feeling enough to observe the ticket receipt, students are asked to answer the next question. It can be seen in Figure 1 below.


3. Buatlah permisalan dari banyaknya tiket yang dibeli dan harga yang harus dibayarkan berdasarkan struk pertama dan kedua!

Struk pertama (Kertapati -> Lubuklinggau)
Banyak tiket yang dibeli : 3 tiket (2 dewasa 1 bayi)
Harga yang harus dibayar : Rp. 75.000
X = 2 y = 1
Persamaan 1 = 2x+y = 75.000

Struk kedua (Kertapati -> Tanjungkarang)
Banyak tiket yang dibeli = 4 tiket (3 dewasa 1 bayi)
Harga yang harus dibayar = Rp 105.000
X = 3 y = 1
Persamaan 2 = 3x+y = 105.000

Figure 1. Group Students' Answer Strategy Activities of Third Question 1.a

Based on figure 1 it can be seen students who have made an example with variables and made it into the form of equations. I figure 1 it shown that students have been able to make an example of the information they get from the train ticket receipt. The second activity, students are asked for students to make mathematical models from examples and solve them. The first step, each group is required to bring the previous activity sheet. This is necessary because the activity 1 sheet is still related to activity sheet 2. Then after getting the example, students are asked to make a mathematical model. The process of processing activity 2 can be seen in figure 3 below.

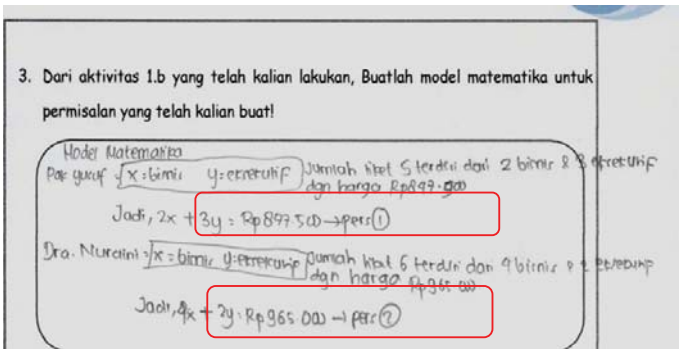


Figure 2. Group Students' Answer Strategy in making mathematical models

From Figure 2 it can be seen that students have been able to make mathematical models of the examples they have made before. It can be seen from the group of students using the variable x for the example of a business class ticket, and variable x for the example of the executive class destination Kertapati - Tanjung Karang. Then students sharpen their abilities in determining the results of a mathematical model. Students are asked to complete the model using their own settlement method. The results of students' work can be seen in figure 3 below.

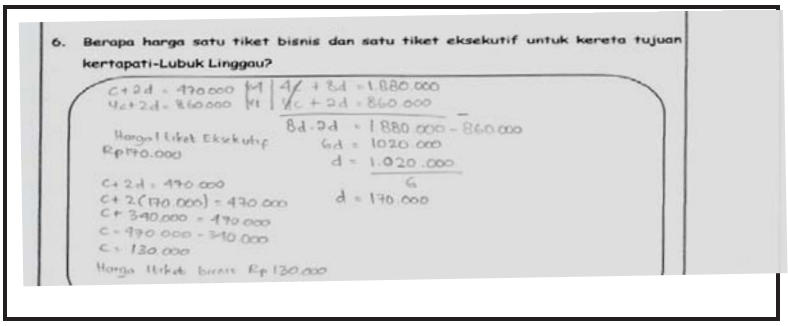


Figure 3. Group Students' Answer Strategy in completing a mathematical model

In the third activity, students are given contextual questions related to SPLDV material. Students are asked to work on questions related to SPLDV which are still related to the train ticket receipt. The results of students' work can be seen in figure 4 below.

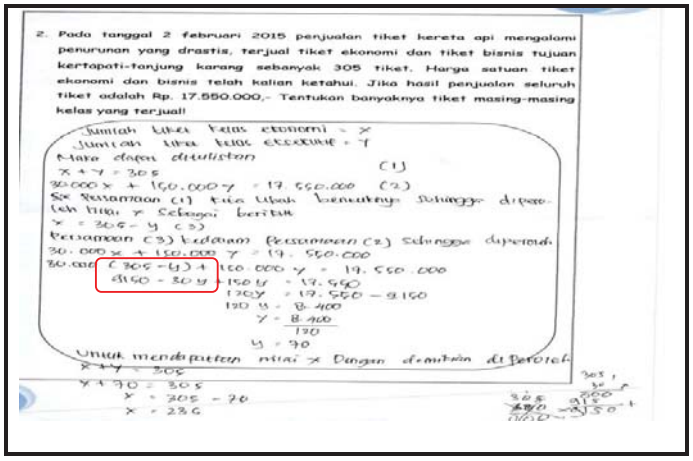


Figure 4. Group Students' Answer Strategy in completing SPLDV material

Based on figure 4, it can be seen that students can solve SPLDV material questions. Students show a new answer strategy that is easier that is using a substitution method that is easier and more practical. First, second and third activities are concluded to help students understand SLDV material. This is consistent with the results of retrospective analysis on activities 1, 2 and 3 in cycle 2 (teaching experiment), learning is in accordance with the designed HLT and it can be concluded that students have understood the SPLDV material using train ticket receipts. This study also reflects the three principles of PMRI in the learning process as expressed by Zulkardi & Putri (2010), the first principle is guided reinvention and progressive mathematizing, didactical phenomenology and self-developed models. In Activity 1, students are introduced to the train ticket receipt.

Which is the selection of the problem is based on the principle of the first characteristic of PMRI namely guided reinvention and progressive mathematizing. Where through the use of the context of this train ticket structure, students are given the opportunity to explore problems that begin with contextual problems which then through the activities of students find realistic mathematical concepts that they can essentially encounter in everyday life. The second principle characteristic of PMRI is didactical phenomenology. Moreover an educational phenomenon arises from the use of the context of the train ticket receipts structure that introduced through the concept of story into a mathematical topic in exchange for receipt of tickets to train tickets. In addition, based on the learning design developed or the results of its implementation, students use and develop their own self-developed models in identifying information that they can through media figures into their own sentences to be able to write down the required data and write down the core of the problem.

CONCLUSION

Based on the results of research and discussion, it can be concluded that the learning path obtained in this research consists of 3 activities, which are students can identify problems related to SPLDV and express problems into the form of examples.

Activity 2, Students create mathematical models from the example by making a mathematical model of the examples they have made. The last stage of the activity of 3 students was given questions related to the resolution of SPLDV problems in daily life. In addition the results of the study showed that the use of train ticket receipts could help students understand the SPLDV material.

REFERENCES

[1] Akker et al. 2006. Educational Design Research. London: Routledge Taylor and Francis Group.

[2] Bransford , J., and B.S. Stein. 1993. The IDEAL Problem Solver: A Guide for Improving Thinking, Learning, and Creativity (2nd ed). New York: W.H. Freeman.

[3] Cikla, O. A. (2004). The Effects of Multiple Representations-Based Instruction on Seventh Grade Students' Algebra Performance, Attitude Toward Mathematics, And Representation Preference. Thesis. Ankara: Middle East Technical University.

[4] Depdiknas.2008. Panduan Pengembangan Bahan Ajar. Jakarta: Dirjen, Disasmen, Direktorat Pembinaan Sekolah Menengah Atas.

[5] Neria, D. & Amit, M. (2004). Students Preference of Non-Algebraic Representations in Mathematical Communication. Proceedings of the 28th Conference of the International Group for the Psychology of Mathematical Education, 2004. Vol. 3 pp 409 – 416.

[6] Peraturan Menteri Nomor 23 Tahun 2006 Tentang Standar Kompetensi Lulusan

[7] Putri, Ratu.I.I. (2011). Professional Development of Mathematics Primary School Teacher in Indonesia Using Lesson Study and Realistic Mathematics approach. Proceeding of the International Congress for School Effectiveness and Improvement (ICSEI). Limassol, Cyprus.

[8] Rahayu,Putri (2017). Analisis Kesalahan dalam Menyelesaikan SPLDV. Yogyakarta: 2-3

[9] Slavin, Robert E. 2006. Psikologi Pendidikan. Terjemahan oleh Drs. Marianto Samosir, S.H. 2009. Jakarta : PT. Indeks.

[10] Thomas & Tall (2001) The Long-Term Cognitive Development of Symbolic Algebra; Falcao, 1995 Journal of Research in Mathematics Education, 25 (2), 115–141.

[11] Van de Walle, John, A. (2008). Matematika Sekolah Dasar dan Menengah: Pengembangan Pengajaran Jilid 2. Jakarta: Penerbit Erlangga.

[12] Wijaya, A. (2012). Pendidikan Matematika: Suatu Alternatif Pendekatan Pembelajaran Matematika. Yogyakarta: Graha Ilmu

[13] Zulkardi. (2002). Developing a Learning Environment on Realistic Mathematics Education for Indonesian Student Teacher. Netherlands: University of Twente, Enschede.