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The effectiveness of learning cycle with lesson study for learning community to build students creative thinking skills on algebraic form

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Abstract. This research aims to describe the effectiveness of the learning cycle model (LC-5E) with Lesson Study for Learning Community (LSLC) to build students creative thinking skills in algebraic forms. The research procedures Consists of three stages: preparation of learning instruments, validation and revision, and the implementation of research. Data collection using Triangulation methods and creative thinking tests is based on The Torrance Test of Creative Thinking (TTCT). The data analysis shows that: the implementation of the lesson plan is very good category; the frequency of student activity that stands out is collaborative learning with positive responses to learning models; classical completeness of students algebraic ability are increase, creative thinking indicators achieved are fluency and flexibility, the not creative and less creative students are decrease, and the creative and very creative students are increase accompanied by growing collaborative learning and jumping task. Based on the results of data analysis, it was concluded that the implementation research is effective.

1. Introduction

The development process in era 4.0 requires students to have better knowledge and skills. These skills include critical thinking skills, creative thinking, the ability to argue, discuss, make decisions, and solve problems[1]. Therefore there is a need for a variety of effective learning models or strategies that can hone these skills. One learning model that can provide opportunities for students to optimize ways of learning and developing reasoning power so that it can improve mathematical communication skills is the Learning Cycle learning model[2]. Effective teaching is teaching that provides opportunities for self-study or self-activity [3]. One way of learning that involves students actively is to apply the Learning Cycle model. The Learning Cycle model is divided into several types, including the 5E Learning Cycle. The learning phase on 5E Learning Cycle includes engagement, exploration, explanation, elaboration

and evaluation[4] . Based on the survey results of the implementation and impact of Lesson Study (LS) in 2012 and BIMTEK results in 2013, it was concluded that Lesson Study activities in general could improve the quality of the lecture process and competence. Lesson Study (LS) is already exist in Japan more than 100 years ago. Lesson study is a professional development process that Japanese teachers engage in to systematically examine their practice, with the goal of becoming more effective[5]. In LS there are three lessons, namely: collaborative learning, caring community, and jump task. Lesson Study for Learning Community (LSLC) is a lesson study type that can build collaborative abilities and train collaboration between work groups to create an atmosphere that makes students learn from other students, not allowing students to feel abandoned and unable[6].

One of the most important skills developed in the 21st century is the ability to think creatively. Creative thinking is a habit of sharp thinking with intuition, moving imagination, expressing new ideas, and inspiring unexpected ideas[7]. To assess the creative thinking abilities of children and adults can be done using "The Torrance Test of Creative Thinking (TTCT). The three components used to assess the ability to think creatively through TTCT are fluency, flexibility and novelty[8].

Classically students have not mastered the algebraic form material because students who are classified as mastering algebraic material are only 3.7% and individually students have not mastered algebraic form material that is only 70.4% which achieves minimal completeness[9]. The most common mistakes occur in the concept of addition and subtraction of the form of Algebra. Therefore, the problem in this study is how the effectiveness of LC-5E-based LSLC learning is to build students' creative thinking skills in algebraic material. The expected goal is effective LC-5E LSLC learning to build creative thinking skills so as to obtain findings on how to improve students' creative thinking skills in algebraic form.

2. Method

The research was conducted with a qualitative approach with class action research design. This research used a mixed Method with concurrent triangulation between the qualitative and quantitative formula to address similar problems[10]. This research was carried out through three stages, namely: (1) the preparation stage of the learning device, (2) the stages of validation and revision, and (3) the stage of implementation of learning in the classroom using the design of one group pretest and posttest design. The research was conducted at 7 grade Junior High School in Lumajang, East Java, Indonesia.

Data collection methods used are observation, tests and documentation. This observation is carried out by direct observation of the teaching and learning actions of students, especially in terms of performing the Plan, Do and See stages. The activities in the Plan stage are the re-discussion of the learning process plan and Student Worksheets with other experienced math teachers. In the Do stage, learning activities are carried out according to the plan in the plan stage. While in the See phase, reflecting on the learning process that has been carried out related to student activities. Test data collection is used to determine learning achievement and students' creative thinking abilities. Whereas documentation for recording all learning processes. The instrument used was in the form of a teacher and student observation guide, as well as test questions. The validity of the data is obtained by source triangulation and methods. Data analysis was carried out in a qualitative descriptive manner, carried out by the flow method consisting of data reduction, data presentation, conclusion drawing or verification.

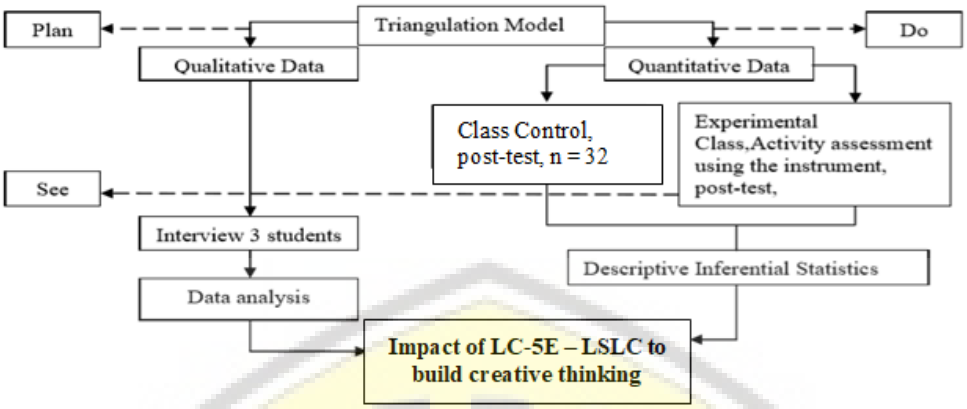

Figure 1. Research Design

3. Result and Discussion

The initial stage in this study was the preparation, validation, and revision of the instrument. The validation process is carried out by 3 validators consisting of two mathematics education lecturer validators and one validator from the practitioner. Average validation results instructional instruments and research instruments from the three validators have reached more than 3.5 of a maximum scale of 4. So it can be concluded that the instrument is appropriate to be used to explore data. The next step is " *Do* ". Stage of *LC-5E*- based *LSLC* implementation held in 3 cycles, where each cycle goes through 3 stages, namely *plan-do-see*, according to the learning cycle in *lesson study*. The material in cycle 1 is to recognize the algebraic form, the addition and subtraction of algebraic operations, in the second cycle of the algebraic multiplication, division, and rationing operations, and in the third cycle the algebraic form fractions.

At the time of the learning process, the observer observes activity of student and teacher activities that pervades and gives score 1, 2, 3, and 4. The process of inviting, exploring, explaining, applying the concept, and evaluating the *5E Learning Cycle* stage from the application of cycles 1, 2 and 3 of each activity tends to increase from cycle 1 to cycle 3. This is caused by the *Lesson Study* process that applies the *Plan, Do, See process* where at the *See* stage or reflection and evaluation, teacher really gets input and evaluation of an observer so that the application of learning tends to be improved. Based on the results of the study, the ability of students who need to be improved is the ability to ask questions because on this indicator, students only experience an increase of 5 points from the previous point 75 to 80.

Table 1. Indicator of creative thinking ability and completeness.

TTCT & completeness		Indicator
K1	*Fluency*	Fluent making questions / understanding the purpose of the problem / explaining steps
K2	*Flexibility*	Different ways
K3	*Novelty*	Novelty solutions provided.
K4	Completeness	Value $\geq$ 70

Table 1 is the development of indicators of students' creative thinking abilities which consist of 3 indicators. Based on the table above, a question test for creative thinking ability was developed consisting of 2 types of questions. Type A for the process of measuring ability before the research process and type B questions for the process of measuring students' abilities after getting a learning experience in *Learning Cycle* with *Lesson Study*. The test results of these questions are presented in Figure 2 with analyse using table 1. In general, we can conclude that *novelty* ability is the smallest ability to score, meaning that only a few students have this ability. But in general, each indicator increase the

score, which means that the learning process *learning cycle* is able to build creative thinking abilities of students.

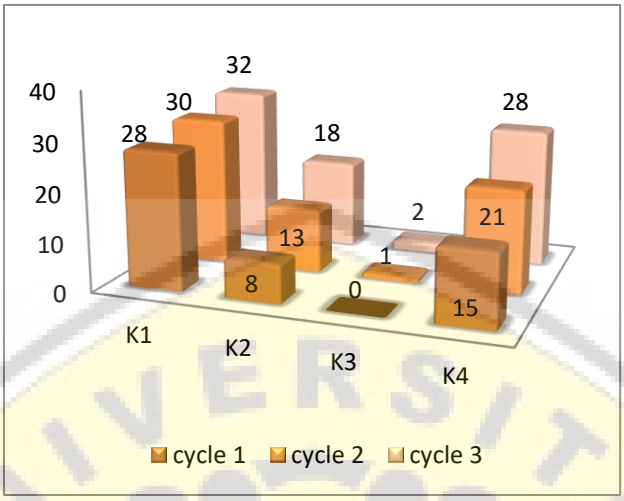

Figure 2. Achievement of indicators of creative thinking and completeness

Figure 2 explains that in cycle 1 to cycle 3 there were 4 students who were able to build *Fluency* ability, there were 10 students who were able to build *Flexibility* abilities, and there were 2 students who were able to build abilities *Novelty*. This goes hand in with an increase in students' ability to material in the form of algebra, which is that there are 13 additional students who complete or increase. In general, each student's creative thinking ability is *Fluency's* ability 100 %, *Flexibility* 56.25 %, and *Novelty* 6.25 %.

Cycle 1 begins with a plan carried out by researchers together with other mathematics teachers, Endang Sekarningrum, S.Pd and Dra. Madeiyah. This plan stage begins with making a Learning Process Plan, Student Worksheets and tests of creative thinking skills in material in the form of algebra. Activities at this stage that is designing *Learning Cycle* -based algebra learning steps in accordance with the systematics of the 2013 curriculum material, preparing supporting media, and determining the number of possible meetings. After the *plan* , *do it* cycle 1 is held on December 3, 2018, at 07.20-09.20 WIB in class 7-H . The initial stage, the teacher conditions the class and conducts pre-learning. Students are divided into 8 groups, each group consisting of 4 students. The teacher gives an initial material stimulus to the algebraic form in the form of a sheet containing a table of introduction to algebraic forms and things that need to be filled relating to *learning cycle* based algebra learning, both related to group discussions, between groups, and discussions with teachers.

After the *do* stage , immediately proceed with the *see*/reflection stage . Some of the things obtained from the results of reflection discussions in this cycle are: learning that has not been carried out in accordance with the plan, for example in planning *Learning Cycle* -based *learning* students are required to be skilled at asking questions, thinking freely, and skilled at explaining. In this first cycle students tend to be less interested in asking questions, thinking monotonously (imitating friends), and tend to be shy about delivering explanations. This is also in line with the results of reflection, that teachers are less able to arouse student interest. So that this becomes an evaluation material for researchers to look for more interesting ways to increase and arouse student interest. Also in this first cycle, indicator creative thinking ability is still not visible, so there needs to be improvement in the next cycle.

In accordance with the observations of the activities of students and teachers, it can be seen that the ability score invites, explores, explains both students and teachers both have scores below 80 or in good categories, so this becomes a correction especially for teachers to further enhance students' inviting

abilities. explore students' abilities, and explain knowledge in a simple, understandable way. In connection with the weakness found in cycle 1, needs to be implemented Improving the action in cycle 2. The following figure 3 is student sitting position in the group.

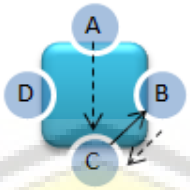

Figure 3. Illustration chart of cycle 1 learning process (Student A, Student B, etc,- - - > : Asking →: Answering)

Cycle 2 begins by carrying out the plan by paying attention to the improvement plan in cycle 1 . This *plan* phase begins with revising the learning plan that has been made according to the results in cycle 1, and making learning plan and worksheet of the multiplication operational material, division and form of algebraic ranks, namely compiling *learning cycle* -based *learning* steps which is adjusted to the 2013 National learning Curriculum. In cycle 2 has been established according to stages of the process *5E learning cycle* in each of the groups, which have started to grow atmospheric collaborative learning*(collaborative learning)* and the nature of the care for others *(Caring Community) w*ith respect to not achieving a score of ability to ask the students, then there needs to be improvement of the learning process in cycle 3 that the learning process is focused more indicator of the ability to think creatively and need to be directed to the *learning community*, in other words the process *5E* on *Learning Cycle* not only appear in each group but must appear in the class with the interaction of *5E* between groups in the class. Cycle 3 begins with a plan carried out by researchers and other mathematic teachers by paying attention to the improvement plan in cycle 2 . This *plan* phase begins with revising the previous learning plan, and making lesson plans and worksheet algebraic fractions operation adjusted the reflection algebra learning in cycle 2. Implementation *do* in third cycle, students remain divided into 8 group. It can be observed that in this cycle 3 the grouping process which is student learning is faster and more regular than the previous cycles.

After do, immediately proceed with the see/reflection stage. Some of the things obtained from the results of reflection discussions in this cycle are: In this third cycle, the algebra learning process is good because students' self-confidence increases which will also affect communication between students. 30 students in the class also understood and mastered the material about algebraic material and had fluency's creative thinking skills, 23 students have flexibility and ability 15 students have novelty abilities, and students who complete 32 students. Based on the results in cycle 3, algebra learning with the *Learning Cycle* method with *Lesson Study* yielded satisfactory results. Learning that prioritizes processes in the form of *Engagement, Exploration, Explanation, Elaboration, and Evaluation* can motivate each individual student to better understand the basic concepts of knowledge, explore self-abilities, express opinions and self-evaluation. So that it will indirectly grow the ability to think creatively on students, in the form of *Fluency, Flexibility, and Novelty* abilities.

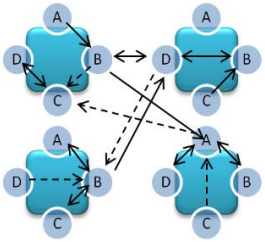

Figure 4. Illustration chart of cycle 3 learning process

Figure 4 explains that the discussion in each group was very good, between students expressing their opinions and students who understood guided one group of students who did not understand. Likewise, when other groups feel poorly understood, groups that already understand will guide groups who do not understand when the group asks. Learning looks like a group that learns from each other between students and between groups in one class, so that the class creates a learning community

The greater learning community-based learning is seen in the process of the flow of Engagement, Exploration, Explanation, Elaboration, and Evaluation which is not only dominated by one group, but between groups in the class so that there is an active learning process that promotes learning cycle skills that foster creative thinking from each student. It is this process that causes learning algebra become active and increase students' understanding of algebra that d i accompanied by the growth of creative thinking abilities and the growth habit of a collaborative study, care for others and the ability to complete tasks independently and critically (jumping task). This is in line with Weny's (2015) study, which concluded that Learning Cycle learning can improve students' mastery of concepts and critical thinking skills[11]. Another study that is in line with this research is the research conducted by Rahmawati (2016) which concluded that LC-5E learning effectively improve students' science skills[12]. The research is in line with Hobri that the result shows that there is an improvement in their ability to learn mathematics collaboratively. They could work together and appreciate the opinions of their group members and another group[13].

Table 2. Guidelines modification for classification creative thinking level

Level	*Criteria*	*Fluency*	*Flexibility*	*Novelty*	*Level modification*
0	Not creative	-	-	-	0 is not creative
1	Less creative	√	-	-	1 Less Creative
2	Creative enough	-	√	-	
		-	-	√	
3	Creative	√	√	-	2 Creative
		√	-	√	
4	Very creative	√	√	√	3 Very Creative

Description: √ = fulfilling ; - = not fulfilling

Table 2 is guidelines research to classify creative thinking level of students[14]. Researcher was modify the guidelines from 5 level to 4 creative thinking level because no one students rich creative enough level at this research. Analysis of the level of creative thinking of students is done through observation and qualitative analysis of student answers based on tests conducted in cycles 1, 2 and 3 based on table 2. The questions given are open ended type questions so that students can answer in many ways. The relationship of creative thinking with the aim of *LSLC-LC5E* (collaborative learning, caring community, and jumping task) is presented to the answer as shown in Figure 5. Each aspect of creative thinking is interrelated.

In cycle 1 the majority of students are still level 1 (less creative), namely as many as 20 students or 62.5%; 4 students are not creative and 8 students are at the creative level. A student's level is less creative which only meets the fluency indicator, which is only able to understand the problem and only find 1 method and only find one image that is similar to the example. This case maybe the lesson study is not success. Base on Raymond research, the students teachers did not formulate a research question for their research lesson, they did not focus on observing pupil learning, and their lesson was not organised to make pupil learning visible[15].

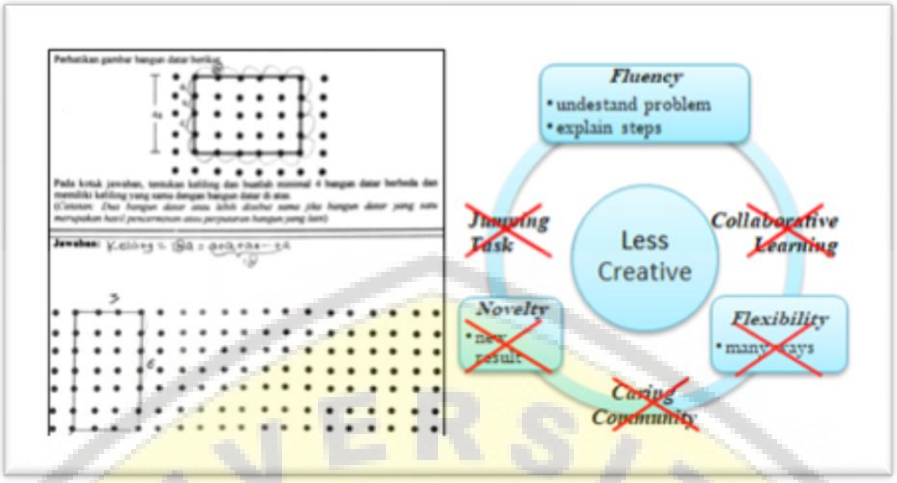

Figure 5. Result of less creative student and its schema

Based on Figure 5, it can also be explained that less creative student has not been able to bring itself to collaborate in learning, caring, and thinking critically and having low mathematical abilities (incomplete). This is in line with the research of Fira[16] which concluded that students with high abilities fulfilling aspects of fluency and flexibility, students with the ability to fulfilling aspects of fluency and students with low ability do not fulfilling the three aspects of creative thinking.

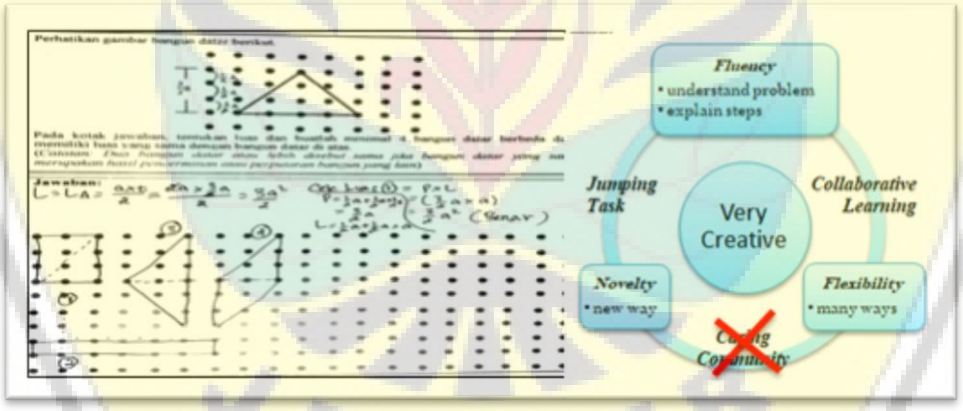

Figure 6. Result of very creative student and its schema

Figure 6 is the answer of students with a very creative thinking level that occurs after cycle 3. The student answers in detail and fulfilling all aspects of creative thinking and aspects of *LSLC.* Students answer by identifying the per-unit length between the two closest points with vertical and horizontal directions which are equal to ½ *a* and calculate the area of geometrical shape with the area of the triangle. In the image section, the very creative student is able to find 4 different images that do not only consist of triangles according to the example, but are rectangles and parallelograms. Based on interviews, student search for the image by dividing the initial triangle into two small triangles and combine in the form of flat wake the others. In addition, the students is able to double check the area of the other flat building and produce the same area. The very creative student is a student who is fluent, flexible (finds many ways), and fulfilling the element of novelty (finding new ways / appropriate new results). Based on the results of the interview and directly observation, it was also able to show a collaborative attitude and jumping task, but had not shown a caring attitude towards others. When viewed in terms of mathematical abilities, very creative student is a student who has high ability. This

is evidenced by the completion of the very creative student in each learning cycle. The LSLC give very significant effect because the products of lesson study are not limited only to what participants had learned from particular class and post class reflective discussion[17].

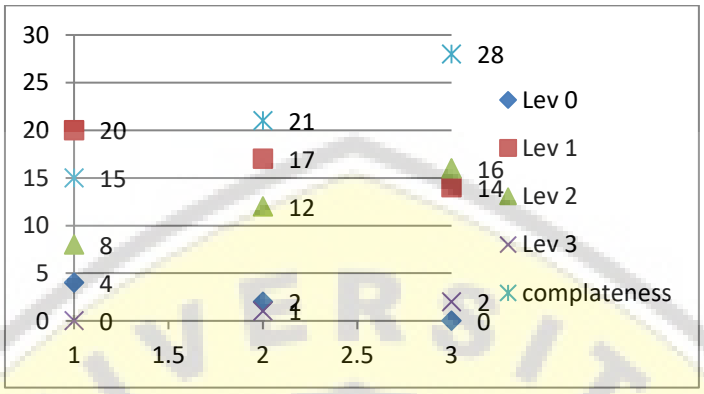

Figure 7. Level of students' creative thinking and completeness

The ability to think creatively and the completeness of student is explained generally in figure 7. Based on analyse carefully, it can be concluded that the level of creative thinking 2, 3, and completeness is directly proportional and has increased from cycles 1, 2, and 3. While level 0 and 1 are inversely proportional to completeness. This explains that if more effective the learning method is used then the students completeness will be increase. This result have similarly conclusion with research that Learning Cycle can increase critical thinking skills[11]. If completeness increases, students who think creatively and are very creative increase while students who are not creative and less creative are reduced. In line with the results of this study, LSLC has a significant effect on students ' ability to increase High Order Thinking Skill (HOTS)[6] As is well known, there are students' creative thinking abilities in HOTS. The increase in students who think creatively is followed by the emergence of collaborative and jumping task attitudes, and still need to be improved in caring community attitudes or caring for others for very creative students.

4. Conclusion

This section contains conclusions according to the research objectives. Based on the analysis of data, it can be concluded that learning algebra-based LSLC Learning Cycle 5E (engagement, exploration, explanation, elaboration and evaluation) highly effective and can increase students 'understanding right, and can build students' ability to think creatively. Judging from the results of observations about the learning process that has been carried out has increased from cycle 1 to cycle 2, and from cycle 2 to cycle 3. Student completeness is directly proportional to increasing levels of students thinking creatively and very creatively and inversely with students who are not creative and less creative with the results showed that: the implementation of the lesson plan is very good category; the frequency of student activity that stands out is collaborative learning with positive responses to learning models; classical completeness of students algebraic ability are increase, creative thinking indicators achieved are fluency and flexibility, the not creative and less creative students are decrease, and the creative and very creative students are increase accompanied by growing collaborative learning and jumping task. Based on the results of data analysis, it was concluded that the implementation research is effective.

5. Acknowledgments

The learning implementation based of LSLC-LC5E can be continued with other different topic, or the same material about algebra but with different research aims.

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