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Students' creative thinking skill on scientific approach based on lesson study for learning community

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Students' creative thinking skill on scientific approach based on lesson study for learning community

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Abstract. The ability to think creatively is one of the abilities needed in the 21st century. But in fact, the students' creative thinking is still relative. Therefore, this research was intended to develop mathematical learning tools on the material of Sequence and Number Series on the ninth grade of junior high school through scientific approach that was on Lesson Study For Learning Community and its influence on students' creative thinking skill. The method used was the mixed-methods that combined qualitative and quantitative research. Thiagarajan model as the developmental research was taken as qualitative one. This research consisted of two classes; exsperimental and control classes while quasi-experimental method of non-equivalent control group design. In normality test, the data obtained was normally distributed and the data were homogeneous based on the homogeneity test, so that it was necessary to do parametric data analysis by using independent sample t-test analysis. Based on the results of this research, the conclusions were summed up into: (1) The development of learning tools was into the category of valid, effective and practical, (2) The application of Scientific Learning based on LSLC had a significant effect on students' creative thinking skill indicated by a significance value of 0.000 ($p<0,05$).

1. Introduction

Mathematics is a branch of sciences which is able to drill the process of students' critical and creative thinking skills. The ability to think creatively is one of the high-level thinking skills urgently needed in the 21st century [1]. The material of sequence and number series is one of the mathematical materials taught in the junior level that is able to train students' creative thinking skills. Through this material, the students are expected to be able to manipulate the pattern by making a generalization of a number pattern. The given task of exploring patterns can contribute to the development of students' problem solving skills through the analysis on certain cases, organizing data, and generalization [2]. There are four aspects of creative thinking, each of which consists of several indicators. The indicator of creative thinking are shown in the tabel 1 [3].

Table 1. Creative Thinking Skill Indicators

Aspect	Indicator
Fluency	•ask lots of questions • answer with a number of answers if there are questions • smoothly expressing his ideas • work faster and do more than other children • can quickly see errors or shortcomings in an object or situation
Feksibility	•provide various interpretations (interpretations) of an image, story or problem. • applying a concept or principle in different ways • in discussing or discussing a situation always has a different position from the majority of groups. • if given a problem, usually think of different ways to solve it • classify things according to division (different categories). • able to change the direction of thinking
Originality	• think of problems or things that others don't think. • question old ways and try to think of new ways. • choose another way of thinking than others
Elaboration	• seek deeper meaning for answers or problem solving by carrying out detailed steps. • develop or enrich other people's ideas.

The problems which generally occurred were the students still haven't experienced a meaningful learning process, students' ability in creative thinking has not been honed yet, and there was no emergence of collaborative activities among students so that students tend to be individuals and have not yet emerged caring for their friends who have learning difficulties.
Learning activities need to use principles, such as: student-centered, develop students' creativity, creating interesting and challenging condition, covering values, ethics, aesthetics, logic, and kinesthetic, and provide a diverse learning experience through the application of various learning strategies and methods which surely joyful, contextual, effective, efficient, and meaningful [4]. An example of a student-centered approach and in accordance with the current principle of learning is scientific approach. Scientific approach is a learning approach following scientific activities, with a sequence of activities or learning experiences as follows: observing, questioning, exploring, associating, and communicating [5]. Based on the steps and activities contained in scientific approach, it can be seen that the scientific approach makes the students actively involved in learning activities. Whereas Learning tools for Learning Study is lesson study based on collaborative and learning community [6]. In this case, the objective of learning community is that the students learn from each other (listening to each other), and the teachers must also learn from each other [7]. The implementation of LSLC learning also has the provision of jumping tasks, which is giving assignments in the form of application questions to encourage the students to solve problems so that their cognitive skill improved.
Based on the problems above, it was necessary to develop learning plan through scientific learning based on LSLC to improve students' creative thinking skills. Scientific learning based on LSLC was carried out collaboratively between teachers and other teachers (plan, do, see), teachers and students, or between students in which there was a sense of mutual care and none of the students are neglected. Meanwhile, the elements that could train the students to think creatively were found in exercise and presented discussion material. This learning was carried out through several stages, namely: (1) Observing, (2) Questioning, (3) Exploring, (4) Associating, and (5) Communicating.

This research is certainly different from previous researches. A research conducted by Hobri, Ice Septiawati and Antonius Cahya Priandoko [8] aimed at developing mathematical

learning tools through Contextual Teaching and Learning (CTL) based on Lesson Study for Learning Community (LSLC) on the material of sequence and series of the tenth grade students at Vocational School and to know their influence towards students' high level thinking skills. A research done by Scipper [9] was intended to determine the effect of learning tools in improving teacher professionalism in teaching and doing collaboration to determine new teaching material or learning method. A Research conducted by Tohir, et al. [10] aimed at analyzing the students' creative thinking skills in generalizing arithmetic sequences. Whereas another research conducted by Wan Har Chong & Christine Anne Kong [11] had the objective to explore the benefits obtained from the collaborative activities of teachers as well as its implications on teaching. The purpose of this research was to develop learning tools with scientific approach based on Lesson Study for Learning Community-based on sequence and series of the eleventh grade students and know their effects on students' creative thinking skills

2. Research Methods

This study used Mixed Methods with Sequential Exploratory Design model, a method that combined sequentially qualitative and quantitative research methods [12]. The development of these learning tools used the development of Thiagarajan model, Semmel & Semmel (4-D) which consisted of four stages, namely the define, design, develop, and disseminate stages [13]. In this development, the research was about to develop mathematical learning tools with scientific approach based on Lesson Study for Learning Community. The developed learning tools were Lesson Plan, Student Worksheet, and Student Learning Outcomes Test. In addition, validation of the research instruments was also performed, namely the observation sheet of student activities, observation of the implementation of learning tools, open class observation, and response questionnaire. If learning tools and research instruments were valid, they could be used on learning. But if the learning tool and research instrument were still not valid, it needed to be revised according to the input from the validator. Explanation of development research prosedures was illustrated in the chart as follows.

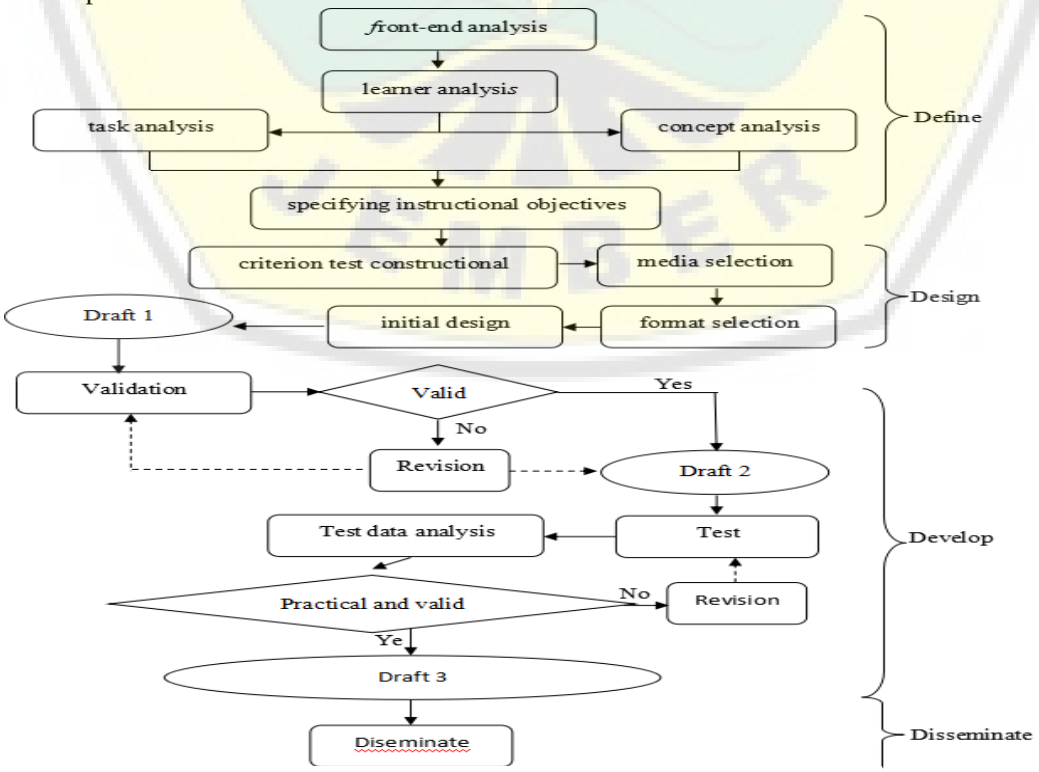


Figure 1. The Model of Reseach and Development (4-D)

In the experimental research, a quasi-experimental of non-equivalent control group design pretest was used. The population in this research was the ninth grade students of Lumajang Islamic Junior High School in the academic year of 2018/2019, IXB class was selected as an experimental class that received learning using learning tools that had been developed and IXC class as a control class was taught by using Direct Instruction. After collecting data in the form of test results and observations, then the normality assumption test was carried out by using the Kolmogorov-Smirnov test and variance homogeneity was by using Levene's test. Each test for normality and homogeneity of variance was performed with a significance level of 0.05 ($p < 0.05$). The independent sample t-test was carried out if the data were normally distributed and homogeneous, but if the data were not normally distributed or not homogeneous then Mann-Whitney test would be used.

Population

This research was done to the ninth grade students of Lumajang Islamic Junior High School in the odd semester of the 2018/2019 academic year. The sampling technique used was random sampling by randomly selecting two classes, the first class was the experimental class with the implementation of scientific learning which was consisted of 18 students, and the second class was class control with the application of direct instruction that consisted of 18 students.

Instrument

The instruments used in this research were tests, observation, and interview. Theinstruments of observation is observation sheet of student activities, observation of the implementation of learning tools, open class observation, and response questionnaire. Explanation of exsperiment research prosedures was illustrated in the chart as follows.

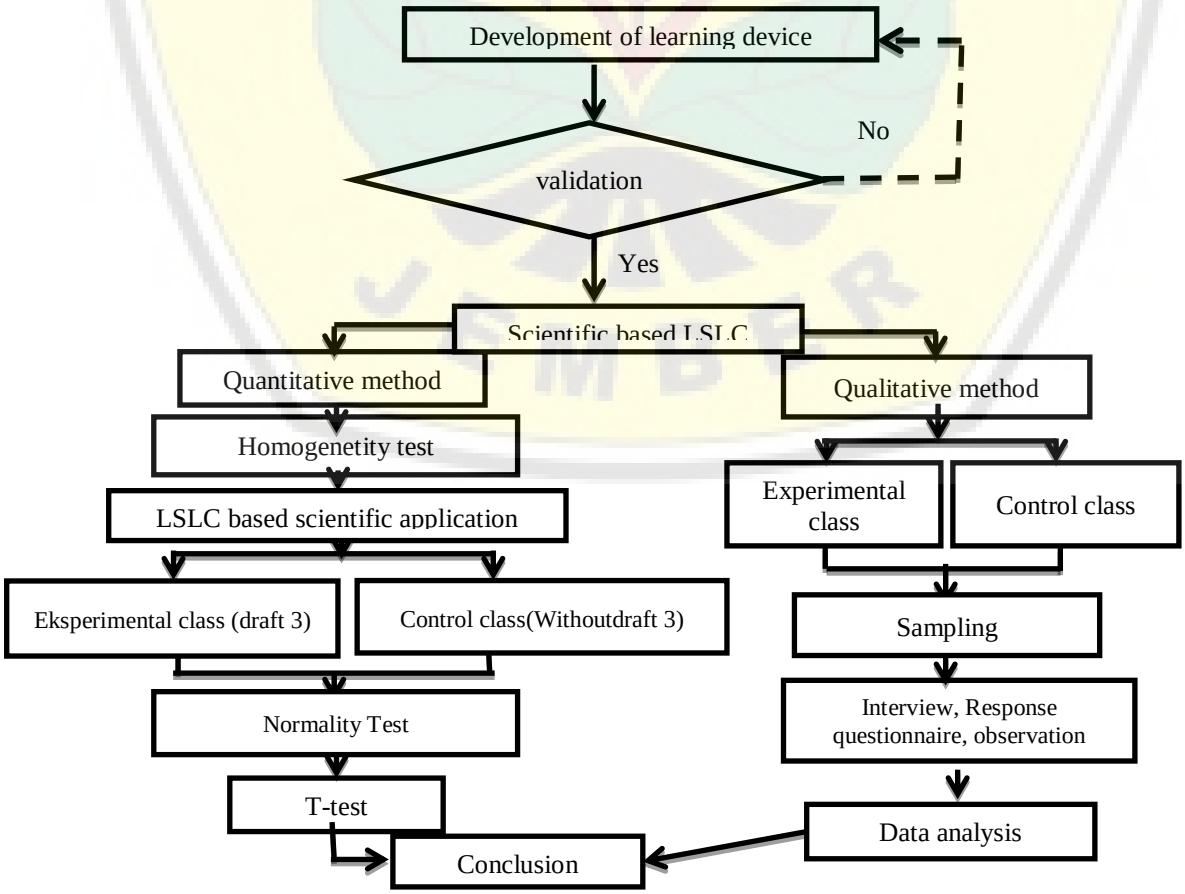


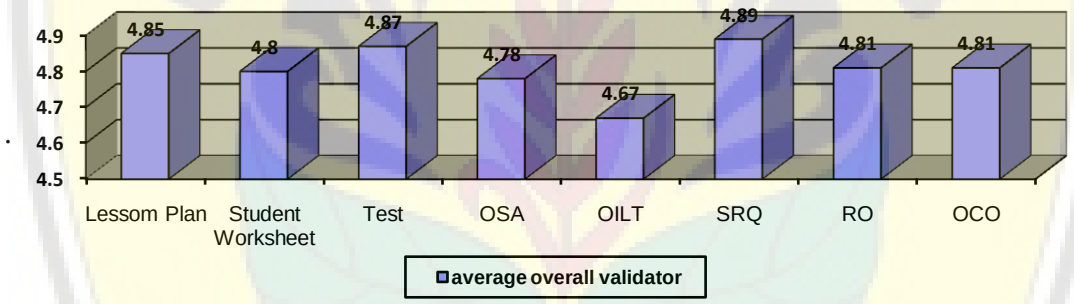
Figure 2. The Exsperiment Research

3. Research Finding

The Result of Data Analysis

The process of developing learning tools such as Lesson Plan, Student Worksheet, and Student Learning Outcomes Test was conducted before implementing the treatment to the experimental class and the control class. In the plan stage, that was asking for advice and input to fellow teachers of Lumajang Islamic Junior High School (SMI) related to the process of preparing the learning tools to be used. This is in line with research on developing a culture of dialogue between teachers [14, 15]. Learning outcomes tests were given as the pre-test and post-test to the control class and the experimental class with the aim of obtaining data on the improvement of students' creative thinking skills. The research instruments were observation sheets of students' activities (OSA), observation of the implementation of learning tools (OILT), open class observations (OCO), students' response questionnaires (SRQ) and review observation (RO) were also validated. The validation process was carried out by 3 validators, which were 2 mathematics education lecturers and a practitioner, the mathematics teacher at Lumajang Islamic Junior High School (SMI). The overall results of the validation of research tools and instruments can be presented on chart 1 below.

Chart 1. The Validation Result of Learning Tools and Instrument



The learning tools and research instruments could be used in this research if it was declared valid with validity average values (Vr) were at the intervals of $4 \leq Vr < 5$. Thus, based on Figure 3 above, it showed that the results of validation of learning tools and research instruments could be used in this research. The interval of this study was made different from the previous research related to the interval of validation of learning tools namely the value of mean validity (Vr) at interval $3 \leq Vr < 4$ [8].

The next stage was the "Do" stage, which was the implementation of scientifi learning based on Lesson Study for Learning Community in IXB class at Lumajang Islamic Junior High School (SMI) on the material of Sequence and Series. This stage consisted of 7 meetings which were 5 times learning, and 2 times giving test activities (pretest and post-test). The test giving activities were also given to the control class. However, direct learning was given in the control class.

The pre-test activity which consisted of three questions was carried out at the first meeting in both the experimental class and the control class within 80 minutes. The pre-test activity aimed to measure the students' initial creative thinking skills before the learning implementation. The students' pre-test results are shown in the following table 2.

Table 2. Pre-Test Result

	N	Minimum	Maximum	Mean	Std. Deviation
pretes_eksperimen	18	10.00	69.00	27.7778	19.41363
pretes_control	18	10.00	67.00	28.6111	16.71962
Valid N (listwise)	18				

In the experimental class, the treatment was given in the form of LSLC-based scientific learning which was done at the 2nd to 6th meeting. In the learning activities, the students made groups consisting of 3-4 students to collaborate in their groups. The stages in this learning included; (a) observing, (b) questioning, (c) exploring, (d) associating, and (e) communicating. This was certainly different from the control class which was in the form of direct learning and students were only given problem exercises then discussed it together.
During the group discussion activities, students collaborated with each other so that there was no friend in the group who felt neglected, on the contrary, there was a caring community. LSLC aims to share information with each other to maximize learning in schools so that a situation that is fair and full of love is built [16].

LSLC-based learning states that if children receive psychological support, they tend to support others, as well as those who receive learning assistance from others; they will tend to offer concrete assistance to others [17]. It seems that students shared knowledge in groups when using LKS based on Lesson Study for Learning Community. While students who still did not understand were expected not to be shy to ask questions. Student worksheet was also presented exercise that could measure the ability to think creatively, the activities occurred collaboratively in a community that cares for each other. The activities of students in groups are presented in the following figure by taking one group as a sample.

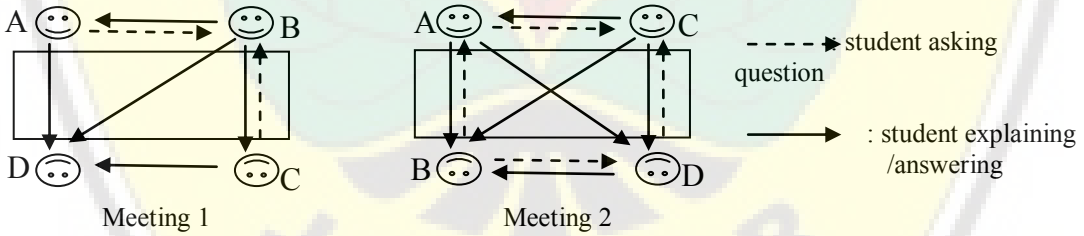


Figure 3. Students' activity in group discussion in the experimental class

The group discussion in the experimental class went pretty well. Student B provided explanations to all group members. Whereas, there were only two students who had dared to ask the group, they were student A and student C. At the meeting, it appeared that student D was still less active in the group because student D still lacked of understanding of the material related to number patterns, but friends in his group (students A, B and C) understand that, so they kept trying to explain to student D who still did not understand. This certainly shows the feeling of caring for friends in their group [16]. At the next meeting, students seemed to have been able to collaborate well and there was a caring community, which was marked by a feeling of caring for the inability of their friends in the group and the exchange of seating positions in the group. Student D sat side by side with student B who was more active and more understand the material. Thus student D began to grow the courage to ask or share related to the material that he did not understand even he began to grow courage to help his friends who had difficulty understanding the material. This is in line with research that states that the concern for community-based learning is very effective, not only can improve student understanding and achievement, but also increase their confidence in communication [18]. At

this meeting all students appeared active in the study group. They had become accustomed to collaborating, which was sharing with each other in study groups.

The learning conditions in the control class were very different from the experimental class. The following are discussed activities in the control class for groups 1 and 2.

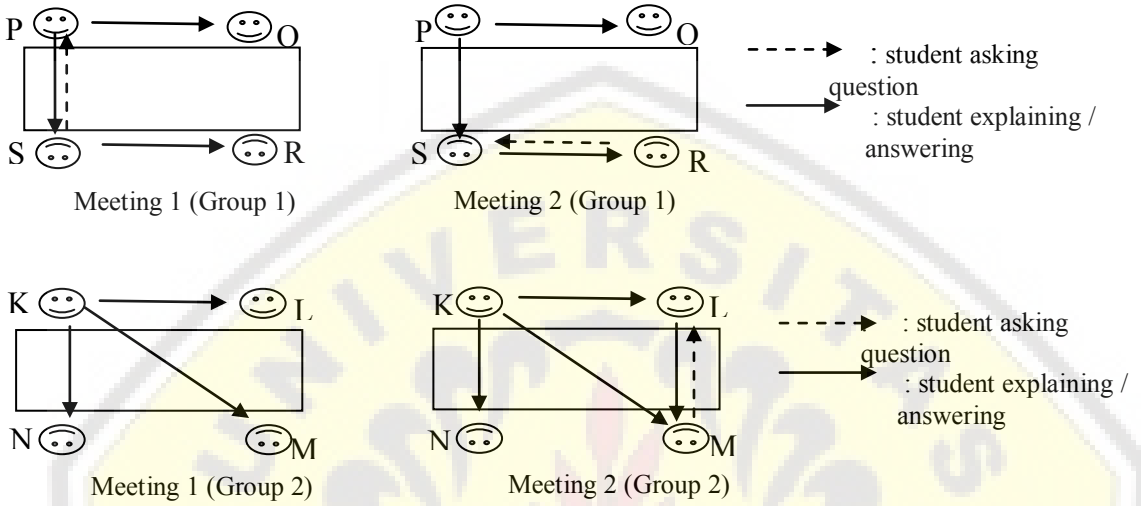


Figure 4. The activity of group discussion in the control class

In the control class, the group discussion activity did not run well. This can be seen from the first meeting that in group 1, there was one discussion happened between two students that were student P and student S while student Q and student R were not courage enough to question even though they did not understand the material. This also happened in group 2, on the contrary, there was no discussion happened within this group. Student K who understood more about the material only gave the answer to the whole members of the group without any explanation or group discussion. The second meeting was not really different from the first one. Overall, the group discussion activity aimed only at answering the question of the given problem without any sense of care for the group members who still did not understand the material.

Based on the result of the student activity observation in the experimental class, it was known that students were active in group activity, questioning/reasoning, finishing, and presenting task. In the experimental class, it was known that from the total 18 students, as much as 11 students (61%) were categorized as active, 6 students (33%) were quite active, and 1 student (6%) was less active. This was because the students seemed to actively shared, helped, encouraged, and facilitated each other with learning to reach the objective[19]. Whereas, the control group showed that, from 18 students, as much as 4 students (22%) were categorized as quite active, and 14 students (78%) were less active. Thus, it can be concluded that after following LSLC-based scientific learning, the students' active level average was active.

The open class activity, which had been attended by 10 teachers of various lesson subjects in Lumajang Islamic Junior High School, conducted in the third and fifth meeting. This activity incorporated many teachers as the characteristic of more effective teacher professional development [20]. Open lesson was one of LSLC activities in which in see stage contained reflection activity based on the observation result in the class. This stage was focused on the observation of how students learned in group while the observation of teacher's activity during learning was only used as suggestion in learning activity. Some teachers of different subject

were interested in implementing LSLC in their lesson. This was because in the experimental, the students seemed to could collaborate and had high sense of care to their friends. In LSLC-based scientific learning, the students became easy to get meaningful knowledge and improve activeness, creativeness, argumentative and discussion skills. The teacher of open class believed that LSLC-based scientific learning would be able to improve students' creative thinking process because, during learning, the students really experienced meaningful learning within their group.

Post test was administered in the last meeting to know the level of students' creative thinking process after following the learning process. The result of post-test was presented in the following Table 3.

Table 3. Post-test Result

	N	Minimum	Maximum	Mean	Std. Deviation	Classical Completeness Percentage
Experimental Post test	18	56.00	100.00	87.0000	13.81815	89%
Control Post test	18	44.00	85.00	70.6667	14.02938	72%
Valid N (listwise)	18					

Prerequisite test was early step to analyze the data before conducting hypothesis test which covered normality test by using Kolmogorov-Smirnov statistical test and homogeneity test by using Levene's test. The data analysis aimed at knowing the effect of LSLC-based scientific learning toward students' creative thinking skill. The following table 4 is the result of normality test.

Table 4. Kolmogorov-Smirnov Normality Test

Classes	Kolmogorov-Smirnov[a]		
	Statistic	Df	Sig.
Experimental class Pretest	.149	18	.200
Control class Pretest	.193	18	.075
Experimental class Posttest	.176	18	.147
Control class Posttest	.175	18	.152

Based on the table, it was known that the pre test value of students' creative thinking skill of the experimental class was sig=0.200 and the control class was sig=0.075, while the post-test value of the experimental class was sig=0.147 and the control class was sig=0.152. Therefore, it can be concluded that the data about pre-test and post-test value of the two class that are distributed normally because the significant value was more than 0.05 (p>0.05).

The result of homogeneity test of pre-test and post-test is presented in the following Table 5.

Table 5. Levene's Test Homogeneity Test

	Levene Statistic	df1	df2	Sig.
Pretest	.019	1	36	.890
Posttest	.007	1	36	.934

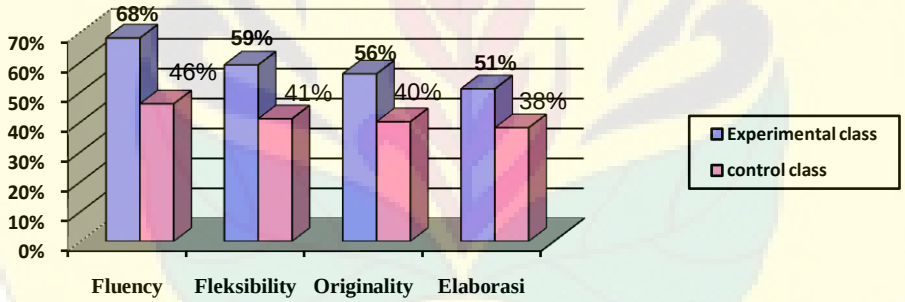
Based on Table 5 above, it was known that the result of homogeneity test of students' creative thinking skill showed the significant value of 0.890 for pre-test and 0.934 for post-test. Therefore, it can be concluded that the data about students' creative thinking skill of the experimental and control classes was homogenous because it had same value. Thus, there needed a data analysis by using parametric test that was independent sample t-test. The result of the data analysis is presented in Table 6.

Table 6. Data Analysis by using *independent sample t-test*

	Hasil Post-Test
Mean Difference	50.77778
Std.Error Difference	3.76883
Df	36
Sig. (2-tailed)	.000

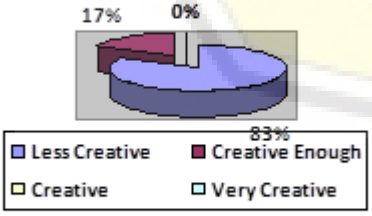
Based on Table 6 above, the sig. value was 0.000 ($p<0.05$), therefore it can be concluded that there was a significant different on students creative thinking skill in the experimental and control classes. The following Figure 6 presents the average improvement of creative thinking skill of each aspect in the experimental and control classes.

Chart 2. The Average Improvement of Creative Thinking Skill Aspects

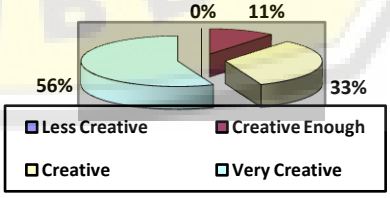


Based on the above figure, the experimental class showed a significant improvement in creative thinking skill of each aspect compared to the control class. In this research, the indicators to measure creative thinking skill referred to Munandar's opinion [3]. The students' creative thinking data from the experimental and control classes based on the result of pretest and posttest is shown in the following chart 3.

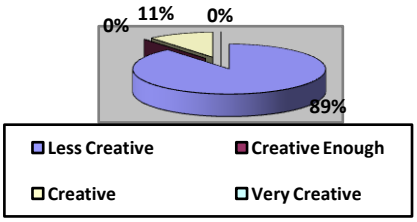
Chart 3. Data of the Students' Creative Thinking Level



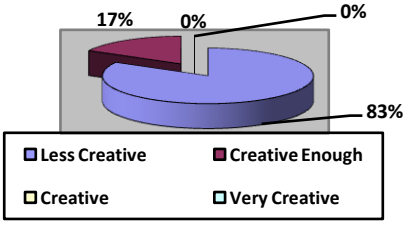
Experimental pre-test



Experimental post-test



Pre-Test of the Control Class



Post-Test of the Control Class

Based on the chart 3, it is shown that there was a significant improvement in the experimental class, especially on the pre-test that revealed the students who were less creative reached 83% and the students who were creative enough as much as 17%, while in the post-test there was an improvement of the students' creative thinking ability that was the students who were creative as much as 11% and very creative reached 56%. These results were different from the control class, even though both of classes had an improvement; however, the experimental class got a better improvement [21]. The following is the Figure 5. One of the students' answers that contains the 4 aspects of creative thinking

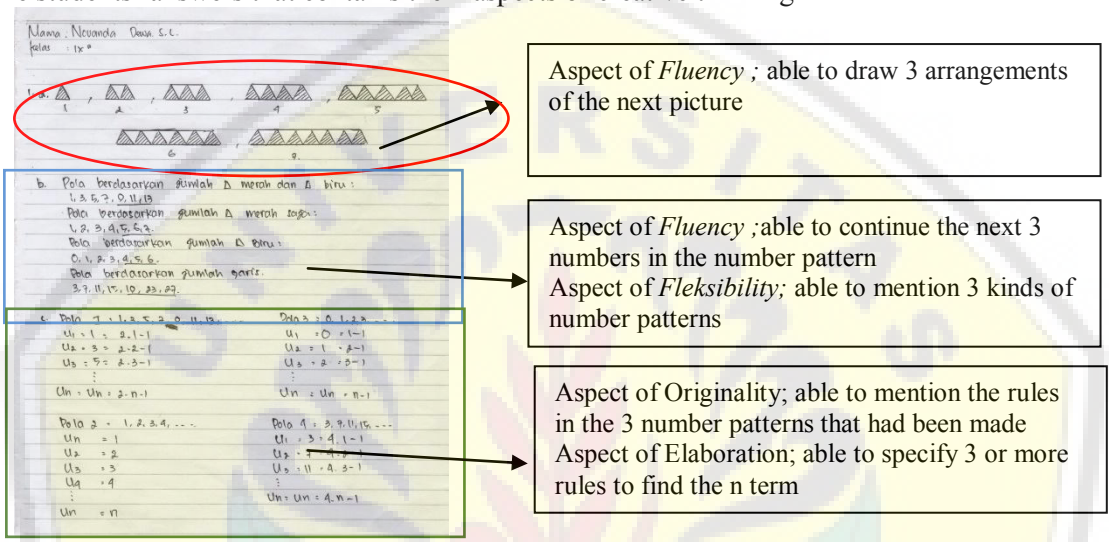


Figure 5. Results of students' answers on the 4 aspects of creative thinking.

In the figure 5 above, it is known that the students already had the creative thinking ability because the students' answers showed the four aspects of creative thinking covering fluency, flexibility, originality and elaboration aspects. The students who were very creative could be seen from the fluency aspect were able and fluent in expressing ideas to answer the question that were able to continue the next 3 pictures and the next 3 numbers in the number pattern they made. Whereas, from the aspect of flexibility, the students were able to mention any kind of number pattern formed based on the problem's picture, even the students were capable to find other different pattern from others'. Based on the aspect of originality, the students thought about the stuffs that other people did not that were thinking various different ways to find a number pattern, and from the aspect of elaboration, the students were able to determine the rule of the pattern in each number pattern with the detailed steps [3]. This was certainly different from the students' answers that belonged to the low level of creative thinking ability. Here is the figure 6. The students' answers were categorized as less creative thinking students.

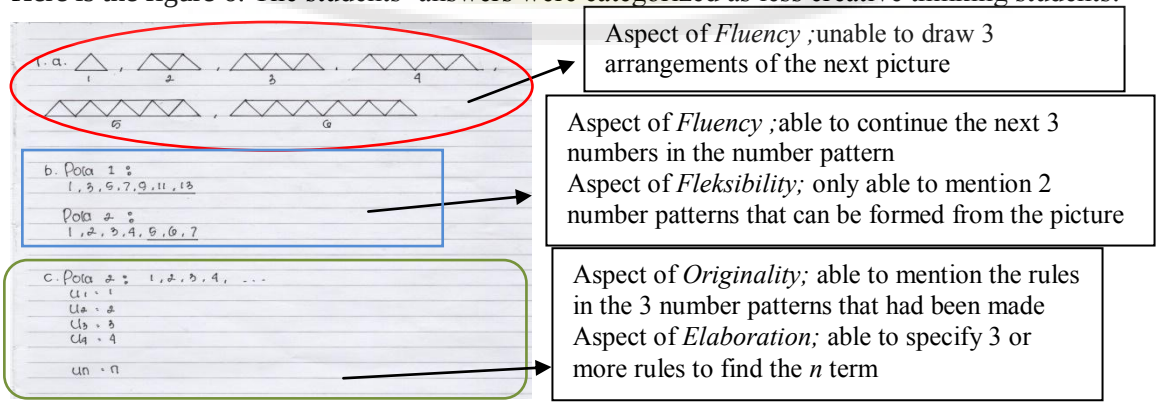


Figure 6. The Answers of The StudentsWho had LessCreativeThinkingAbility

Based on the pictures above, it can be seen that the students with less creative thinking ability had difficulties in drawing the next pattern in the aspect of fluency, but they were able to determine the next 3 numbers from the number pattern they made. From the aspect of flexibility, the students were only able to mention 2 number patterns that could be formed from a picture, while from the aspect of originality, the students were only able to determine a rule in the number pattern that they made while for the second number pattern, the students had difficulties in determining the rule of the number pattern. The students were only able to show the detailed steps of the number pattern they made and these were just simpler form of number pattern. Therefore, the students with less creative thinking ability had not fulfilled the four aspects of creative thinking. Here was the interview result between the teacher and the students whose answer showed above.

Teacher: Does the picture in question number 1 only have 2 patterns?
Student: Yes ma'am, the pattern is only based on the number of triangles with red triangles.
Teacher: Are there no other patterns besides the pattern that you found?
Student: There's no more mom.
Teacher: Try, you see the picture in question number 1 again, does the number of lines in each arrangement not form a pattern?
Students: (Students start counting), 1st arrangement of the number of lines is 3, 2nd arrangement of lines is 7, 3rd arrangement of lines is 11. Oh ... yes ma'am, based on the number of lines also forming a pattern with a difference the same which is 4.
Teacher: Why don't you answer the option *c* in pattern 1?
Student: I am still confused about the rules of the bu.
Teacher: Pay attention to the arrangement of numbers formed, how is then arrangement between numbers close together?
Students: (Students observe the answer option b again in pattern 1), the difference is the same as bu, which is a number that is close together has a difference of 2.
Teacher: What do you think about the pattern rules?
Student: Difference between two adjacent numbers 2, so that the pattern formed is 2*n*.
Teacher: Check again, if the pattern 2*n* can form a pattern like pattern 1 that you have made? (students seem confused, but try to recount)
Student: It turns out that I am still mistaken if the pattern is 2*n*, it should still be reduced by 1.
Teacher: Yeah right.

Based on the results of the interview above, it appears that students are still not able to think creatively that is on the fluency aspect. The fluency aspect in question is smooth in expressing ideas by mentioning numbers for the next arrangement. While in aspects of flexibility, students are still not able to think of different patterns that can be formed in an image, and in the aspect of originality, students are still unable to make rules on the pattern of numbers that have been made, and in the elaboration aspect students still have difficulty in compiling steps or ways with details so that a number pattern is found

4. Disscusion

The class sample data used in this study is normally and homogeneously distributed so that the data analysis used is parametric analysis (independent sample t-test) but if the sample data is not normally distributed so data analysis used is nonparametric analysis (Mann-Whitney)[8]. Related to the effectiveness of learning tools, it can be said that the learning tools was effective. This can be known from: (1) the percentage of classical completeness of the students' learning outcomes reached 89%, (2) the results of the students' activity during the learning process were categorized as active, (3) there was a significant improvement of the students' creative thinking ability in the experimental class. While, based on the observation results, it is known that the implementation of learning process in each aspect showed that it run well with the mean score of 4.88. Whereas, from the questionnaire of the students'

response, it was obtained that the students gave the positive response towards the learning tools on the implementation of LSLC-based scientific learning as much as 85%. Based on the data above, it can be concluded that the practicality test of the learning tools being developed fulfilled the criteria of: (1) the implementation level of the learning process was categorized as practical; (2) the students had a positive response toward the media as well as the implementation of LSLC based scientific learning.The results of the analysis of non parametric showed that there was a significant different on students creative thinking skill in the experimental and control classes.The results of this study show that there was a significant improvement in the experimental class, especially on the pre-test that revealed the students who were less creative reached 83% and the students who were creative enough as much as 17%, while in the post-test there was an improvement of the students' creative thinking ability that was the students who were creative as much as 11% and very creative reached 56%. The results of different studies indicate that the test results, students who have high, medium and low creative thinking skills have a significant increase between task 1 and task 2 and there are some students who are able to adapt quickly and well in research-based learning. In addition, the level of students' creative thinking skills based on their performance in task 1 is in the "less creative" category, while in task 2 is in the "creative" category [21].

5. Conclusion

Based on the overview and data analysis, it can be concluded that Lesson Study for Learning Community-based scientific learning tools on the material of sequence and number series in the class IX of junior high school is valid, effective and practical. In addition, the development of these learning tools had a significant influence toward the students' creative thinking ability. In the experiment class, there was a significant improvement of the students' creative thinking ability that were creative enough reached 11%, creative 33% and very creative 56%.

Acknowledgement

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