
DEVELOPMENT OF WORKSHEETS BASED PROJECT USING THE LESSON STUDY

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ABSTRACT

Often students are only given practical problems in the form of algorithms without inviting them to think at a high level and almost never given daily problems in the form of projects. From this it can be seen that there are still teachers who have not carried out directives from the government that is to assess competencies made in assessments that require students to demonstrate certain competencies using projects. This study aims to produce worksheets in the form of school cooperation projects on the value of direct proportion and social arithmetic, and analyze students' answers in solving these problems and the implementation of learning is carried out using a lesson study for learning community (LSLC) system. This research uses design research method which is a form of qualitative approach. The stages in the design research type of development study/design research. The subjects of this study were Grade VII students of SMPN 1 Palembang. From this study, student worksheets were generated about direct proportion and social arithmetic consisting of four activities including determining the price list of goods purchased, determining the price of capital goods, reporting prices of goods and selling prices, and determining conditions of sale. Based on the results of the analysis of students' answers to worksheets, some students can perform procedures of direct proportion and determine conditions of sale (profit, loss, or break even) so that this worksheet has been deemed valid and practical to use.

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1. INTRODUCTION

Direct proportion material is the ratio of two or more values of a similar quantity (Ben-Chaim, Keret, & Ilany, 2012; Zuhra, Zubainur, & Abidin, 2018). Situations that show value comparisons such as quantity, per, value, or price contained in real problems (de la Cruz & Garney, 2016; Lobato et al., 2010). Direct proportion can be solved by factors of change, unit rate, and cross multiplication (de la Cruz & Garney, 2016). However, at present, students still have mathematical modeling difficulties and calculation procedures in solving direct proportion material, and students often lose the meaning of direct proportion because they are accustomed to using cross multiplication in solving the problem (Arican, 2018).

Social arithmetic materials are usually found in everyday life such as buying and selling transactions (profit/loss/break-even) in trading activities (As'ari et al., 2016). But in reality in social arithmetic material, students often fail in the principles and calculation techniques in completing social arithmetic (Astutik & Kurniawan, 2015).

Another problem in learning mathematics is that students are rarely given problems related to the project because they are often given problems in the form of algorithms (Mahendra, 2017). This doesn't meet the demands of Permendikbud concerning assessment standards that to assess competency skills can be done through performance assessments that require students to demonstrate certain competencies using a project (Kemdikbud, 2013). The government has also made a program to build the golden generation of 2045, which is equipped with 21st century skills, including 1) the quality of character which generally consists of religion, nationalism, independence, independence, mutual cooperation, and integrity; 2) literacy consisting of language, numeracy, scientific, digital, financial, cultural and citizenship literacy; and 3) competencies consisting of critical thinking, creativity, communication, and collaboration.

In this research a project activity will be carried out by making a project plan: the implementation of my school cooperative. Some basic mathematical competencies completed in this project include 3.8. Analyze direct proportion and indirect proportion using data tables, graphs, and equations; 4.8. Resolve problems that occur by using direct proportion and indirect proportion; 3.9. Get to know various analyzes related to social arithmetic; 4.9 Solve problems related to social arithmetic; and the basic competency of IPS is 3.3. Understanding the concept of interaction between humans and space produces a variety of economic activities (production, distribution, consumption, demand, and supply) and interaction between spaces for the survival of Indonesia's economic, social and cultural life (Kemdikbud, 2016).

The government plans to build a golden generation of 2045 equipped with 21st century skills requiring three things including 1) quality of character consisting of religiosity, nationalism, independence, mutual cooperation, and integration; 2) literacy consisting of language, numeracy, scientific, digital, financial, cultural and citizenship literacy; and 3) competencies consisting of critical thinking, creativity, communication, and collaboration (Kemdikbud, 2016).

To complete these efforts, it can be done with lesson study for the learning community (LSLC). There are some things that are still lacking in the learning system, among others, some teachers are still unable to manage the class well (Bustang, Zulkardi, Darmawijoyo, Dolk, & Van Erde, 2013); teachers do not pay attention to students who have difficulty in learning because it is difficult for teachers to guide them individually (Sato, 2012); and also the education system in schools still pays little attention to the evaluation system and the learning process taking place in the classroom (Fauziah et al., 2020). While education discusses how students learn and how to teach teachers, not only on learning outcomes (Brooks & Brooks, 1999).

The application of the lesson study system in learning is by collaborating among colleagues to support, try, discuss and reflect on the learning done, where there will be many improvements that will indirectly improve the quality of learning by redesigning (Lewis, 2002; Sato, 2012). That is because in learning from lesson study is collaborative learning, where students work in groups with unequal final answers from each student that creates interconnected and mutually supportive relationships between students (Sato, 2012). Enabling learning can improve the quality of learning or improve educational practices by building learning communities that encourage collaboration and collegatives (Octriana, Putri & Nurjannah, 2019; Sato, 2012). This is contrary to Vygotsky's theory of the learning process will occur more effectively if with the help of others (Vygotsky, 1980).

This is supported by several studies which generally explain that lesson study for learning community (LSLC) has a positive impact and can improve the quality of learning, among others, according to Arini and Putri (2019) who use Lesson Study has a positive impact on students including increasing awareness with friends, reduce the emergence of competition in learning activities, and establish collaboration between students in learning. The same thing according to Nuraida and Putri (2019) that lesson study also has a positive impact on the learning process because it can help students to understand the concept of a material through their activities in their study groups by collaborating and caring for each other.

The purpose of this study is to produce valid and practical problems on worksheets in order to be able to help them with direct proportion material and social arithmetic in school cooperative projects.

2. METHOD

This research uses a design research method which is a form of qualitative approach. Stages of research development in design research (van den Akker, 1999). The development study undertaken is the initial stage of applying the initial idea of a literature study before designing learning activities; and the formative evaluation stage which includes self-evaluation aimed at researchers to evaluate and examine the initial prototype itself, prototyping (expert reviews, one-to-one, and small groups) aimed at validating each prototype in terms of content, structure, and language (Tessmer, 1993; Zulkardi, 2002) (Figure 1).

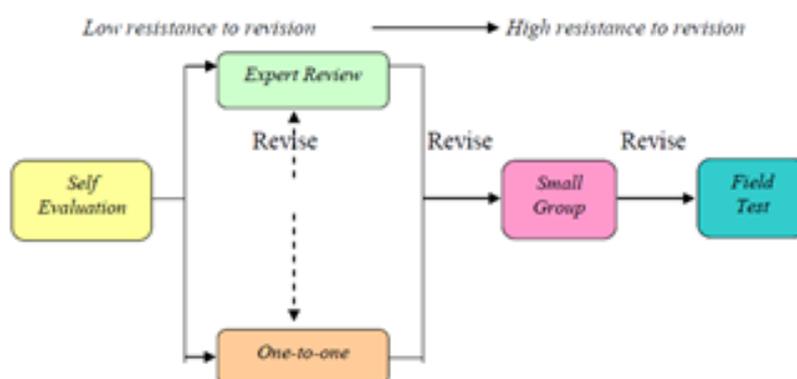


Figure 1. Stages of research development in design research

In this research the development of professionalism that uses lesson study is to plan, do, and see. This research was conducted in seventh grade students of SMP N 1 Palembang with direct proportions and social arithmetic. This study involved 8 students in small groups. The research lasted for several weeks.

3. RESULTS AND DISCUSSION

The stages in this research are development research and lesson study system which include plan; do and reflection. The following is an explanation of each stage carried out by the researcher.

Researchers discuss with the teacher at SMP N 1 Palembang about the material to be designed. Then from the discussion, the researcher obtained information that VII values in the second semester had understood the concept of direct proportion and social arithmetic so the next step was for the researcher to design questions or problems in the form of a school cooperative project.

Researchers design worksheets that contain problems and then validate worksheets with colleagues and mathematics teachers to obtain information about whether the worksheets are correct and can be understood by students in terms of structure, content, and language (Figure 2). The validation results will be considered by the researcher whether to make revisions or not (Wahyuni et al., 2020). The results of changes at this stage include increased front-page writing (semester information, work time, and learning objectives) and the difficulty level of the worksheet.

Researchers along with colleagues and mathematics teachers predict the possibility of students' answers ranging from low ability, medium ability, and high ability that there may be differences in thinking patterns. This is needed so that researchers can plan scaffolding if something happens that was predicted beforehand.

Some revisions made after the discussion included changing the title of the student's activity sheet from "come on, entrepreneurship in a school cooperative" to "a direct proportion of economic activity"; figures on the agreed price list to make it easier for students to calculate; on the worksheet the students agree to get, break even, and losses related to selling prices and buying prices; improve more than one answer prediction from students.

After that go to the stage one-to-one. Questions on the worksheet that have been designed are being tested on three students with various levels of ability including high, medium and low ability students. Students are also expected to contribute in validating worksheets in terms of language level and their understanding of the purpose of the questions on the worksheet (Figure 3). After that, the results of students' answers are analyzed and students are interviewed with a focus on the work process carried out when completing the worksheets.

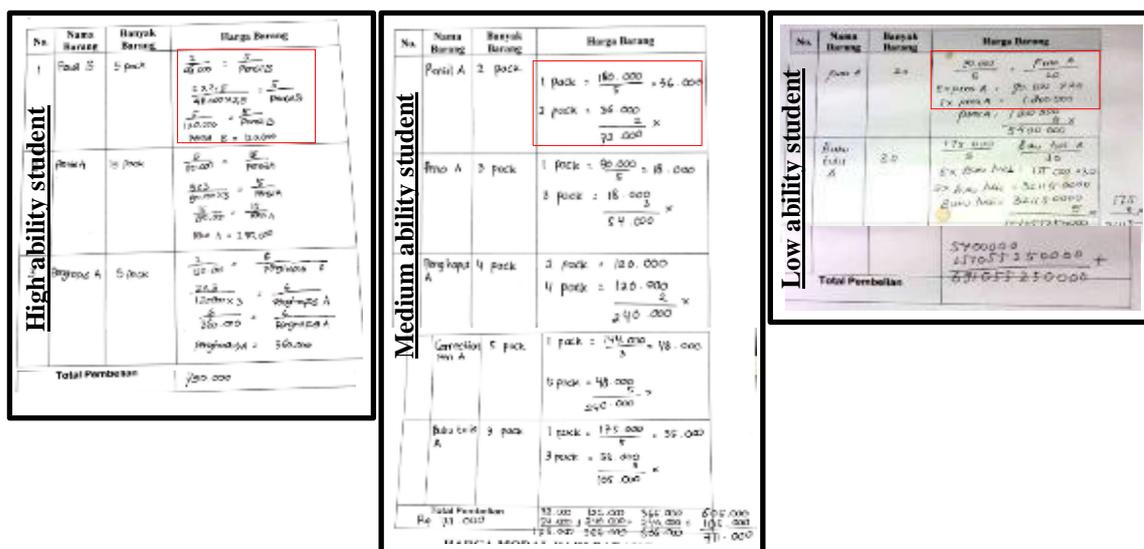


Figure 3. Student answers in determining price lists

In determining the price list of goods, high-ability and medium-ability students can determine the price list of goods correctly and correctly in different ways (Figure 3).

However, in low-ability student, there are still errors in completing the calculation of the direct proportion. The following is an explanation of each students' abilities,

From the results of the answers to high-ability students, she determines the price of goods by making a direct proportion equation, then the ratio on the left which is the selling price of the distributor agent multiplied by the numbers that can produce the same number as the ratio on the right. For example, he wrote to buy as many as five pack pencils and known the price of the distributor agent of Rp. 48,000 for two packs. Students are correct by making the following direct proportion, $2/48,000=5/(\text{price of 5 packs})$. After that, students determine the exact number to multiply by 2 to produce the number 5 is 2.5 so that the students make the equation become $(2 \times 2.5)/(48,000 \times 2.5)=5/(\text{price of 5 packs})$. The price for five packs of pencils is Rp. 120,000. Judging from the procedures that have been carried out by students, he already understands the direct proportion because he tries to equate the proportion on the left with the one on the right to find out one unknown variable from the proportion on the right. Then, there are no errors in students in calculating the total purchase, which is Rp. 750,000 and enough from the maximum limit to buy the goods specified on the worksheet even though he does not need to process the calculation, but the final results that have been written are correct.

In students the ability of being seen from the answer that he first determines the price of goods for one unit and then calculates the number of packs purchased. This can be seen by students writing to buy two packs of pencils. He calculated the price of one unit by dividing the price of goods and the number of packs, namely $\text{Rp.}180,000 \div 5 \text{ packs} = \text{Rp.}36,000$. After that, multiplied by $\text{Rp.}36,000 \times 2 \text{ packs} = \text{Rp.}72,000$ because he wrote to buy two packs of pencils. Students then calculate the total purchase by adding the total price of items purchased. From the procedure that has been done by students is correct and there are no mistakes even though he solved the problem in a different way from high-ability students by calculating the price of a package first and then multiplying it with many items purchased.

In low-ability student viewed from the answer that the student has been able to write it in direct proportion. He uses cross multiplication in solving these problems by writing $90,000/5 = (\text{pen A})/20$. then multiply the cross to $5 \times \text{pen A} = 20 \times 90,000$ after completing it to $5 \times \text{pen A} = 1,800,000$. But there was a mistake he did while looking for the value of pen A, he wrote it into $\text{pen A} = 1,800,000 \times 5 = 5,400,000$. He was wrong in calculating what should be the $\text{pen A} = 1,800,000 \div 5 = 360,000$. From these answers and the results of interview information that students are still wrong in determining the operation of one of the variables sought in the equation.

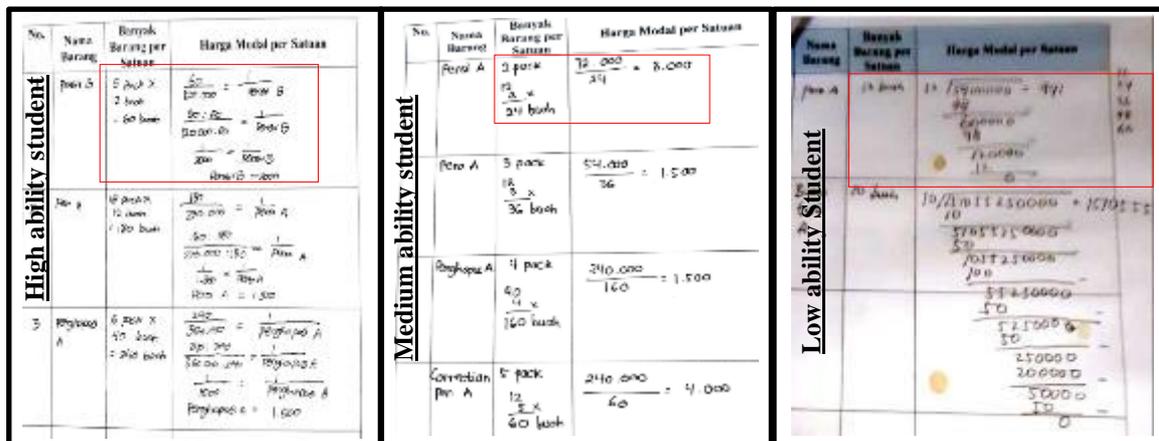


Figure 4. Student answers in determining the price of capital per unit

For high ability student, she already understands to calculate the unit price, so the required number of units of the whole pack purchased (Figure 4). This can be seen by student writing down a lot of pencil B is 5 packs \times 12 pieces = 60 pieces. After that, she wrote down $60/120,000=1/(\text{price of a pencil B})$ then look for the right arithmetic operation so that the proportion on the left is the same as the proportion on the right by dividing it 60 into $(60 \div 60)/(120,000 \div 60)=1/(\text{price of a pencil B})$, then obtained $1/2,000=1/(\text{price of a pencil B})$ so the price for a pencil B is Rp. 2,000 From the whole procedure is correct and there are no errors in the calculation so that it can be said that students have been able to solve the problem of direct proportion.

In the medium ability students also already understand to calculate the unit price, it requires the number of units of the whole pack purchased (Figure 4). This can be seen by students writing a lot of pencils A is 2 pack \times 12 pieces = 24 pieces. After that, he divides it by the total price of pencil A, which is $72,000 \div 24 = 3,000$ so that the price for a pencil A is Rp. 3,000. From the whole procedure it is correct and there are no errors in calculations so it can be said that students have been able to solve the problem. However, it made clear that the students' understanding of the direct proportion was conducted interviews related to the answer and it was found that the students understood the comparative worth of the explanation that is "because the price of one pencil is sought, then the ratio of the value is directly divided between the price of goods with the number of items".

In low ability students, it appears that he only wrote A pen 12 pieces, even though he bought 20 packs of pen A, which should have written 20 packs \times 12 pieces = 240 pieces (Figure 4). From this it appears that students do not understand the purpose of the problem. It was also strengthened from the results of his interview, he only wrote it according to the guidance table containing 1 pack = 12 pieces, so he wrote 12 pieces. Then students calculate the price of capital per unit by writing $5,400,000 \div 12 = 441$. From the answer the students also showed that students did not understand the division operation. The result of the division should be $5,400,000 \div 12 = 450,000$.

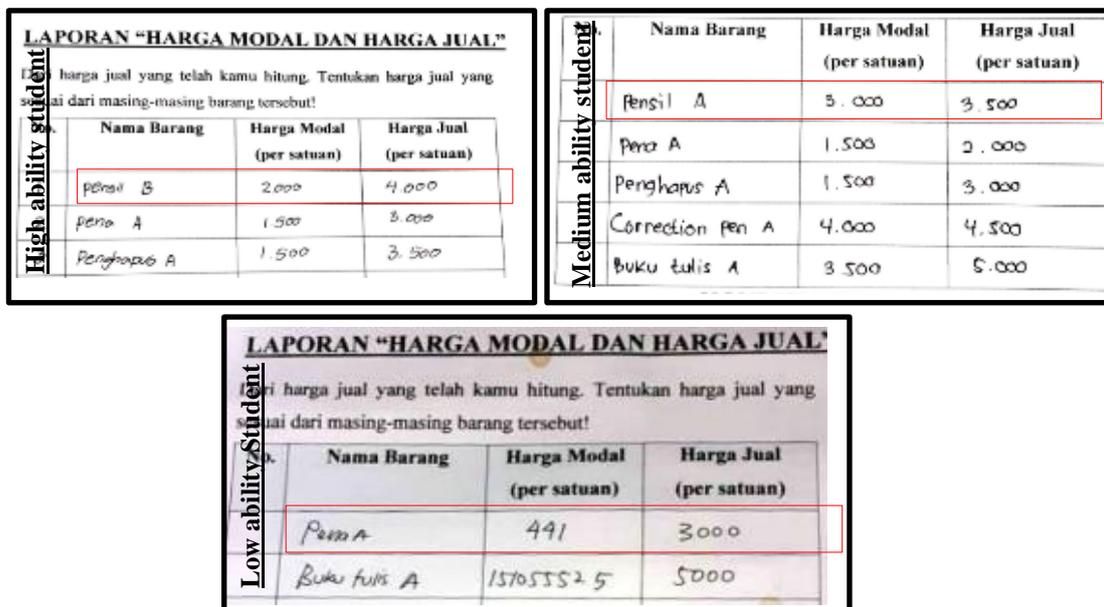


Figure 5. Student answers in adjusting the selling price to the price of capital

From the answers of high-ability student and medium-ability student (Figure 5), it appears that they have understood the price of sales must be greater than the purchase price. This can be seen from the answers to the students' high ability to write the capital price of

pencil B for Rp. 2,000 and the selling price of Rp. 4,000. The same thing is done by medium-ability students by writing the capital price from pencil A of Rp. 3,000 and the selling price of Rp. 3,500. Their answers also show that they have been able to determine the ideal price for the selling price by not raising the selling price too much or not raising the selling price by too little. However, for low-ability student (Figure 5), from the results of the answers and also the results of the interview he wrote the selling price is not based on the price of capital but based on the selling price he knows in everyday life. This is because the results of determining the wrong capital price will also create confusion in writing the selling price.

High ability student	No.	Nama Barang	Selisih Harga Jual dan Harga Beli	Kondisi Penjualan
			Pensil B	4000 - 2000 = 2000
		Pensil A	3000 - 1500 = 1500	Untung
		Penghapus A	3500 - 1500 = 2000	Untung

Medium ability student	No.	Nama Barang	Selisih Harga Jual dan Harga Beli	Kondisi Penjualan
			Pensil A	3.500 3.000 - 500
		Pena A	2.800 2.300 - 500	Untung
		Penghapus A	3.000 15.000 - 1.500	Untung
		Correction pen A	4500 4000 - 500	Untung
		Buku tulis	5000 3000 - 1500	Untung

Low ability Student	No.	Nama Barang	Selisih Harga Jual dan Harga Beli	Kondisi Penjualan
			Pena A	3000 411 - 2589
		Buku tulis A	5000 11055525 - 45155525	U

Figure 6. Student answers in determining sales conditions

From the answers of high-ability student and medium-ability student (Figure 6), it is seen that they understand how to calculate the difference between the selling price and the purchase price. This can be seen from the way they calculate the difference between the selling price and the purchase price by subtracting both of them. In high ability student, she wrote the difference in price for pencil B was Rp. 4,000-Rp. 2,000 = Rp. 2,000. The same thing is done by students of medium ability by writing Rp3,500-Rp3,000 = Rp.500. After that, they can also determine the conditions of sale appropriately ie when the selling price is greater than the purchase price, their sales conditions are in a profit. However, in low-ability student (Figure 6), it can be seen from the results of answers and interview results that these student have weaknesses in calculating the reduction operations. This can be seen from the way he reduced the price of notebook A which has an error, which is 5,000-15105525 = 45155525 but the results obtained must be 5,000-15105525 = -151050525. In addition, the students were seen from the results of the answers and interview results which he said were confused when determining the conditions of sale due to errors in calculating the difference between the selling price and the purchase price. But after further questioning, he understood that the profit was obtained when the selling price was greater than the purchase price.

From the overall results from stage one to one, it was concluded that all students could understand this goal so that making this worksheet would proceed to the small group stage.

3.2. Stages of implementation

At the implementation stage, the worksheet will be tested on a small group of 8 people and then divided into 2 groups, the distribution of groups is also based on the level of student ability. Here the researcher becomes a teacher and conducts a learning process in accordance with the worksheets that are designed and tries out worksheets that have been validated from the previous stages. In filling out the worksheet using the system of lesson study for learning community (LSLC). The questions on the worksheet consist of sharing assignments and jump assignments which are packaged in questions in the form of projects. The teacher model has the task to observe the learning process in small groups. The learning process that takes place in small groups will be analyzed whether the learning goes well or not and also the results of student answers will be analyzed to see the extent of students' ability to the worksheets provided.



Figure 7. Student expressions

When learning in small groups, the classroom situation seems calm and focused on each worksheet (Figure 7). They completed their respective projects by determining the items they wanted to fill in the school cooperatives provided that the total purchase was not more than Rp. 750,000. When there are students who have difficulty in solving problems, they ask for help from their friends who can answer it, creating a conducive classroom atmosphere and they do not riot in their groups and their friends teach students who have difficulty until they understand, then students who experience difficulty saying the word "thank you" to friends who have taught them.

After that, students who have difficulty in each group are asked to come forward and present the results of their answers to the class. From these, it will create the learning atmosphere desired by researchers, which are students who have a caring nature to their friends who are having difficulties, students who value their friends by saying "please teach me" and the word "thank you" when asking for help from their friends so that they will arise mutual respect for each other, then the nature of the responsibility of students who ask to be taught by their friends to present the results of the answers so that researchers can understand the extent of student understanding in what his friend explained, and also with this atmosphere there are no more students who do not learn during class time because all students can help each other in the study group which makes students no longer get score of 0 when completing their respective worksheet.

Table 1. Recapitulation of student answers

Student	Student Ability Level	Group	Student Answer				Average
			Determining Price Lists	Determining the Price of Capital Per Unit	Adjusting the Selling Price to the Price of Capital	Determining Sales Conditions	
1	High	1	81	87	75	74	79.25
2	Medium	1	68	77	80	80	76.25
3	Low	1	80	82	74	84	80.00
4	Low	1	73	77	76	56	70.50
5	High	2	86	71	86	74	79.25
6	Medium	2	75	73	70	70	72.00
7	Medium	2	70	81	86	72	77.25
8	Low	2	76	65	63	70	68.50
Average			76.13	76.63	76.25	72.50	75.38

Table 1 shows that problem 1 and problem 4 are problems of jumping task. This can be seen from the achievement of students' value at the time of problem 1, namely students who determine the purchase price of all items purchased and total purchases with a value of 76.13 and problem 4, namely students determine the choice of sales in profit, profit, or break even with a value of 72.50. Then for problem 2 and problem 3 is the sharing task. This can be seen from the achievement of students' value in problem 2, which is determining the price of goods per unit with a value of 76.63 and problem 3, which determines the difference between the selling price and the purchase price with a value of 76.25. From achieving these values, worksheets in the form of projects can already be used because they consist of problems in the form of sharing task and jumping task.

In addition, it can be seen in the table that the average value of all students is 75.63. For high-ability students in group 1 with 79.25 and group 2 with 79.25 so the average value for high-ability students is 79.25. These values indicate that high-ability students are above the average value of overall students. For medium-ability students in group 1 of 76.25 and group 2 of 72.00 and 77.25 so that the average value for students of medium ability is at 75.16. These values indicate that students with medium abilities are below the average of the overall value of students. For low ability students in group 1 amounted to 80.00 and 70.50 and group 2 amounted to 68.50 so the average value for low ability students was 73.00. These values indicate that low-ability students are below the average of the overall value of students. But an interesting fact from low ability students is that one of them gets the highest score of 80.00 and also the lowest value of 68.50. Collaborative learning from the LSLC system has a positive impact on learning because there are no group members who can't answer at all or get zero marks.

4. CONCLUSION

The conclusions of this research are, (1) the process of LSLC system, Collaborative Learning, PMRI Approach and Design Research are the right series of learning to be used in learning at SMPN 1 Palembang; (2) during the learning process, using context in daily life such as school cooperatives can be recognized by students helping them to more easily solve material problems of direct proportion and social aritmetika by using school cooperative projects; (3) there are still some students who have obstacles to counting in division and subtraction operations (4) overall, after examining the research, students were greatly helped to solve material direct proportions and social arithmetic in completing school

cooperative projects; (5) problems 1 and 4 including jumping task, and problem 2 and 3 including sharing task.

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