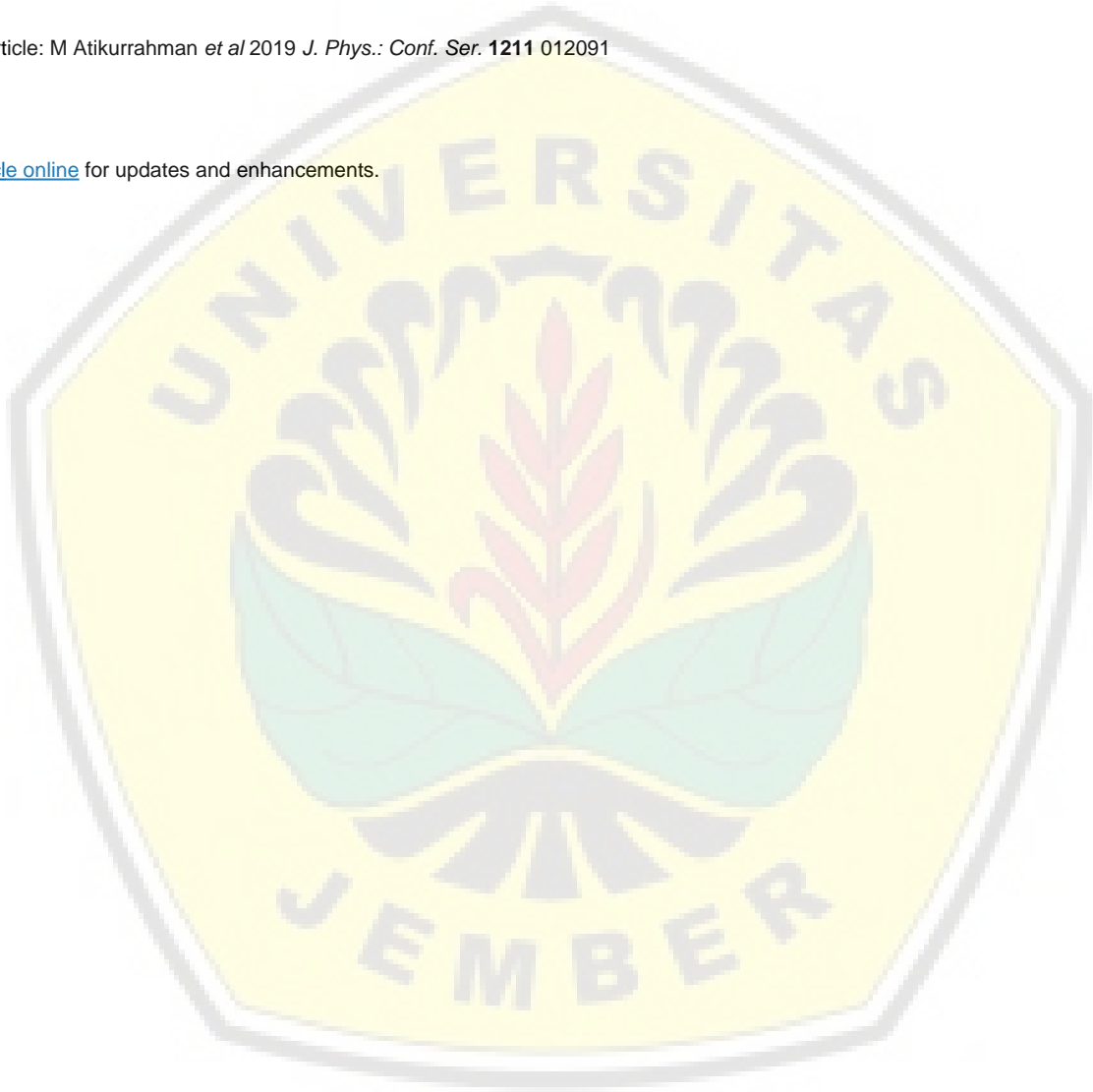


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## The development of comparison material tool with problem based learning based on caring community and its effect on the students' connection ability

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**Abstract.** This research was intended to develop the mathematics learning device with *Problem Based Learning* which also based on *Caring Community* and find out the effect on the students' connection abilities. The method used was Mixed Method, in which it used R and D Methods of Thiagarajan Model and quantitative method used quasi experimental pretest-posttest together. The students of SMP Ibrahimy 1 Sukorejo, which was class VII L was selected as the control class, whereas class VII M was chosen as the experimental class. The students' connection abilities were measured by using essay test. Before analyzing the data, normality test and homogeneity of variance were performed. The data were normal distributed, so that T-test was performed. From the result of this research, it was obtained (1) the development of comparison material with problem based learning which also based on caring community could be said valid, practical and effective (2) According to the result of difference test, the increase on students' connection abilities showed its significance value (2-tailed) as much as 0,000 ( $p < 0,05$ ) showed that the implementation of *Problem Based Learning* which also based on *Caring Community* had a significant effect on the students' connection abilities.

### 1. Introduction

Mathematics in the world of education is one of the basic sciences that can be used to support other sciences. The demands of the progress in this era are what encourage educators to be more competent and creative in developing and applying mathematics as a basic science which also plays an important role in human life. Mathematics has contributed much to the development of human civilization. The rapid progress of science and technology cannot be separated from the role of mathematics. It can be said that mathematics is the main foundation of science and technology. Thus mastering mathematics is one of the main ways to develop science and technology. However, we cannot deny the fact that many students still experience difficulties in learning mathematics. One of the mathematical problems that often found in VII grade students after conducting interview with mathematics teacher is a problem related to the material about comparison [12], in general, the mistakes in the learning process that cause difficulties for students in solving problems in mathematics learning caused by several matters, such as: (1) students still have difficulty in changing the form of story questions to mathematical models, (2) not being able to plan steps for solving problems, (3) not being able to use mathematical concepts that have been studied before to solve problems, and (4) most students do not re-checking the final results of the calculation, (5) students lack of enthusiasm for mathematics, (6)



students are not optimal in working with study groups and tend to think about themselves and ignore friends around them [7].

Based on the above problems, it is the time to hold a renewal, innovation or a movement to change the mind-set towards achieving educational goals. Learning mathematics should be with more varied methods and strategies to optimize the potential of the students. Therefore, the choice of methods, strategies and approaches in designing learning models to achieve active and meaningful learning is a demand that must be fulfilled for teachers. One of the learning models that can be used to improve students' connection abilities on the subject of comparison, is the development of comparison material with problem-based learning based on caring community and their effect on students' connection skills. This learning is carried out in several stages that are: (1) problem orientation (2) organizing students researching (3) assisting independent and group investigations (4) developing and presenting (5) analyzing and evaluating the problem solving process. The series of stages are carried out collaboratively between teachers and students, as well as between students, with mutual care and none of the students is neglected. The elements of connection ability are contained in the material and the questions presented. Problem Based Learning is generally consistent in showing superior efficacy for long-term knowledge retention [2, 15].

Through the Problem Based learning model, students will be trained not to depend entirely on learning activities by the teacher so that independent learning of students will emerge. The students will be encouraged to be active in learning, it challenges students to think, motivates students to continue finding out, and creates a fun learning process. In the end, students are able to apply the knowledge they get in their daily lives. Problem Based Learning focuses on the students by directing students to become independent learners and actively involved directly in group learning. This Problem Based Learning Model helps students to develop thinking that students are superior, skilled and professional in finding problem solving through searching data so that solutions to a problem are rational and authentic. This is expected to be able to stimulate other students to think creatively and be able to develop self-reliance learning together with their groups, in which caring community will create and develop in class. Many students in one class are divided into small groups of 3-4 students where a sense of concern for other students in the group is built. Moreover, care for other students in other groups. Therefore, there is a sense of caring between all students in one class. The teacher also takes part in the community so that the teacher with teacher, teacher with students, and students with students concerns will be interwoven. Caring Community also trains students who are still having difficulties in the learning process especially for those who are in junior high school. They still have difficulty understanding and completing it. This happens because their level of understanding is still low, therefore it requires the participation of many parties, including peers and parents, to overcome this problem (caring community-based learning). To improve the students' understanding and minimize errors that occur in problem solving, learning is enhanced through community-based learning studies that care for learning.

Caring community-based learning is based on Vygotsky-Bruner's theory (the meaning of knowledge), active, collaborative, and reflection. In practice, caring community does not discuss about the input-output of education, it rather points out the process called illumination model, so there is no need to assess the learning outcomes in each learning activity [6] Vision Caring Community: on students' learning should not be left alone or "no student will be neglected". Teacher must know, care for, and educate (caring) the problematic students by facilitating them to be able to learn in collaborative form. Caring Community trains the students who still possess difficulties in learning process especially for those who are in junior high school [5, 6].

Mathematics connection consists of 3 types, they are linking between concepts, mathematics concepts with other sciences, and mathematics concepts on everyday life. It can be said that mathematics becomes a very important lesson since almost every daily problem can be solved by using mathematics. Students' connection is a process covering: (1) finding out the relationship between various representations of conceptual concept and procedure (2) understanding the relationship between mathematical topic with other topics (3) using mathematics in other fields of

study or daily life (4) seeking connections on other procedure in equivalent representation, and (5) using connection between mathematical topic, and between mathematics topic and other topics [1].

## 2. Review of Previous Researches

In general, several studies discussed Problem-based Learning and students' connection, no matter there was nothing exactly the same as the research that was carried out by the researcher. This research was conducted by Nawafilah, Nur Qomariyah which aimed at developing Problem-Based Learning Tools that could support mathematics problem solving abilities of junior high school students on the volume of a flat side space material. Problem solving skill was very important to be developed and owned by students in learning mathematics [13]. The research conducted by Murtikusuma, Randi Pratama, the development of mathematics learning tools, Problem-Based Learning model, assisted by powerpoint media for eleventh grade students at Vocational School on row and series material. The purpose of this study was to develop valid learning tools [9]. A research done by Yunin Nurun Nafiah had an objective to improve critical thinking skill and learning outcomes of the tenth grade students at vocational high school (VOC) on the learning of computer network engineering (TKJ) to improve and reset PCs through the application of Problem-Based Learning (PBL) model [11]. Another research brought by Muhammad Daut Siagian was intended to discuss one of the abilities in mathematics that must be mastered by students in accordance with the mathematics learning objectives recommended by NCTM, in which it was mathematics connection skill. In this research, we discussed how important mathematics connection skill on mathematics learning and how mathematics was taught could develop students' mathematics connection skills. One of them was by applying constructivism understanding on learning process of mathematics at school [14]. A research conducted by Santi Widyawati, her research tended to determine the effect of mathematics connection skill through students' learning outcomes taken from the students who relied on the learning styles of Build Flat-Side Space in class IX at all Middle school in metro [12]. This research was carried out to improve the understanding of algebraic concepts and to minimize errors occurred in solving algebraic problems. The research was conducted in 3 cycles through Caring Community in which each cycle went through 3 stages, they were plan-do-see, according to the learning cycle in Lesson Study [6], but in this research, there were differences from the previous researchers, the current researcher developed the tools with Caring Community-based Problem Based Learning model which was about to determine the effect on connection ability of the student at SMP Ibrahimy 1 with comparative material.

## 3. Research Method

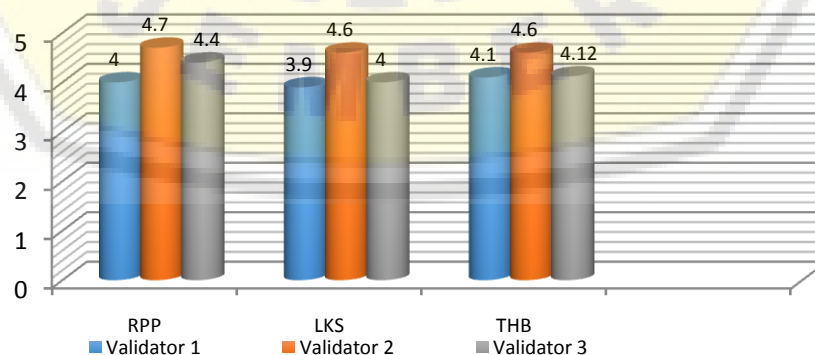
The development model of this research used the development model of thiagarajan, Semmel and Semmel. This development model consisted of four stages known as 4-D (Four D Model). The four stages were the define stage, the design stage, the develop stage, the disseminate stage [4]. The define phase of this stage was used to determine and define the learning conditions (Research and information collecting), and the second step in the Design phase covered the learning tools including RPP, LKS, and THB was designed. The third stage was the stage of development, this stage included the steps to check the validity, practicality, and effectiveness of learning tools, the fourth stage of the deployment stage was the use of learning tools that had been developed on a more scale, for example in other schools, other classes and other by teachers. The purpose of this stage was to test the effectiveness of the use of learning tools [4]. At the define stage, the researcher collected the information related to the product to be developed including several analyzes, namely: (1) Learning Analysis; (2) Student Analysis; (3) Material Analysis; (4) Task Analysis; and (5) Specifications of learning objectives. At the design stage (design) several steps were taken to develop the product, to obtain learning tools in the form of Lesson Plan (*RPP*), Student Worksheet (*LKS*), Learning Outcomes Tests (*THB*). The design of learning tools in the form of RPP, LKS, and THB in this study used problem-based learning approach consisting of five steps, namely: (1) Problem orientation (2) Guiding students (3) Helping students in groups (4) Developing & presenting (5) Analyzing & evaluating.



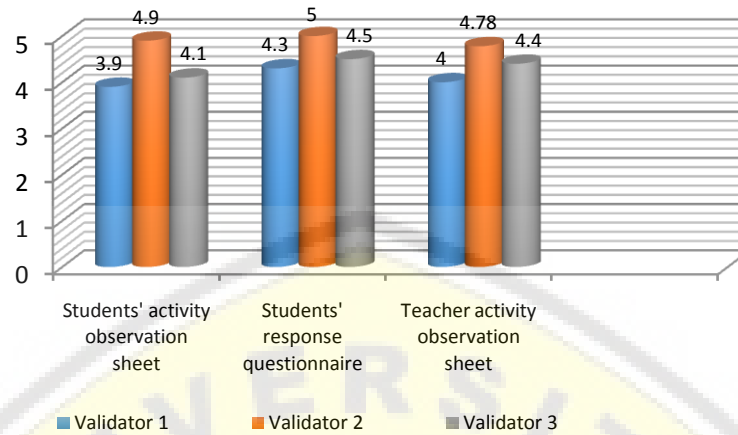
The validation on research instruments called observation sheet of student activities, student response questionnaires, and the observation of teacher activities. Learning tools and research instruments could be used if they were considered “valid”. If it was not valid yet, the learning tools and research instruments would be revised as suggested by the validator. The purpose of the research was to obtain an overview of the effect of the Problem Based Learning (PBL) model on students' connection ability. The results could be seen from the differences on the ability of connection between the classes by using the Problem Based Learning model and the class who used the expository model (control) on comparison material. This research was a quasi-experimental which implemented the method through pre-test post-test non-equivalent control design group, there are two classes involved, the experimental class and the control class. The experimental class was given PBL model, while the control class was taught by using the expository model. The population of this research is the seventh grade students of SMP 1 Ibrahimy in Sukorejo, Situbondo, in the academic year of 2018/2019. The sampling technique used in this study was random sampling technique which chose two classes randomly from the population, then the experimental class was selected, it was VII M, which received learning by using PBL based Caring Community. Meanwhile, class VII L was taught by conventional learning as was commonly applied in schools, namely, lecturing model and question and answer, so that the dominant learning was teacher centered. Data collection was done through tests and observations, then the normality and different test (paired) assumptions were carried out. The normality test used Kolmogorov-Smirnov test while the difference test (paired) used the T-test with each significance level of 0.05 ( $P < 0.05$ ). If the data was normally distributed and homogeneous then t-test test was carried out. If the data was not normally distributed or not homogeneous, then non-parametric tes would be usedt which was Mann-Whitney test.

#### 4. Results and Discussion

After designing the learning tools and research instruments, it seemed that it was necessary to get some input, suggestions and improvements than validation was carried out by 2 expert lecturers, and 1 mathematics education teacher. Validation was done by giving the text of learning tools and research instruments in the form of RPP, LKS, THB, student activity observation sheets, student response questionnaires, and observation of teacher activities, and validation sheets to expert validators. The data from the validation results for each component of the learning tools product were analyzed by calculating the average score obtained by each component. The average score obtained for RPP, LKS, THB, and Research Instruments can be seen in Figure 1 and Figure 2.



**Figure 1.** The validation result of Learning tools



**Figure 2.** The validation result of Research Instruments

Figure 1 showed that the validation result of the tools and instruments was valid so that the learning tools and research instruments could be used in the research. Based on the data from the validation experts, an analysis was conducted to check the validity/appropriateness of the developed product. The product appropriateness was based on the data in the form of average score of research results from three validators. The quantitative data from the validators was converted into a qualitative data. Overall, it was said to be valid or appropriate to be used if it was in the range of  $4 \leq V < 5$  interval. Furthermore, the procedures of *Problem Based Learning* which also based on *Caring Community* was conducted to the seventh grade students of SMP Ibrahimy 1 in Sukorejo Situbondo on the subject of comparison. This research was conducted within 5 meetings with 3 treatments as well as conducting pretest and posttest in the first and last meetings. The same activity was done in the control class by using expository learning. In the first meeting, a pretest consisted of 5 questions was administered within 80 minutes. The results of pretest was used to measure the students connection ability before following the learning. The result of pretest was presented in Table 1.

**Table 1.** The result of pretest of the students' connection ability

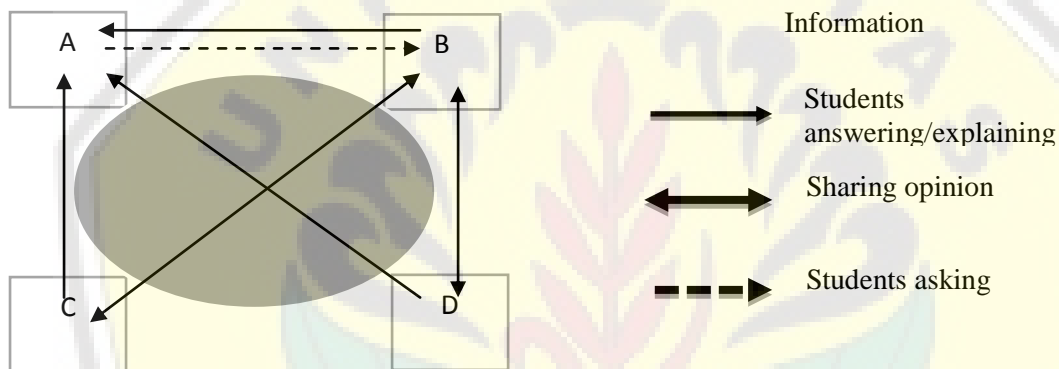
Descriptive Statistics				
Class	Minimum	Maximum	Mean	Std. Deviation
Experimental	35.00	52.00	42	3.65715
Control	37.00	50.00	42	3.60013

Based on the data drawn on table 1 above, it can be concluded that the results of pre-test of students' connection abilities were still below the average as seen from the mean scores of experimental and control class were 42; and the minimum were 35 for the experimental class; while 37 for the control one; and the maximum was 53 in the experimental class, 50 belonged to the control one, the value of Std. Deviation of both was 3,65715 dan 3,60013.

In the experimental class, PBL learning based on *Caring Community* was conducted in the second meeting up to the fourth meeting. The learning activities were done through the collaboration with the students and making group independently which consisted of 4 students. The learning was carried out through some stages, that were; (a) problem orientation, (b) organizing students, (c) helping group investigation, (d) developing and presenting, (e) analyzing and evaluating the problem solving process. Whereas, in the control class, the learning was carried out through expository learning in which in presenting the material oriented to the teacher and guided exercise was given [8].

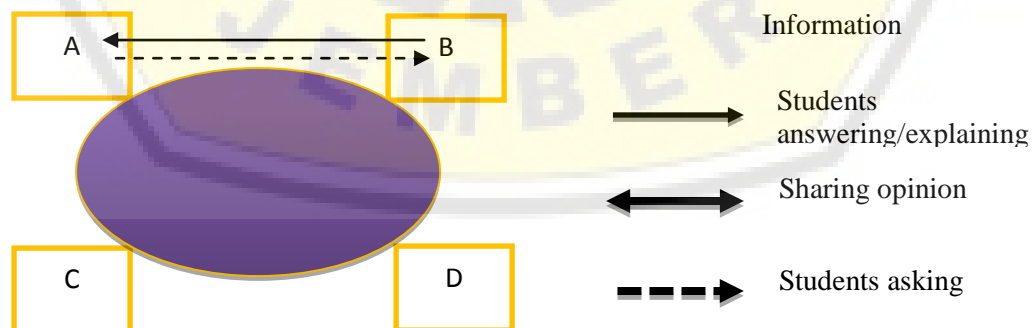
In the learning process, the students were guided to think individually beforehand then collaborate with their friends within the group and none of the students is neglected (*caring community*) [10]. In Caring Community-based learning, it assumed that every student was accepted and cared no matter how the condition, belief, or weaknesses they have. So that in assessment stage where exercise questions were presented with the level of students' connection ability, the activities went collaboratively in a cared community. Therefore, in the experimental class, the students were guided to be in a group, questioning each other, and explaining to their friends so that the sense of care among friends emerged. Accordingly, by using Students' Worksheet (LKS) of *Problem Based Learning* based on *Caring Community*, the students would be more able and glad to understand the material.

In this class, the students work together, questioning each other, and the sense of care emerged among friend. The students' activities of questioning and explaining as well as sharing opinion within the group was presented in the following Figure 2 (taken from one group as a sample).



**Figure 3.** Group Discussion Activities in the Experimental Class

The group discussion in the experimental class ran well in which student B was the central point of sharing opinion and explaining to the other friends who lack in understanding the material, it was also seen that student D and student C were enthusiastic to help explaining to the student A. This revealed that the students could collaborate and build caring community with high care to fellow friends. The group discussion occurred in the control class was presented in the following Figure 3.



**Figure 4.** Group Discussion Activity in the Control Class

The discussion in the control class occurred only between student A and student B. Student C did not understand the material yet he did not ask his friend who knew better than him. Other students were only copying their friends' answer without understanding the answer. Overall, the group discussion happened in the control class was only aim to answer the question given by the teacher and ignoring whether a friend within the group understood or not.

The discussion in the control class was only done by the students A and B. The students C and D did not understand the material but they did not ask to their friends who had understood. The other students only copied their friends' answers without understanding the answers. Overall, the discussion done in the control class aimed to find the answer the problem given by ignoring if the other members in a group really understood. High score was the main goal of the group and neglected the meaningfulness of the science given. This was contrast with the discussion in the experimental class. Generally, based on the observation results of the students' activities covering the activities of asking, arguing, cooperating, conducting, presenting and responding the group discussion in the experimental class, showed that most of the students were active in the learning process.

Post-test was administered in the last meeting, to find out the students' connection ability after following the learning process. The results of the post-test were shown in the following table 2:

**Table 2.** Students' Connection Ability Based on the Post-Test  
Descriptive Statistics

Class	N	Minimum	Maximum	Mean	Std. Deviation
Post-test of Experimental Class	30	76.00	100.00	86.8000	6.13301
Post-test of Control Class	30	41.00	74.00	58.2667	8.35808

From 30 students in the experimental class, there were 25 students categorized as active (86%) and 5 students categorized as less/not active (14%). Whereas, different condition showed in the control class that was from 30 students, as many as 15 students were active (42%) and 21 students were less/not active (58%). Thus, it can be concluded that in average, the students were active in joining the mathematical learning with Caring Community-based PBL.

The data analysis to find out the impact of Caring Community-based Problem based learning on the students' connection ability was started by prerequisite test. This was the first step done before the presumption test including normality and homogeneity tests. Normality test used Kolmogorov-Smirnov statistics listed in the table 3 below:

**Table 3.** Normality Test by using Kolmogorov-Smirnov  
One-Sample Kolmogorov-Smirnov Test

Class		Kolmogorov-Smirnov		
		Mean	Df	Sig. (2-tailed)
<i>Pre-test</i>	Experimental Class	42,9	3,6	0,093
	Control Class	42,7	3,6	0,496
<i>Post-test</i>	Experimental Class	86,8	6,1	0,427
	Control Class	58,2	8,3	0,885

Based on the table 3, it showed that the significant value data of the students' connection ability in the pre-test in the experimental class was sig = 0.093 and the control class was sig = 0.496 while the significant values of post-test in the experimental class was sig = 0.427 and the control class was sig = 0.885. Therefore, it can be concluded that the data of pre-test and post-test in both classes were normally distributed. Thus, normality test was fulfilled. Due to the significant value was higher than



0.05, it means that the students' connection ability data (pre-test and post-test) in both classed could be said as normal. After normality test was conducted in the table 3 above and normally distributes, therefore difference test was conducted between the pre-test and post-test, with the basic concept that the researchers data must be normally distributed. Difference test (paired) in the table 4, as follows.

**Table 4.** Difference Test (paired) simple Statistics

		Paired Sample Statistics			
		Mean	N	Std. Deviation	Std. Error mean
Pair 1	Pre-test of Ekperimental Class	42.9333	30	3.65715	.66770
	Post-test of Ekperimental Class	86.8000	30	6.13301	1.11973

Table 4 showed that there was a substantial change between Pre-test and Post-test. This could be seen from the mean of pre-test of 42.9333 from 30 data. The distribution of the data (Std. deviation) obtained was 3.65715 with standard error of 0.66770. Post-test became 86.8000 from 30 data. The distribution of the data (Std. deviation) obtained was 6.13301 with standard error of 1.11973. The table of paired samples test was shown in Table 5.

**Table 5.** Paired Samples Test

	mean	Std Deviation	Std error mean	lower	upper	T	df	Sig.(2-tailed)
Pretest-Posttest	43,8667	6,58490	1,20223	46,32551	41,4078	-36,488	29	0,00
					2			

**Basic of Decision making**

- If the sig value (2-tailed) < 0.05, it means that there was a significant difference of learning outcomes between pre-test and post-test.
- If the sig value (2-tailed) > 0.05, it means that there was no significant difference of learning outcomes between pre-test and post-test.

From the result of difference test, the increase of students' connection ability of both classes used *Paired* test revealed the value of sig. (2-tailed) 0.000 ( $p < 0.05$ ), so it could be concluded that there was an increase on the difference of the students' connection ability between the control class which used conventional learning (Direct Instruction) and the experimental class which used *Problem-Based Learning* which also based on *Caring Community*.

In this research, the indicator used to measure connection ability by showing three indicators (S1, S2, S3). S1 = the aspect of using connection between ideas in mathematics, which refers the ability to relate the concepts in one material. S2 = the aspect of connecting an idea with other ideas which result in a whole relations by connecting mathematics principles with other material. S3 = the aspect of connecting mathematics in a daily life by implementing mathematics concept to solve problem which related to the problem in daily life.

Note:

S1 = aspect of using connection between ideas in mathematics

S2 = aspect of connecting an idea with other ideas which resulted in a whole relations.

S3 = aspect of connecting mathematics in daily life

The students' connection ability in answering the question was presented in Figure 4.

Diket: bahan bakar = 3 liter  
 Jarak tempuh = 45 km  
 bahan bakar = 5 liter

Ditanya: Jarak tempuh jika 5 liter bensin

3	45
5	?

$$\frac{3}{5} \times \frac{45}{x} = \frac{5 \times 45}{3x} = \frac{225}{3x}$$

$$x = \frac{225}{3} = 75 \text{ km}$$

Untuk jarak tempuh 45 km membutuhkan 3 liter bensin adalah  $\frac{45}{3} = 15$   
 untuk 5 liter bensin adalah  $5 \times 15 = 75 \text{ km}$   
 Jadi sebuah kendaraan dengan 5 liter bensin bisa menempuh jarak 75 km

S1 = Aspect of using connection between ideas in Mathematics.

S2 = Aspect of connecting an idea with other ideas which resulted in a whole relationship.

S3 = Aspect of connecting mathematics in daily life.

**Figure 5.** The students' answer who master connection ability with 3 aspects  
 Students with low connection ability had not been able to show the three indicators of connection ability as shown in the students' answer presented in the following Figure 5:

Diket: bahan bakar = 3 liter  
 Jarak tempuh = 45 km  
 bahan bakar = 5 liter

Ditanya: jarak tempuh jika 5 liter bensin

3	45
5	?

$$\frac{3}{5} \times \frac{45}{x} = \frac{5 \times 45}{3x} = \frac{225}{3x}$$

$$x = \frac{225}{3} = 75 \text{ km}$$

S1 = Aspect of using connection between ideas in Mathematics.

S2 = Aspect of connecting an idea with other ideas which resulted in a whole relationship.

**Figure 6.** Students' answer who had low connection ability

Thus, it can be concluded that the students had no ability on the level of drawing conclusion. He had not recognized the comparison deeply so that he could not conclude the result.

The students who could connect 3 aspects fulfilled the indicators as follow: (1) aspect of using connection between ideas in mathematics, which refers to the ability to relate the concepts in one material, (2) aspect of connecting an idea with other ideas in which resulted in a whole relations,

which refers to connecting the principles of mathematics with other different material, (3) aspect of connecting mathematics in daily life, which refers to the use of mathematics concept to solve problem related to the daily life.

From the data that has been presented, the effectiveness test of learning device with problem-based learning based on caring community had been fulfilled, it was showed by: (1) the result of students' connection ability test which reached 3 aspects (S1, S2, S3), (2) the students' activity during indicator 3 the students were not able to analyze the obtained information then structuring the information into smaller part in order to recognize the pattern or the relationship high learning, (3) there was a significant increase in mean scores of the students' connection ability in the experimental class.

The result of the observation toward the learning showed that the learning ran well in each aspect. Thus, the practical test for the learning device which had been developed fulfilled the criteria of: (1) the level of administration in good category, (2) the students were positively responded toward the learning device and the learning itself with problem based learning based on caring community [3].

### 5. Conclusion and Suggestions

Based on the results and data analysis of the research conducted, it can be concluded that: There was an influence of Caring Community-based Problem Based Learning (PBL) on the students' connection ability in the mathematical learning on the comparison material. This research revealed that the students' connection ability that were taught by using Problem Based Learning (PBL) were better than the students who were taught by using expository or Direct instruction. In addition, the results of this research showed that the mathematical learning tools with Caring Community-based Problem Based Learning (PBL) on the comparison material in the class VII of SMP Ibrahimy 1 Sukorejo was categorized as valid, effective, practical, as well as had a significant effect on the students' connection ability.

The suggestions that the researchers conveyed based on the research were: 1. For the teacher, especially mathematics teacher, should use Problem Based Learning (PBL) model as one of the learning alternatives in an effort to develop the students' connection ability in their daily life, so that the learning process becomes effective. 2. For the future researcher, should refine the research and make the time effective as well as not eliminating the main characteristics of this learning that is Lesson Study for Learning Community (LSLC)-based to get maximum result.

### Acknowledgement

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