Project based learning design “trade in school cooperation” for seventh grade students of junior high school

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Abstract. The direct proportion and social arithmetic are difficult topics for students. The difficulty on the topic of direct proportion is that students make mistakes in adjusting the application of direct proportions. The difficulty of social arithmetic is a mistake in determining the conditions of profit, loss, or break even. Project-based learning is an innovation for teachers and can improve students’ thinking abilities. The characteristics of the project involve some topics. Teachers are expected to work together to create learning according to expectations by implementing a lesson study system. Project-based learning that takes a long time can be overcome by using Edmodo because they can do learning without space and time limits. This research aims to determine the role of the learning trajectory in project-based learning "trade in school cooperation". This study uses a design research method of validation studies type in seventh grade students of junior high school in Palembang. The results are the role of project-based learning in resolving direct proportions and social arithmetic through learning trajectory such as students getting more training in problem-solving procedures, better understanding the relationship of numbers proportions, and to achieve understanding in decisions of profit, loss, and breakeven situations.

1. Introduction

Based on the results of the pre-test that the direct proportion and social arithmetic are topics that still considered difficult for students because the percentage of students who reach the minimum completeness criteria is still low on the topics. The same thing was expressed by Sagita, et.al that students solve problems the direct proportion is still low [1]. The same thing was stated by Dila and Zanthy that students have difficulty in solving social arithmetic problems [2], as well as the results of observations made related to the ability of arithmetic in elementary school students is also still low [3]. The difficulty of students in direct proportion material is because students make mistakes in applying the direct proportion application and students make mistakes in mathematical modeling, and students often ignore the relationship between the numbers that make up this proportion [4–6]. The direct proportion is the ratio of two or more values of the same quantity [7,8]. Situations that can show direct proportion such as quantity, value, or price of goods are a real problem, the direct proportion can be solved by a factor of change, unit rate, and cross multiplication [9]. Social arithmetic in everyday life with situations that indicate it as a trade transaction [10]. One of the things that become difficult for students in social arithmetic material is an error in determining the conditions of profit, loss, or break-even [2]. The condition of profit when the selling price is greater than the purchase price; the break-even condition when the selling price is the same as the purchase price; and the condition of loss when the selling price is lower than the purchase price [11].
Teachers still rarely give problems in the form of projects while project-based learning can also improve students' thinking abilities [12,13]. Project-based learning is also needed for students so they can demonstrate competence [14]. Projects are learning tasks that include planning, implementing, and reporting in a certain amount of time. The appropriate learning model used is project-based. The project-based learning model is a learning model that is relevant to the 2013 curriculum and can be a solution to this problem. Project-based learning focuses on using projects or activities as media by directly involving students in contextual learning processes [15–18]. The characteristics of the project involve some topics [19,20]. From this, the project that will be used is the project of “trade in school cooperation.

2. Method

This study uses a design research method of validation studies type which aims to prove learning theory [43,44]. Learning by using project-based learning models and lesson study for learning community system implemented through Edmodo using the project activities "trade in school cooperation". This research activity was carried out in seventh grade of Srijaya Negara junior high school in Palembang in the even semester 2019/2020. This research was conducted by giving prerequisite questions to determine students' initial abilities, apperception questions to remind students of basic topics before starting to direct proportion and social arithmetic, student worksheets for completing projects "trade in school cooperation" and post-test or evaluation questions to determine the student's final ability after learning.
Data collection uses observations, results of student project activity sheets, interviews, and photos. All data collected was analysed descriptively.

3. Result and Discussion

Teacher activities that use the lesson study system consist of a plan, do, and see [45].

3.1. Plan stage

At this stage, the teachers who are part of the learning community will collaborate to make a lesson plan to be achieved by teachers at the open class [45]. This plan material is based on the lack of learning that has been conveyed from the results of reflections on learning activities that have been done before. General contents of the lesson plan included, need analysis: the pre-test results of direct proportion and social arithmetic indicate that their ability is low; problem solution: teachers and students use the Edmodo application so that learning activities are not limited by space and time to complete projects, learn to use project-based learning models to overcome student difficulties from direct proportion and social arithmetic, and use collaborative activities from lesson study system so students can learn from each other; and things that need to be anticipated: Things that need to be anticipated: the teacher gives questions to students to see their understanding, the teacher reminds students to ask if they have difficulty in solving project problems and the teacher gives praise to students who ask and answer so they can increase their motivation.

3.2. Do stage

This stage is the stage of applying the designed learning design called the open class stage [45]. The syntax of the project-based learning model starts with the essential question, design a plan for the project, create a schedule, monitor the students and the progress of the project, assess the outcome and evaluate the experience [46].

3.2.1 Start with the essential question

The teacher explains that one example of economic activity in a school is cooperation. School cooperation is something familiar to students because of their presence in schools so that buying and selling activities in school cooperation can be used as a context in learning.

This is consistent with one of the characteristics of the PMRI approach namely, the use of context [47]. They stated that at school they sold various items, one of which was stationary. Students are guided to be able to determine the essential questions of the project of trade in school cooperation namely, students who are positioned as administrators of school cooperation are given Rp. 750,000 to be assigned to buy stationery at the distributor and then students will determine the selling price. The final product of this project is a report on the conditions of sale of capital prices and selling prices of stationery.

3.2.2 Design a plan for the project

Activities carried out by students following the learning trajectory are observing the price list table and determining the stationery purchased and knowing that this activity is a matter of direct proportion and social arithmetic. In the 1st.a student activity, students observe the price list table and determine the amount of stationery purchased. Students are given the freedom to determine their stationery to buy. From the answers of all students, they were seen buying different stationery. This can foster their sense of responsibility in completing projects because they have to complete each project to provide independence and flexibility for students to be creative [46].

In the 1st.b student activity, students know that this activity is a matter of direct proportion and social arithmetic. The teacher asks students about the topics used in completing the project in the price table and the number of stationery they specify, and the conditions of sale. Students give various answers, but some students answer correctly namely direct proportion and social arithmetic. Students who answer the direct proportion give a reason that is looking for stationery prices that are not yet known based on the available price tables, then the reason students answer social arithmetic is that it determines profit, loss, or break-even. Explanation from students is almost close to understanding direct proportions according to experts, among others, a direct proportion is the ratio of two or more values of the same
quantity [8], and a proportion is said to be a direct proportion if a change in value in one quantity is followed by a change in another quantity, with the same change in value and direction [48]. Students discuss the steps in project work. The results of the discussion note that steps to complete the project include, determine the purchase price of stationery and the total purchase price of the stationery then add up the total purchase; determine the price of a piece of stationery; determine the selling price of stationery following the wishes of each student; and determine the conditions of sale.

3.2.3 Create a schedule
Students are asked to negotiate to determine the project completion schedule to find the ideal time for them. This is so students can be trained in estimating the time needed until their project can be completed with effective time [46]. As a form of agreement from the teacher for the results of negotiations, the teacher provides a link assignment as a place for students to submit project assignments within the agreed time limit of students.

3.2.4 Monitor the students and the progress of the project
The teacher suggests that students who don't understand can ask for help from students who already understand by asking for "help" and after getting help to say thank you. With collaboration, students who know are required to answer that question. This is following the learning procedure in the lesson study system, if there are students who have difficulty in solving problems, capable students must help them on the condition that students who have problems ask for help from able students [45].

From each group there is an interactive discussion about the questions and answers in completing the project, although with different discussions. In the 2nd student activity, students determine the purchase price based on the number of stationery purchased using direct proportion. Some groups provide different ways to resolve the direct proportion. The various strategies used among other things, use the unit rate to determine the price of a stationery package and then multiply it with many packages purchased; using cross multiplication is for cross multiplication of two proportions of the price of the stationary and the number of stationery in the packages, and using a factor of change is to determine the right amount to operate in initial proportions to get the right proportion to what is sought. This is consistent with the theory direct proportion can be solved by factors of change, unit rate, and cross multiplication [9].

From this activity, it can be seen that the question and answer discussion occurs on students. This is following one of the characteristics of the PMRI approach namely, interactivity [21]. In the 3rd.a student activity, students add the number of stationery from the package to pieces. In converting the number of stationery from packages to pieces by using multiplying the number of packages and the amount of content from one package. From this activity it can be seen that the discussion went well; there were questions and answers among students but there was no difference in the way students answered. In the 3rd.b student activity, students calculate the capital price of a piece of stationery using direct proportion, there are three ways given by students among others, using cross multiplication, the factor of change, and unit rate. This is consistent with the theory that direct proportion can be solved by a factor of change, unit rate, and cross multiplication [9].

In the 4th student activity, students determine the right selling price from their stationery. Students give various answers, among others, the selling price given is higher than the price of capital, the selling price given is equal to the price of capital, and the selling price given is lower than the price of capital. There is no discussion in determining the selling price because the selling price is determined by students according to their desires. In the 5th.a student activity, students calculate the difference between the selling price and the purchase price. Students calculate the selling price minus the purchase price. From this activity, it can be seen that the discussion went well and there were questions and answer activities between students but there was no difference in the way students gave answers. In the 5th.b student activity, students determine the conditions of sale (profit, loss, or break-even).

In this case, it can be seen how students determine the conditions of sale by calculating the difference between the selling price and the purchase price previously calculated. This is consistent with the theory that the profit condition when the selling price is greater than the purchase price; the break-even
condition when the selling price is the same as the purchase price; and the condition of loss when the selling price is lower than the purchase price [28,29].

3.2.5 Assess the outcome

They were assigned to show the results of their products in the form of capital prices and selling prices of stationery purchased and conditions of sale on the Edmodo homepage. Products from several students were commented on by other students and a question and answer process occurs that can make students whose answers are wrong can find the location of their mistakes and can learn from instruction by teachers and other students who comment so students who are given comments can find the correct answers with the guidance of friends and teachers. Various results of answers from project reports in completing projects are one of the characteristics of the PMRI learning approach namely, student’s contribution [21].

3.2.6 Evaluate the experience

Learning experiences experienced by students among others, students feel happy and interested in learning, students get new experience in completing the project of “trade in school cooperation”, students can solve the problem of direct proportion, students can determine the conditions of profit, loss, or break-even, and students can learn how to sell to get benefits. Students complete projects from concrete mathematics to formal mathematics with the topic of direct proportion. Some students use cross multiplication, the factor of change, and unit rate. This is following one of the principles of the PMRI approach, namely the self-developed model [49]. After students know how to solve direct proportions using various strategies understood by students, students are asked to symbolize from informal equations made by students to formal mathematical equations of direct proportion. This is following one of the characteristics of the PMRI approach, namely the use of models [21].

3.3. See stage

The teacher gives the impression in learning that the process runs well when students who are having difficulties can ask for help to be taught by their peers because some students still feel shy to ask the teacher, students are enthusiastic in the reporting process and comment on project results so wrong students can learn from their mistakes, and online learning has a different effect because students who are passive in class become active in online learning. Some responses from observers include, based on the posttest score which is better than the pretest shows that learning goes well because students who do not understand can be taught by students who understand so that their understanding is evenly distributed, and project-based learning that takes a long time will be very appropriate if done using online learning because it can facilitate teachers and students.

4. Conclusion

The teacher begins to learn by explaining contexts that are close to student life, namely the context of “trade in school cooperation” which aims to enable students to recognize context as a starting point in learning. The role of project-based learning “trade in school cooperation” in resolving direct proportions and social arithmetic through learning trajectory for students such as students getting more training in problem-solving procedures, better understanding the relationship of numbers proportions, and to achieve understanding in decisions of profit, loss, and break-even situations.

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