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The students' creative thinking ability in accomplishing collaborative learning-based open-ended questions

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Abstract. The purpose of this study is to describe the process and result of the collaborative learning-based open-ended learning development and its impact on the students' creative thinking. This study applied mix method research in which the method used balance method between qualitative and quantitative research. The development model used in this study is Thiagarajan 4D. It was then being tested to the students of Grade VIII MTsN2 Jember in 2017/2018 academic year. This mix method research is used to test the effectiveness of the process and the result of a particular product. The process effectiveness was tested qualitatively while the result effectiveness was tested experimentally. The data of the study was obtained from the validation sheet, the observation sheet of the students' and the teacher's activities, the observation sheet of the students' creativity and skill development, the students' worksheet, and self-assessment sheet. The product of this study is the collaborative learning-based open-ended teaching administrations. The validity of the average value of those teaching administrations (lesson plan, the students' worksheet, THB) is 3,8. Based on the result of the statistical analysis between the experimental and control group upon the students' creative thinking skill in solving the open ended questions, the Sig value (2-tailed) was $0.000 < 0.05$. Due to the significance value is less than 0.05, it means that H_0 is rejected; H_a is received, so that the learning outcomes of students' creative thinking in the experimental group are better than the control group.

1. Introduction

The education development in the globalization and technological era demands the learners to improve the ability to think creatively. The ability to think creatively is one of the demands of the 21st century education which had been implemented in 2013 curriculum (K13). The purpose of this is to prepare the young generation to be able to face the global era which has four basic skills: (1) critical and problem solving skills, (2) collaboration skills, (3) communication skills, and (4) creativity and innovation skills that are generally known as the 4C's [1, 2, 3].



Creative thinking can be defined as the ability of students to generate many possible answers and ways to solve the problem [4, 5]. To know the students' creative thinking process, the teachers can provide open-ended mathematics problems to students. It is based on Mihajlovic and Dejic statement that one of the advantages of the use of open-ended problem is to develop the students' creative thinking [6, 7, 8]. Russeffendi also revealed that to select the creative people, it is better to use open-ended questions (divergent), the divergent questions demand somebody to guess, create hypotheses, check the validity of the hypothesis, review the problem solving thoroughly and take decisions [9]. To measure the ability to think creatively, there are four criteria proposed by Munandar: the aspect of fluency, the aspect of flexibility, aspects of authenticity, and the aspects of elaboration [10, 11, 12].

Fatah et al conducted a study which the result is the open-ended approach could increase the ability to think creatively and mathematically (Kemampuan Berpikir Kreatif Matematis / KBKM) and Self-Esteem (SE) in mathematics on high school students in terms of school category. The results generally show KBKM improvement and the students SE's achievement who received open-ended learning perform better than the ordinary learning [13]. While Febriyanti et al's research revealed that students of TBK 1, TBK 2, TBK TBK 3 and 4 perform the indicators of creative thinking that is associated with the characteristics of creative thinking as proposed by Munandar, ie fluency, flexibility, and novelty. With the exception of students with TBK 0 did not perform the three indicators of creative thinking [14].

Learning which can develop the creative thinking abilities of learners is not only by providing open ended question, but also can be supported by collaborative learning. Through collaborative learning, students are trained to get used to ask his peers when he gets a problem to be solved in the learning process. Besides, the collaborative learning students are also trained to be responsible for the learning of other students, so that the success of a student can be a help for other students to be successful. Kusumastitik also argued that collaborative learning will be easier for students to learn each other to contribute ideas and thoughts that can train students' thinking skills to solve the problem of the group [15]. This is in line with Widodo's statement that the application of collaborative learning method could improve the students' active participation, in the terms of affective, psychomotor, and cognitive [16]. With learning Together contributed to the development of students' mathematical performance due to proper formation of groups, group members' cooperation to each other's learning and their sincerity to teachers' incentives during the treatment period [17]. Azizah's research tell that discovery based learning implementation can improve student's innovative thinking skills in solving open ended task of pattern generalization [18].

Based on the introduction above, it is necessary to have a specific research on the development of collaborative learning based open ended teaching administrations and its impact on the students' creative thinking.

Therefore, in line with the research problem, the objective of this study was to describe the influence of open-ended learning-based collaborative learning to the students' creative thinking skill.

2. Research Methods

This research method combines the two types of research: research and development (R & D) and experimental research. Research and development uses 4-D models developed by Thiagarajan, and Semmel consists of the definition stage, the design stage, the development stage, and the dissemination stage. On the other hand, the experimental research tries out the teaching administrations to both of the experimental and control group.

The subjects of this study were VIII grade students of MTsN 2 Jember. Samples were taken by using the homogeneity test. The sources of data in this study are the teacher of mathematics subject, expert validator, the data from the observations sheet about the students' creativity, the data from the teacher's activity observation, the data from the student's questionnaire and the data from the students' results of study. The data collection methods used in this research is observation, interview, questionnaire, test and documentation. The research instrument was the interview guide, validation

sheet, the teacher's activity observation sheet, the observation sheets of the students' creative thinking skills, the questionnaire sheet of the students' responses and achievement test.

Qualitative data analysis is done by analysing the validity, practicality and effectiveness. The analysis of the students' creative thinking skill use a scoring combination of creative abilities and one of the criteria in fluency, flexibility, originality, elaboration and evaluation skill. On the other hand, the quantitative data analysis is done by Normality Test techniques with one-sample Kolmogorov-Smirnov. If the normality of the test is concluded that the data were normally distributed test scores, the statistical analysis used is a parametric statistical analysis, namely the technique independent sample t-test. Conversely, if it is concluded that the data are not normally distributed, then the statistical analysis used is a nonparametric statistical analysis techniques, usingmann-Whitney test.

3. Results And Discussion

In this study, collaborative learning-based open ended teaching administrations which have been successfully developed are lesson plans, student's worksheets, and THB. The assessment of the teaching administrations was carried out by three validators that consist of two lecturers and one mathematics teacher. The validator's comments and suggestions were used to revise the teaching administrations which are developed by the researcher. The results of the assessment of the three validators state that the teaching administrations are worthy and ready to be used for research. Here are the analysis results of the data validation of the lesson plans, students' worksheet and THB from the three validators as seen in the following table.

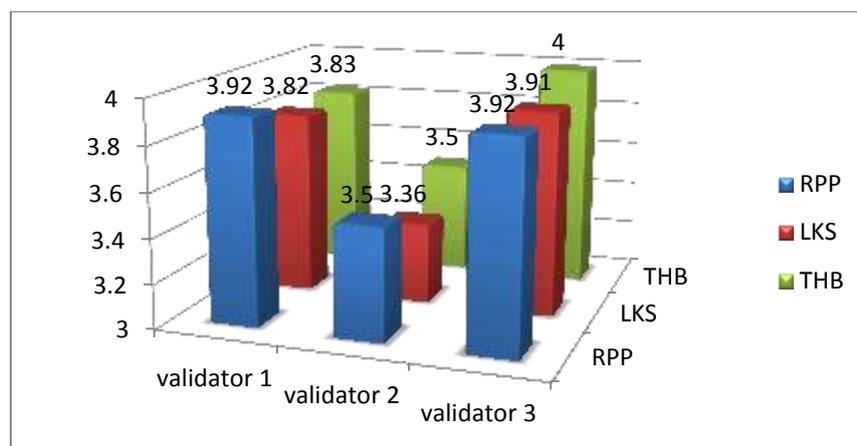


Figure 1. Results of analysis validation.

Based on the results of the assessment of experts who have been presented in the table, it can be concluded that the final product of the collaborative learning-based open ended teaching administrations which consists of lesson plans, students' worksheet and THB, each of them is valid that the average value is 3,75. The validated teaching administrations was applied to the experimental group, while the control group applies the conventional teaching administration. Based on data of the students' creative thinking skill test on the subject of the system of linear equations of two variables, it was obtained that the value of the post-test performed after learning activities in the form of essays as much as 4 questions. Here is the data of the creative thinking learning outcomes in the experimental group and control group briefly.

Table 1. Value of creative thinking learning outcomes descriptive statistics.

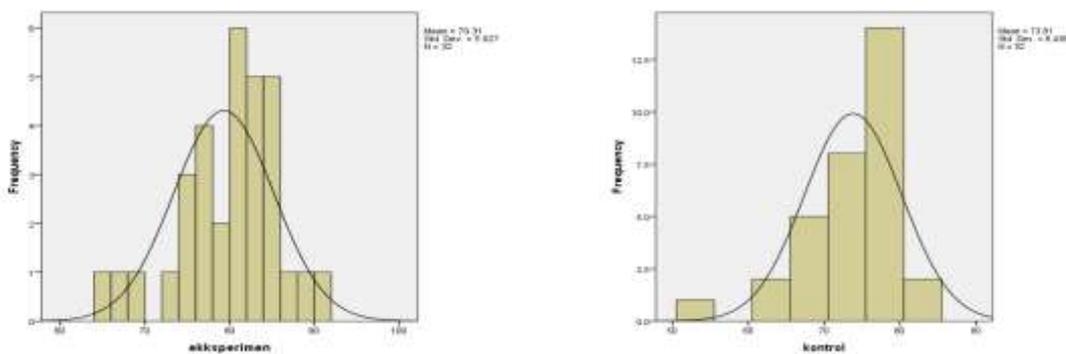
	N	mean	Std. deviation	Minimum	maximum
Ex	32	79.31	5.927	65	90
Control	32	73.81	6.438	53	80

Based on Table 1, the value of the students' learning outcomes in experimental group is higher than the control group. The highest value obtained by the experimental group is 90 and the lowest value obtained by the control group is 53. Then, the data of the students' creative thinking learning outcomes were analyzed by using kolmogorov- Smirnov test with SPSS 23 version to determine the data of the students' creative thinking learning outcomes which have normally distributed or not. Here is the result of normality test using kolmogorov- Smirnov test.

Table 2. Normality test results creative thinking learning outcomes one-sample *Kolmogorov-Smirnov* test.

		ex	control
N		32	32
Normal	mean	79.31	73.81
Parameters a, b	Std. deviation	5.927	6.438
Most Extreme	Absolute	.140	.139
Differences	positive	.075	.116
	negative	-.140	-.139
Test Statistic		.140	.139
Asymp. Sig. (2-tailed)		.113 ^c	.118 ^c

- Test distribution is Normal.
- Calculated from data.
- Significance Lilliefors Correction.
- This is a lower bound of the true significance.

**Figure 2.** Histogram of experiment class and control class.

From the figure, it can be concluded that the data (histogram) follow the normal curve pattern so that it can be said that the distribution of the data is normally distributed. Likewise by Kolmogorov Smirnov statistical test results that have been presented in Table 2, it can be seen that the sig. on Asymp. Sig. (2-tailed) is 0.113 to 0.118 for experimental group and control group. Sig value of the experimental

group and the control group $> 0,05$ (*level of significant*), it can be concluded that the results of the data value of students' creative thinking learning outcomes in experimental group and control group are normally distributed, so that it can be tested by using independent sample t-test.

Table 3. Test results independent sample t-test.

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Std. Error Difference
Student_Creative thinking	Equal variances assumed	0,75	0,785	3,556	62	,001	1,547
	Equal variances not assumed			3,556	61,580	,001	1,547

Based on the table 3, it can be seen that the Sig. on Levene's test for equality of variances is 0.785 > 0.05 so that the students' creative thinking learning outcomes is homogeneous then the decision making use strips of equal variances assumed. In assumed equal variances, it was obtained the value of Sig. (2-tailed) of 0.001 $< (0.05)$. Due to the significance value less than 0.05, it means that H_0 is rejected and H_a accepted. If the decision is referred to the guidelines described above, the the students' creative thinking learning outcomes in the experimental group is better than the control group. This is in line with the results of Mursidik research states that the development of performances of open ended learning can improve students' creative thinking ability [5] [10] [14].

Based on the quatitative analysis, it can be concluded that creative thinking abilities of students in the experimental group is better than the control group. This happens because the experimental group used teaching administrations which have developed previously, collaborative learning-based open-ended teaching admnistrations, while in the control group used the worksheets that have been provided by the school. In the experimental group, the teaching administrations used in this class were the teaching administrations that have been developed in the form of lesson plans, students' worksheets, and THB. Then, the teaching administrations can be said to be qualified if they can reach the criteria of practicality. To be a practical teaching administration, the teaching administration developed must be tested on the activities of the learning process with an open lesson activities. The tests were conducted on VIII A class as the experimental group which the learning activities held in 3 meetings, the first meeting material discusses the Linear Equation of Two Variables, then the second meeting discusses the completion of Linear Equations Two Variables, and the third meeting discusses the Two-Variable Linear Equation System and its completion.

The learning process between the experimental group and control group is described as follows. In the experimental group, group work activities, students were having active discussions with friends in a group to solve the problems that exist in the students' worksheet. Each cycle of open lesson interaction among students has increased. In addition, students also have the couragement to ask if there is a material that is poorly understood to friends who understand it better, then, if they still do not get a solution, they asked the nearest group. For students who already understand about the material, they are willing to share their understanding. The students do not feel embarrassed in expressing opinions and also want to share the answers to correct each other jobs. The following are examples of the students' work on the subject of Linear Equation of two variables at the first open lesson.

Students 1

Jawab:

Persamaan linear dua variabel	Bukan persamaan linear dua variabel
1. $2x - y = -5$	1. $2x + cy = d$
2. $2x + 5y = 0$	2. $2x + c = d$
3. $2x + 5y = 12$	3. $2 + 5 = 7$



The first student, she has developed her creative thinking for the answers given more than one and true. But he thought that PLDV only contains variables and xy

Students 2

Jawab:

Persamaan linear dua variabel	Bukan persamaan linear dua variabel
1. $4x - 7y = -2$	1. $2x + 5y + 4z = 45$
2. $6x + 2y = 14$	2. $2x + 5 = 12$
3. $3x + 2y = 90$	3. $x + 9 = 10$
4. $2x + 9y = 25$	



Students two has been developing creative thinking to answer the questions more than one answer correctly and the answers given more than any other friend

Students 3

Jawab:

Persamaan linear dua variabel	Bukan persamaan linear dua variabel
1. $3x - 7y = 4$	1. $2x + 9 = 10$
2. $2x + 3y = 6$	2. $x + 2 = 5$
3. $2x + 5 + 2z = 10$	3. $x + 4 = 2$



At third student, he is less creative, because do not understand the concept of PLDV and assume that that is not the shape PLDV containing only the variable x only other

Students 4

Jawab:

Persamaan linear dua variabel	Bukan persamaan linear dua variabel
1. $2x + 4y = 6$	1. $2x + 3 = 10$
2. $x - 3y = 9$	2. $x + 2y + 3z = 15$
3. $\frac{2}{3} + \frac{2}{3} = 5$	3. $\frac{2}{3} + 5 = 20$



The fourth student is more creative than the other students. He is proven to give different answers and all answers are correct

Figure 3. Students' work result.

There are some issues obtained from the observation at 3 times open lesson that has been done in experimental group and control group: in the experimental group, the learning process happens according to the lesson plan, students in solving problems in students' worksheet complies with provided steps and also provide some answers to problems which is the demand in solving the open ended questions. However, there are some students who still have to be considered in order to develop creative thinking in solving the problem. While in the control group, the learning activities of students tend to be less active and this is because the model that is applied in the conventional learning. When the teacher taught the students by using lecturing method, the students are less actively involved in

learning activities, lack of creative thinking and initiative. In addition, the students' attention uneven, the students always focus on the teacher's explanation only the students who sit front row, while students who sit in the back row tend to be less attentive and cause them passive learning. Students are also less active in answering questions posed by the teacher.

After do implemented later, immediately followed by a phase-see / reflection. Some issues are derived from the discussion of reflection at at 3 times of the open lesson that have been done that are the learning process accomplished according to the lesson plan, students solving problems in students' worksheet complies with the measures that exist and also provide answers to the problem which is the demand of the open ended questions. However, there are some students who still have to be considered in order to develop creative thinking in solving the problem. Here is the recapitulation result of the activities done by the students in the experimental group and control group

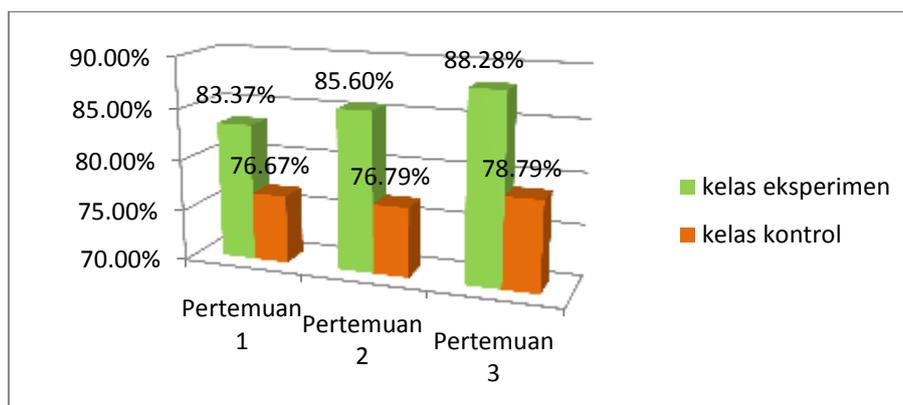


Figure 4. Students activities.

From the table, it reveals the result of practicality ratings of the teaching administrations, which is obtained from the assessment of the students' activity in the experimental group that is 85,75% while students activity in control group is 77,42%. It can be concluded that activity of students in the experimental group is better than the activity of students in the control group. This is in line with Widodo's opinion that the application of collaborative learning methods is proven to improve students' activity, both from the affective, psychometric, and cognitive spheres [16]

Further, the lesson plans, students' worksheets, and THB are qualified if these teaching administrations meet the criteria of effectiveness. The effectiveness of the teaching administrations that was developed can be determined by analyzing data from students' responses to worksheets that have been developed. Here are the result of the effectiveness analysis as presented in Table 3.

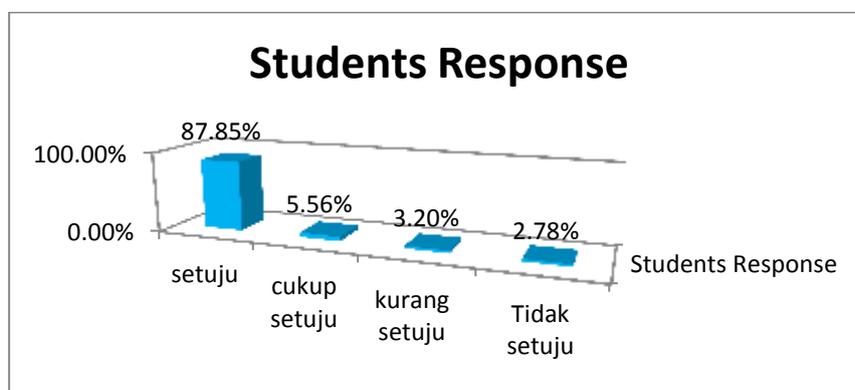


Figure 5. Response analysis students.

The students' questionnaire responses sheets were filled out by 32 students. Based on the results of the responses that has been presented in the Figure 3, the teaching administrations are considered effective because students who gave positive responses $\geq 80\%$ are 87,85%. It can be concluded that in general that the students gave positive responses and the teaching administrations are effective.

4. Conclusions and Recommendations

Based on the results of research and discussion, it is obtained some conclusions that the collaborative learning-based open ended teaching administrations and its impact on the students' creative thinking which are developed have valid criteria, practical and effective. After Kolmogorov -Smirnov test, it can be seen that the Sig. on Levene's test for equality of variances is $0.225 > 0.05$, thus, the students' learning outcomes were homogeneous. Therefore, the decision making use strips of equal variances assumed. In the equal variances assumed, it was obtained the value of Sig. (2-tailed) of 0.000. (< 0.05). Due to the significance value is less than 0.05, which mean H_0 is rejected; H_a is received, so that the learning outcomes of the students' creative thinking in the experimental group are better than the control group.

Further, it is suggested that teachers must guide students and put their self as a facilitator for the students, so that students can further develop their creative thinking in solving the problem.

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