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The application of problem based learning (PBL) based on lesson study for learning community (LSLC) to improve students' creative thinking skill

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Abstract. of the important factors determining the ability of a nation in facing the challenges of the globalization era with the existence of qualified human resources is through the optimization of the role of education. The 2013 curriculum aims to prepare Indonesian people to have creative thinking skills. Creative thinking can be built when students do the process of solving problems scientifically, and it is done in small groups through Problem Based Learning (PBL). In learning, students in groups find their own solutions to the problem while the teacher acts as a facilitator. In small groups, students also collaborate, learn, and care for each other so that no student feels neglected through Lesson Study for Learning Community (LSLC). This study aimed to improve students' creative thinking skills by applying tools learning through PBL-based LSLC. This research was a 4-D model development study from Thiagarajan which was analyzed using validation sheets. This research was carried out in Islamic junior high school, and the research subjects were students of class VIII A. The results showed that (1) based on the test results that the application of LSLC-based PBL teaching administrations had a significant effect on students' creative thinking abilities, (2) students' attitudes, activities, and creative thinking processes increased after applying the teaching administrations that contained the PBL syntax based on LSLC.

1. Introduction

The 21st century learning is a transition of learning where the curriculum that is developed today requires schools to change the learning approach that centers on educators (*teacher-centered learning*) into one that centers on learners (*student-centered learning*). This is in accordance with the future demands of which students must possess great thinking and learning skills. The characters of the 21st century learning are referred to as 4C, namely: *Communication, Collaboration, Critical Thinking and Problem Solving, Creativity and Innovation*. One of the goals of learning mathematics is to train and foster creative ways of thinking and develop perseverance and confidence in solving problems.

Creative thinking is original and reflective thoughts that produce a complex product [1]. There are 3 components of thinking (1) thinking is a cognitive activity that occurs in a person's mental or mind, is not visible but can be concluded based on observed behaviors, (2) thinking is a process that involves a lot of cognitive system knowledge manipulation, (3) thinking activities directed to produce solutions to problems [2]. Creative learning provides opportunities for students to solve problems with unique solutions in various ways and has varying answers according to their own abilities [3]. To achieve creative mathematics learning, it is indicated that each individual must be able to express themselves



efficiently and be able to find similarities or differences from the problems they face [4]. There are 4 characteristics of creative thinking, namely: (1) fluency, (2) flexibility, (3) novelty, (4) detail [5]. The intended level is in accordance with the work produced by students. Therefore in this study the level of Creative Thinking Ability (TKBK) of students is described in the following table

Table 1. Indicator of creative thinking ability.

No	Creative Thinking Ability	Indicator
1.	Fluency	<ul style="list-style-type: none"> • Resolve the problem correctly • Give lots of examples or statements related to certain mathematical concept or situations
2.	Flexibility	<ul style="list-style-type: none"> • Use various strategies to solve the problem • Give many answers to the problem • Provide various examples or statements related to certain mathematical concepts or situations
3.	Novelty	<ul style="list-style-type: none"> • Use strategies that are new, unique or unusual to solve the problem • Provide examples of statements that are new, unique or unusual
4.	Elaboration	<ul style="list-style-type: none"> • The ability to explain coherently and coherently to mathematical procedures, answers or situations obtained

Table 2. Indicator level of creative thinking ability.

TKBK	Indicators Creative Thinking Ability			
	Fluency	flexibility	Novelty	Elaboration
Level 0 (not creative)	x	x	x	x
Level 1 (less creative)	√	x	x	x
Level 2 (creative enough)	√	√	x	x
Level 3 (creative)	√	x	√	x
Level 4 (very creative)	√	√	√	√

Learning that supports students to think creatively and actively is through the application of Problem Based Learning because in Problem Based Learning students are directly confronted with real problems. Problem Based Learning is a learning model that demands the mental activity of students to understand a concept of learning through situations and problems presented at the beginning of learning with the aim of training students to solve problems in using problem solving approaches [6]. There are 5 steps in Problem Based Learning according to Hobri: (1) directing

students to problems, (2) organizing students to study, (3) helping independent and group investigations, (4) developing and presenting *artifact* and *exhibits*, (5) analyzing and evaluating the problem solving process [7]. In PBL learning, students form small groups, and scientific activities occur in students through group work.

In addition, the ability to think creatively can be more developed if the group implements collaborative learning and learning communities. Learning community, according to Saito, encourages collective collegiality between teachers to achieve success and requires collaborative learning in the classroom [8]. The vision of community learning in student learning should not be left alone so that no student feels neglected, the teacher must know, care, and caring for students who have problems by facilitating students to learn in a collaborative form meaning that students learn from each other listen and listen to each other. There are three philosophies of learning community: (1) public philosophy, (2) democratic philosophy, and (3) excellent philosophy [9]. Collaborative learning and learning communities are a series of LSLC learning. The definition of LSLC here is the implementation of lesson study which is intended to build a learning community. Learning community is formed on two main pillars: (1) *Collaborative learning*, the teacher must provide everything related to materials and supporting learning media so that students master the materials, and the teacher's creativity is highly required to stimulate creativity in students, (2) *caring community*, or building learning groups which care for each other and are sensitive to the surroundings [10].

Improving the quality of education is the most important role for teachers. Choosing the right learning model and interesting media and making learning designs that make students active and creative and feel happy in the learning process are not less essential ones. One of the alternatives of approaches to achieve the goal is through PBL based on LSLC with the use of Student Worksheet, the materials of student worksheet is obtained through case design related to learning material.

With the student worksheet integrated into the LSLC-based PBL, it has a good impact on students. In composing the worksheet, the teacher must pay attention to the creative steps in each stage, create the materials and a clear scenario, and pay attention to how the reactions occur at each step. Each given trait must be challenging and stimulating students to think, act and work together in solving problems. Every student's reaction should reflect collaborative activities and in accordance with PBL steps.

Worksheets are discussed in groups in which students learn from each other, tell each other, those who do not understand ask those who have already understood, and vice versa, so that it can be seen that students discuss with each other well. The type used in collaborative learning is the spiral that is always stepping forward by involving students who do not understand, and control the involvement of all students in the group. Mastery of the material is expanded by using creativity so that students can solve problems, understand concepts well, and achieve good learning outcomes [11]. The formulation of the problem in this study was whether the application of PBL teaching administrations based on LSLC could increase students' creative thinking. The expected goal was to improve the ability to think creatively, as well as increase the sense of caring among people in the learning community.

2. Method

This design of this research was R & D (Research and Development) using Thiagarajan, Semmel and Semmel which is commonly known as the Four D Model that has been modified. This model consists of 4 stages: define, design, develop and disseminate. However, this study only reached the stage of development and not yet reaching the dissemination phase. The teaching administrations developed were Lesson Plans (RPP), Student Worksheets (LKS) and Test (THB). Meanwhile, the instruments developed were teaching administrations validation sheets, student response questionnaires, teacher activity observation sheets, and student activity observation sheets.

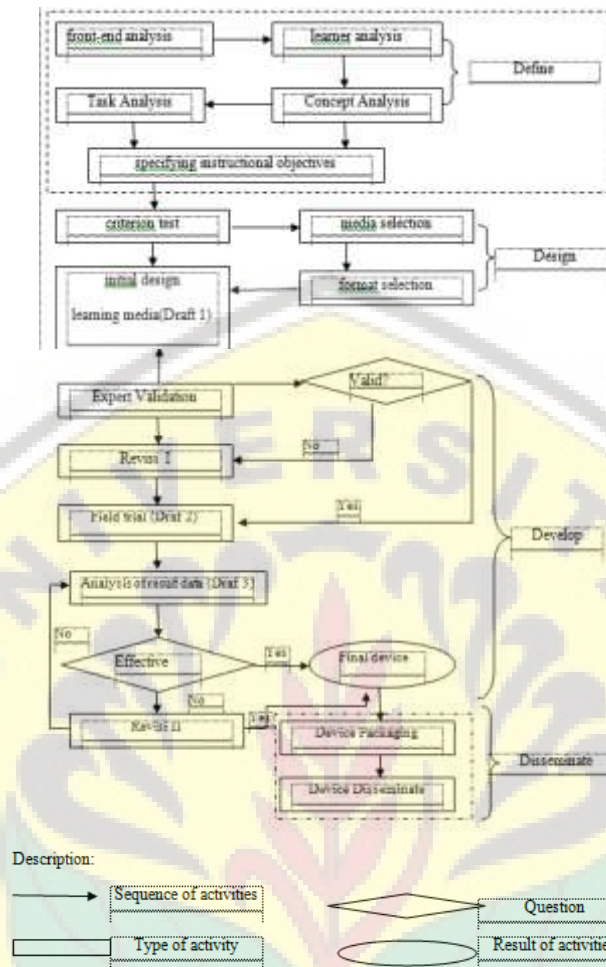


Figure 1. Chart stage of developing learning devices.

To analyze students' creative thinking skills, the test was used. The test was constructed in the form of three open ended questions that must be answered by using LSLC-based PBL steps. In the process of measuring creative thinking, the same test was given twice. The Pre test was administered at the first meeting before students were given treatment. The Post test was administered after students learnt through LSLC-based PBL.

3. Result And Discussion

The teaching administrations developed were Lesson Plans, Student Worksheets, and Test which included the syntax of LSLC-based PBL. Because LSLC is a part of lesson study, the stages also involved Plan - Do - See.

In the *Plan* phase, the researcher together with 8 mathematics teachers developed teaching administrations. The developed administrations aimed at creating a learning atmosphere that was fun for students and allowed students to learn with fellow friends so that no students felt neglected in learning. This condition lead to the ability to solve problems through their own experiences and could improve students' creative thinking skills. Before entering the *Do* phase, the teaching administrations developed together were validated to find out whether they were suitable for use. Validation was carried out by three validators, (2 mathematics education lecturers and 1 mathematics teacher). The recapitulation of the validator results is presented in the following diagram.

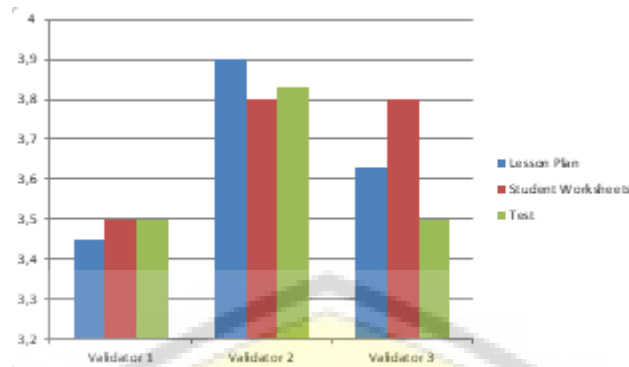


Figure 2. Diagram of validator's assessment results.

Of the three validators, the average values of lesson plans, student worksheet, and the test were at intervals of $3 \leq V_r \leq 4$. Thus, the teaching administrations were said to be valid. In the *Do* phase, the researcher together with 8 teachers applied the developed teaching administrations. Learning activities were carried out with LSLC-based PBL models that were done through the use of student worksheets. The researcher was as a model teacher, and 8 teachers were as observers. The model teacher divided students into 7 groups, each group consisting of 4 heterogeneous students. The model teacher only acted as a facilitator. As for the results of the learning process, it showed that students experienced a better improvement. It can be seen that students were more active in class discussions and active in responding to answers or input from classmates from other groups. Most students were no longer ashamed to ask their group member if they had difficulties when working on problems, and students who had already understood directly helped the members of their group when they had difficulties in solving problems. Therefore, the sense of belonging, respect, and care emerged among for fellow students, and no students felt left out in the learning. In the *See* phase, the researcher and 8 teachers who acted as observers gathered to reflect on various things or constraints and to share students' learning activities in the learning process to improve the learning process at the next meeting.

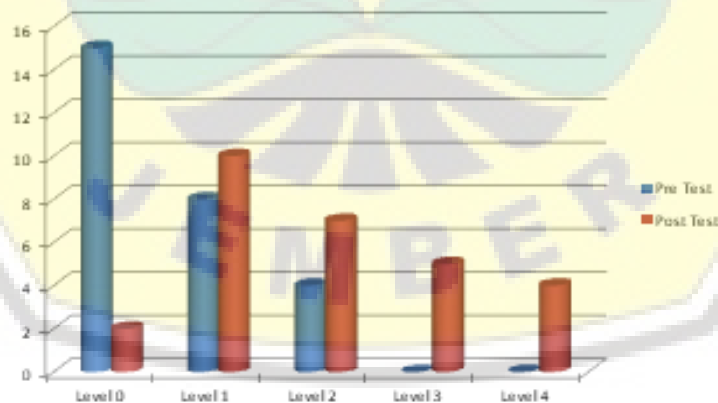


Figure 3. Diagram of students' creative thinking ability based on test results.

In test 1, the level of students' creative thinking was still low as seen from the diagram. No students reached Creative 3 and Creative 4. On the second test, there seems to be some improvements. Some students went beyond Creative 3 and Creative 4. The results of developing PBL model teaching administrations based on LSLC show that it could improve students' creative thinking on the subject of polyhedron for grade 8 A. This can be seen from the answers of the open ended questions which were completed by PBL steps analyzed with indicators of creative thinking ability and level of creative

thinking ability (TKBK). From the above diagram, it can be seen that the results of creative thinking of students in test 2 increased compared to that of test 1.

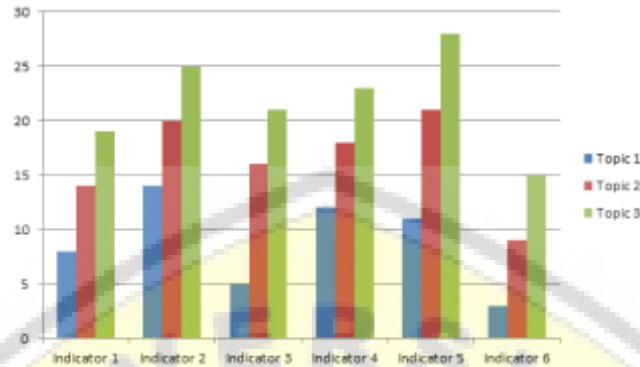


Figure 4. Diagram of student learning activities in PBL learning based on LSLC.

Table 3. Indicators information.

Indicators	
1	Activeness in planning how to solve the problem
2	Willingness to discuss in groups
3	Mutual concern to check on group's answer
4	Concern about giving input related to the results of group's answer
5	Activeness in giving arguments before the agreement is approved by the group members
6	Activeness in responding to the presentation results made by the presenting group

The diagram shows improvement at each meeting. Activeness in planning how to solve problems was achieved by 8 students at the second meeting of topic 1, by 14 students at the third meeting of topic 2, and by 19 students at the fourth meeting of topic 3. Willingness to discuss in groups was achieved by 14 students at the second meeting of topic 1, by 20 students of the third meeting of topic 2, and by 25 students at the fourth meeting of topic 3. Mutual concern to check on group's answer was achieved by 5 students at the second meeting of topic 1, by 16 students at the third meeting of topic 2, and by 21 students at the fourth meeting of topic 3. Concern about giving input related to the results of group's answer was achieved by 12 students at the second meeting of topic 1, by 18 students at the third meeting of topic 2, and by 23 students at the fourth meeting of topic 3. Activeness in giving arguments before the agreement is approved by the group members was achieved by 1 students at the second meeting of topic 1, by 21 students at the third meeting of topic 2, and by 28 students at the fourth meeting of topic 3. Activeness in responding to the presentation results made by the presenting group was achieved by 3 students at the second meeting of topic 1, by 9 students at the third meeting of topic 2, and by 15 students at the fourth meeting of topic 3.

In this study, learning activities were conducted in 5 meetings. In the first meeting, students were given a test which contained 3 open-ended questions. In the second meeting, students were given learning material to determine the surface area of cubes by using the developed teaching administrations with LSLC-based PBL to improve creative thinking skills. In the third meeting, students were given learning material to determine the surface area of the cuboids. In the fourth meeting, students were given learning material to determine the surface area. In the fifth meeting, students were given the same test given in the first meeting. The test was given to determine the increase in students' creative thinking and to know the sense of caring among others in the learning community.

The Learning Process

1st Meeting

In the first meeting, the researcher gave a test containing 3 open-ended questions. Students did the problems individually in 2 lesson hours (2 x 40 minutes).

2nd meeting

The second meeting began with a *plan* carried out by the researcher together with 8 mathematics teachers. The *plan* phase started with designing teaching administrations (lesson plans, student worksheets, and test) in accordance with the PBL syntax based on LSLC under the topic of finding the surface area of cubes.

In the *do* phase, the researcher conditioned the class. In the learning process, the researcher divided the students into 7 groups consisting of 4 students per group. Each group was accompanied by one teacher as an observer to find out the activities of students in the group. Meanwhile, the researcher's activities was also observed by 1 observer. The researcher provided initial material stimulus related to the topic being discussed which was determining the surface area of cubes. The seating arrangement of the groups is shown in the following picture.

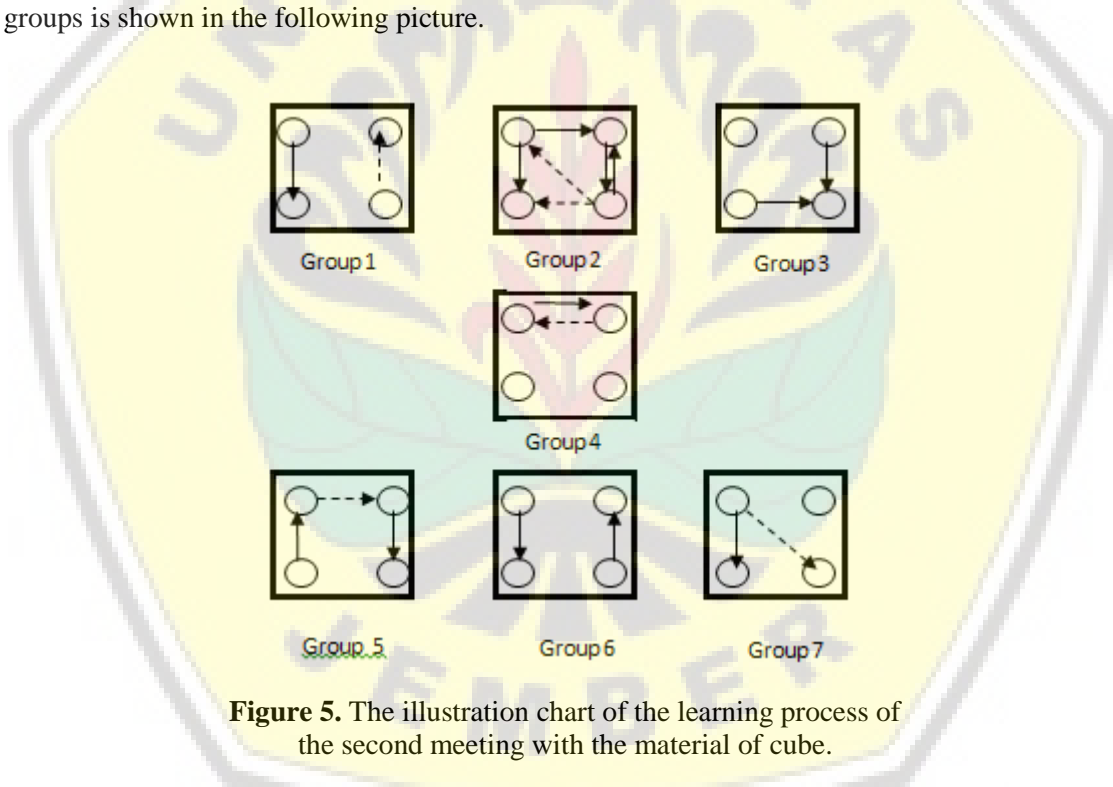


Figure 5. The illustration chart of the learning process of the second meeting with the material of cube.

Description : \longrightarrow : students ask or respond
 \dashrightarrow : students expresses his opinion or guide his peers.

In the second meeting, there was only one group that was active in the discussion (Group 2). Group 2 discussed in solving the problems in the student worksheets. One of the questions that emerged from group 2 was whether looking for the surface area of the box was the same as finding the minimum area of wrapping paper used to wrap gifts. Then, Farhan, a student from group 2 answered the question. He seemed to have better understanding. He explained to his group members that to find the cube surface area they had to understand how to find the area of the plane figure constituting the cube. Then, the result could just be directly multiplied by how many plane figures constituting the cube. Meanwhile, to find the minimum area of wrapping paper, they had to understand the command listed

on the problem. The problem explained that the top area of the cube did not need to be covered with wrapping paper, so the number of the area was not the same as it was when determining the surface area of a cube.

In other groups, it was still apparent that they were still accustomed to working alone and were not used to giving opinions or asking their group members. As can be seen in the picture, in groups 1, 3, 4, and 6 no one was able to express their opinions. They tended to be passive. There was no communication among groups. Hence, in this learning LSLC had not been observable. The students were still used to learning independently and were embarrassed to ask their peers.

The last implemented was the *See/reflection* phase. Some findings were revealed in the reflection stage. According to observations made by observers, the learning in the second meeting was not in accordance with the plan. The sense of caring to help other students among groups had not yet appeared. There were still many students who were seen doing their tasks independently. Likewise with the activeness in group discussions. Most students were still passive and embarrassed to express their opinions. Students were not used to doing class discussion activities. The courage of students was also not ideal. There was no communication at all among groups. What could be observed was that students were still accustomed to learning with lecture strategies so that PBL based learning could not be optimally implied based on LSLC. This resulted in insufficient understanding and mastery of the material.

3rd meeting

The third meeting began with a *plan* carried out by the researcher together with 8 mathematics teachers. The *plan* phase started with designing teaching administrations (lesson plans, student worksheets, and test) in accordance with the PBL syntax based on LSLC under the topic of finding the surface area of cuboids.

In the *do* phase, the researcher conditioned the class. In the learning process, the researcher divided the students into 7 groups consisting of 4 students per group. Each group was accompanied by one teacher as an observer to find out the activities of students in the group. Meanwhile, the researcher's activities was also observed by 1 observer. The researcher provided initial material stimulus related to the topic being discussed which was determining the surface area of cubes. The seating arrangement of the groups is shown in the following picture.

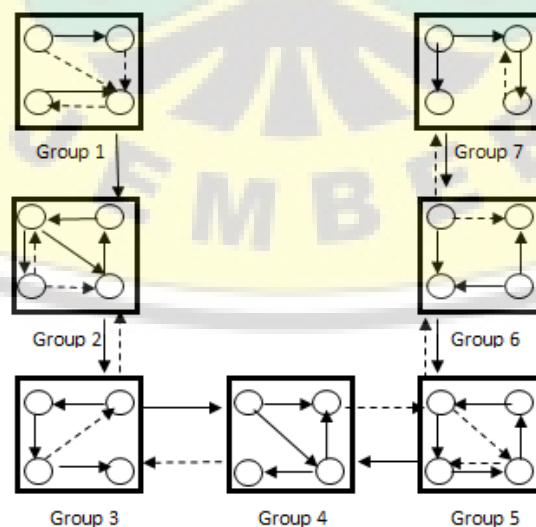


Figure 6. The illustration chart of the learning process of the third meeting with the block material

Description : \longrightarrow : students ask or respond
 \dashrightarrow : students expresses his opinion or guide his peers.

In the third meeting, from group 1 to group 7, students actively argued, gave and presented ideas, helped their friends in groups, collaborated between groups and other groups. Discussion among group members had begun to increase. There were two groups that were very active in the discussion i.e. group 2 and group 5 in solving the following problem:

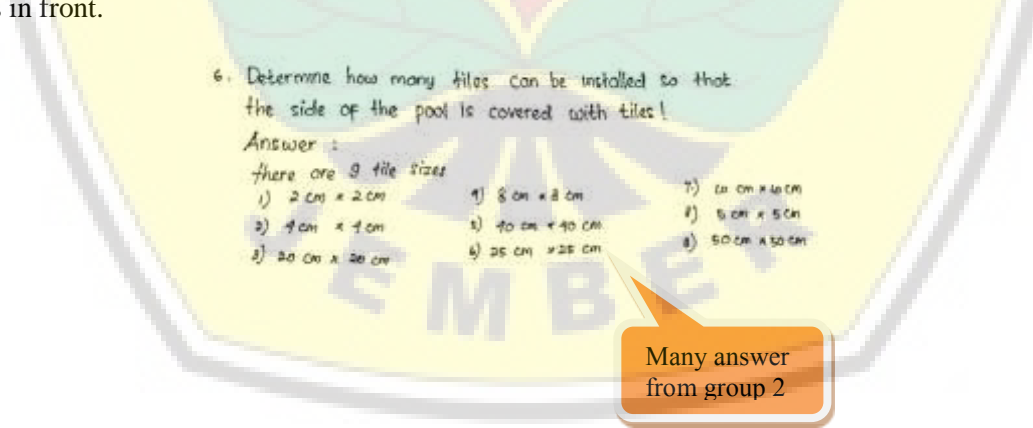
This problem is related to the surface area of a cuboid.

“A builder is going to install tiles on a cuboid-shape swimming pool with the size $l \times w \times h = 20 \text{ m}, 10 \text{ m},$ and 2 m ”. Determine the size of tiles that must be installed and calculate how many tiles are needed to cover the side surface of the swimming pool!

In the above problem, students were asked to determine the size of the tiles that must be installed and calculate the number of tiles to cover the side of the pool. Before students could determine the size of the tiles that would be installed in the pool, they must first calculate the surface area of the pool. Students found their own concept of surface

area by following the steps in the worksheet that was designed in the form of LSLC-based PBL. In student worksheets, there were 5 PBL syntax and questions that could instill students’ creative thinking. The questions displayed LSLC, PBL syntax 1) directing students to problems, in student worksheets there was one question that had to be done by students, syntax 2) organizing, there were three questions, syntax 3) applying group strategy/inquiry, there were seven questions that must be answered by students, for the fifth question, students were asked to calculate the surface area of the pool. Students got the concept of surface area formula to determine the surface area of the pool by working on the steps of the questions available in the student worksheets.

One of the questions that raised creative thinking was question number 6. In this question, students were asked to determine how many tiles should be installed on the surface of the pool so that the tiles could cover the side of the pool. Group 2 and 5 were the two groups that had the most variety of answers when trying to solve problems about finding how many tiles should be installed on the surface of the pool. Here are the answers from group 2 and group 5. Group 2 and group 5 alternately presented the answer in front of the class while the other groups paid attention to what was explained by their friends in front.



Group 2 answered that there were 9 types of tiles that could be installed to cover the pool side. It turned out that group 5 answer was more varied than the answers given by group 2. Here is the answers from group 5.

6. Determine how many tiles can be installed so that the side of the pool is covered with tiles!

Answer:

→ Square:

- 2 cm x 2 cm
- 4 cm x 4 cm
- 8 cm x 8 cm

→ Rectangle:

- 2 cm x 4 cm
- 16 cm x 2 cm
- 4 cm x 8 cm

Many answer
from group 5

Group 5 answered that there were 6 types of tiles that could be installed to cover the side of the pool. Yet, even if they only mentioned 6 sizes, but group 5 could mention the shapes of the tiles installed. There were two square tiles, and rectangular tiles. Square tiles had three sizes that could be installed while the rectangular tiles were the same as the three sizes shown in the student work above. Syntax 4) presenting, there were two questions. Group 2 presented the results of the group work which was the formula to find the surface area of the cuboid which was $2(p \times l) + 2(p \times t) + 2(l \times t)$, while the formula to calculate the surface area of the pool was $(p \times l) + 2(p \times t) + 2(l \times t)$ because the pool did not use a lid. Therefore, the area on the top did not need to be calculated. Syntax 5) evaluating, in the evaluation stage there were seven questions in the worksheet that displayed LSLC.

The last implemented stage was *see/reflection*. Some findings revealed in the reflection phase were in accordance with observations made by observers on the learning of the third meeting. The learning carried out was in accordance with the plan. The sense of caring to help students between groups was good. Activeness in group discussion also increased. Most students seemed active and brave to express their opinions. Students were used to doing class discussion activities so that no students feel alienated in each group because students who had already understood would guide their friends who did not understand. Besides, all students paid attention to the answers presented by their friends in front of the class, there were no students neglecting the lesson. All students listened carefully to their friends' answers. They all concentrated in the learning process. It shows that students had really concentrated in learning and done something instructed by the teacher. Improvements in the learning process had been carried out. The student learning process was good and showed improvement.

4th Meeting

The fourth meeting was the same as the previous meeting which began with a *plan* carried out by the researcher together with 8 mathematics teachers. The plan phase started with designing teaching administrations (lesson plans, student worksheets, and test) in accordance with the PBL syntax based on LSLC under the topic of finding the surface area of prism.

In the do phase, the researcher conditioned the class. In the learning process, the researcher divided the students into 7 groups consisting of 4 students per group. Each group was accompanied by one teacher as an observer to find out the activities of students in the group. Meanwhile, the researcher's activities was also observed by 1 observer. The researcher provided initial material stimulus related to the topic being discussed which was determining the surface area of cubes. The seating arrangement was the same as the previous meeting.

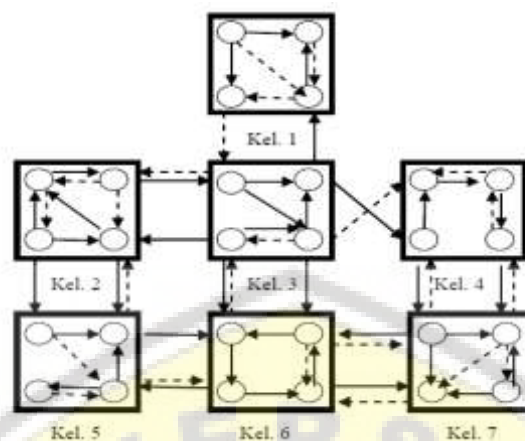


Figure 7. The illustration chart of the process of the fourth meeting with the prism material.

Description : \longrightarrow : students ask or respond
 \dashrightarrow : students expresses his opinion or guide his peers.

According to the picture above, the fourth meeting showed that the discussion in each group had been very good. Activeness of students arguing, giving and expressing ideas, helping their friends in groups, working together between groups with other groups had been going very well. Discussion among group members had increased. No students felt alienated in each group because students who had already understood would guide his friends who did not understand. Likewise when other groups lacked understanding, the group that had understood would provide a guide. Concern for fellow friends between groups was very apparent from these activities.

The last implemented stage was *see/reflection* phase. In accordance with observations made by observers on the learning of this meeting, the learning that was carried out was in accordance with the PBL-based PBL learning plan.

5th Meeting. At the last meeting the researcher gave a test containing 3 open-ended questions. Students did the problems individually in 2 lesson hours (2 x 40 minutes).

4. Conclusion

Based on the research conducted, it can be concluded that the development of teaching administrations with LSLC-based PBL to improve students' creative thinking had a significant effect on students' creative thinking ability. Attitudes, activities, and creative thinking processes of students increased after applying the developed teaching administrations that contained LSLC-based PBL syntax. The development of teaching administrations with PBL based on LSLC on the topic of polyhedron for grade 8 students produced a valid, practical, and effective tool.

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