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The Effectivenes of Model Eliciting Activities on Increasing Mathematical Creative Thinking

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ABSTRACT

Learning mathematics in Indonesia has not had a significant effect on improving students' creative thinking abilities. It is hoped that the Model Elicting Activities (MEAs) trial can be an alternative solution to this problem. So the first objective of the study was to find out whether MEAs learning had a better effect on improving students' creative thinking skills compared to conventional learning models. The second research objective is to determine the level of effectiveness of implementing the MEAs learning itself. The research objectives were achieved using a quasi-experimental study method with the pretest-post-test non-equivalent group design. The research subjects were class VII students of SMP L'Pina, East Jakarta, consisting of 25 students from the experimental class and 25 students from the control class. The research instrument is a test of creative thinking skills. Data on test results were analyzed using the t-test. The results of the data analysis concluded that: (1) MEAs learning has a better influence on students' creative thinking abilities than conventional learning models, and; (2) MEAs learning can significantly improve students' creative thinking skills.

Keywords: MEAs, Creative Thinking

ABSTRAK

Pembelajaran matematika di Indonesia belum berpengaruh secara signifikan terhadap peningkatan kemampuan berpikir kreatif siswa. Uji coba *Model Elicting Activities (MEAs)* diharapkan dapat menjadi alternatif solusi permasalahn tersebut. Maka tujuan pertama penelitian adalah untuk mengetahui apakah pembelajaran MEAs lebih baik pengaruhnya terhadap peningkatan kemampuan berpikir kreatif siswa dibanding pembelajaran model konvensional. Tujuan penelitian yang kedua adalah untuk mengetahui tingkat efektivitas dari penerapan pembelajaran *MEAs* itu sendiri. Tujuan penelitian dicapai menggunakan metode studi kuasi eksperimen dengan desain *the pretest-post-test non-equivalent group design*. Subjek penelitian merupakan siswa kelas VII SMP L'Pina Jakarta Timur yang terdiri dari 25 siswa kelas eksperimen dan 25 siswa kelas kontrol. Instrumen penelitian berupa tes kemampuan berpikir kreatif. Data hasil tes dianalisis menggunakan *uji-t.* Hasil analisis data menyimpulkan bahawa: (1) pembelajaran MEAs memiliki pengaruh yang lebih baik terhadap kemampuan berpikir kreatif siswa dibanding pembelajaran model konvensional, dan; (2) pembelajaran MEAs dapat efektif meningkatkan kemampuan berpikir kreatif siswa secara signifikan.

Kata Kunci: MEAs, Berpikir Kreatif

INTRODUCTION

The attention of education personnel to students' creative thinking abilities continues to increase as awareness arises that these abilities can underlie the presence of new products in the era of the industrial revolution 4.0 (Suherman & Vidákovich, 2022). The ability to think creatively does not only have a positive impact when someone tries to solve everyday problems-days, but what is more important than that is being able to encourage him to produce new ideas for the public interest in the future depan (Hadar & Tirosh, 2019). This ability is also the background for finding a way for humans to get to the moon, creating innovative works of art, and developing various information technology devices including technology for health (Ritter & Mostert, 2017). If it is associated with changes in life in the current era, people who have the ability to think creatively will more easily adapt to the latest developments (Suherman & Vidákovich, 2022).

The reasons above show the importance of someone having the ability to think creatively so that he can keep abreast of current developments in an up to date manner (Nadjafikhah et al., 2012; Tindowen et al., 2017). More specifically for a student, the ability to think creatively does not only have a positive impact when he is practicing developing new ideas, but also as a core competency that will continue to support his success at the next level of education (Lucas et al., 2014). According to Lince (2016) the ability to think creatively has a major influence on students' success in mastering mathematics and other branches of knowledge. UNESCO as an international level organization that handles the field of education further recommends that efforts to develop creative thinking skills can be facilitated through learning processes in all disciplines (Guiding Principles for Learning in the Twenty-First Century UNESCO International Bureau of Education, n.d.)

As a response to UNESCO's recommendations, almost all countries are currently imposing a curriculum containing creative thinking skills as a competency that must be mastered by graduates (Vale, I. & Barbosa, A., 2015). The current curriculum in Indonesia is in line with this, in which one of the competencies students must achieve at the primary and secondary school level is the ability to think creatively. The creative thinking competence of students in Indonesia is planned to be achieved through several compulsory subjects, one of which is mathematics. The goals of learning mathematics are believed to have relevance to the goals of developing creative thinking skills.

After reviewing several previous studies, Gr´egoire came to the conclusion that the essence of mathematical thinking is creative thinking (Grégoire, 2016). The conclusion from many studies in the field of education has also stated the role of learning mathematics in terms of facilitating the development of students' creative thinking abilities (Rahayuningsih et al., 2021; Shen & Lai, 2018; Wahyudi et al., 2020). However Grégoire (2016) adds that to get to the level of creative thinking in learning mathematics is not enough just to guide students to get the right answer to a given quiz question. But to find answers, students first process new ideas or other possible solutions (Sitorus & Masrayati, 2016). At this stage students are said to have carried out the process of mathematical creative thinking.

Hadar & Tirosh (2019) details a person's mathematical creative thinking ability as a thought process: divergent and convergent; find problems; solve the problem; examine new relationships between problems, and; make associations between techniques, ideas, and their applications. In the context of learning mathematics at school, mathematical creative thinking includes skills in solving mathematical problems and the ability to conclude concepts or even find new concepts that he can understand (Hetzroni et al., 2019). A high level of students' creative thinking ability will be shown by their fluency and flexibility in solving mathematical problems (Puspitasari et al., 2018; Yayuk et al., 2020). Based on the opinions mentioned above, the researcher views that there is a considerable opportunity to improve students' creative thinking abilities in Indonesia through mathematics learning activities in schools.

As a preliminary step, the researcher made observations on class VII students at L'Pina Junior High School, East Jakarta. The form of observation that was carried out was to examine students' answers to questions from quiz questions regarding flat wake problems. From the results of observations, it can be seen that students' ability to solve flat wake problems is still relatively low. This is shown by the relatively similar student answers when asked to draw a certain flat shape. Apart from that, from the answers given, it can also be concluded that the students did not understand the meaning of the quiz questions properly. The conditions obtained by the researcher are relevant to the previous conclusion which states that students with moderate to low levels of creative thinking ability will have difficulty understanding the questions, then after being able to understand the questions these students still have difficulty finding different ideas in answering questions (Puspitasari et al., 2018; Yayuk et al., 2020). So, based on the results of observations that have been made, the researcher concludes that class VII students at L'Pina Junior High School, East Jakarta, have low creative thinking skills, especially in solving flat-topped problems. This conclusion is in line with the results of the 2018 PISA which concludes that students' creative thinking skills in Indonesia are still low (Schleicher, 2019; Tohir, n.d.).

The above conditions encourage researchers to find alternative solutions so that the creative thinking skills of class VII students in the following school year increase or are better, especially after participating in mathematics learning on flat shapes material. Furthermore, research questions arise regarding appropriate alternative solutions to improve students' creative thinking skills through learning activities with this material.

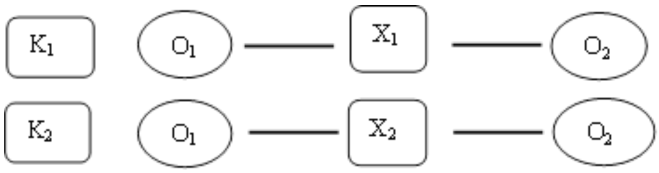
Learning activities in the future must be designed in such a way as to encourage students to get used to thinking creatively and the design is made part of a policy to improve the quality of education (Yen & Halili, 2015) Mathematics teachers also need to give more time to think about ways that the learning process they manage can facilitate the development of student creativity, and can be used as a basis for identifying students who are able to think creatively mathematically (Chamberlin, 2010). The results of research by (Handajani et al., 2018) recommend using the Eliciting Activities (MEA) Model to improve 21st century skills, namely critical thinking skills, creative thinking, communication and collaboration for vocational high school students. Previously (Coxbill et al., 2013) used the Eliciting Activities Model (MEAs) to identify the creative thinking abilities of elementary school students. The application of the Eliciting Activities Model (MEAs) has also been shown to be able to significantly improve the critical thinking skills and creative thinking of high school students (Euis Istianah, 2013). So that the researcher deems it necessary to conduct trials using the Eliciting Activities Model (MEAs) to improve the creative thinking skills of class VII students which are specifically applied to learning quadrilateral shapes.

English, L.D., & Nicholas G. Mousoulides (2011) define Model Eliciting Activities (MEAs) as the activity of creating (building) models and modeling perspectives for problem solving in mathematics, science, and engineering education with a future-oriented learning approach. Chamberlin (2008) more specifically explains that Model Eliciting Activities (MEAs) are specifically designed for learning mathematics with 5 characteristics, namely: collaboration, multiple processes, independent learning and self-assessment, encourage ownership, and model development. Chamberlin & Moon (2016) then confirms if the characteristics in the Model-Eliciting-Activities (MEAs) have the opportunity to provide opportunities for students to take control of their own learning so that later it will significantly encourage the level of student activity. In other words, through the stages in implementing MEAs students will arrive at a level of creative thinking due to the factor of more opportunities to do or do something during the learning activity (Wahyudi et al., 2018). In other words, through the stages in implementing MEAs students will arrive at a level of creative thinking due to the factor of more opportunities to do or do something during the learning activity (Kjeldsen & Blomhøj, 2010; Dossey, 2010; Kim & Kim, 2010). The application of MEAs will bring flexibility and novelty in learning so it is ideal if applied for the purpose of developing students' creative thinking abilities (Wessels, 2014).

The information above shows that there are several features of implementing MEAs and its opportunities in increasing students' creative thinking skills. So that researchers view it as urgent to conduct trials of the application of the learning model, so that later it can be used as an alternative solution to the problems found in this study. This study also developed a test instrument in the form of a package of questions about the material description of flat shapes for the purpose of measuring the level of effectiveness of MEAs implementation in increasing students' creative thinking skills.

METHOD

The research objectives to be achieved are to find out: (1) a better learning model between MEAs learning and conventional learning models in terms of increasing the ability to think creatively mathematically; (2) the level of effectiveness of the application of MEAs in increasing students' creative thinking abilities. The type of research used to achieve this goal is quasi-experimental with the Nonequivalent Pretest-Posttest Control Group Design which is focused on directly examining the effect of a variable on other variables (Sugiyono, 2014). The variables in question are the application of MEAs as the independent variable, the ability to think creatively mathematically as the dependent variable, and students' initial mathematical ability as the control variable. Quasi-experimental was chosen because researchers can only control independent variables that have the potential to affect the dependent variable, otherwise researchers cannot control variables from outside the study that can threaten internal validity. The nonequivalent pretest-posttest control group design pattern involved an experimental group that was given learning using MEAs and a control group that was given learning using conventional models. The research population was L'Pina Junior High School students, East Jakarta, with a total of 120 students divided into 5 classes. The samples were grouped randomly, where the researcher accepted the condition of the samples in groups or classes that had been formed previously, namely using class divisions that had been carried out by the school. The sample consisted of class A as the experimental group of 25 students and class B as the control group of 25 students.. The nonequivalent pretest-posttest control group design used is presented in Figure 1.



Information:
K1: Experiment class K2: Control class O1: Pretest
O2: Posttest X1: MEAs learning X2: Conventional model learning

Figure 1. Nonequivalent pretest-posttest control group design adapted from Sugiyono (2013)

The application of MEAs in the experimental class was carried out in 4 learning sessions. The stages are adapted from Chamberlin (2008) which include 4 stages: (1) identification; (2) create models; (3) model transformation, and; (4) interpretation models. The research data was obtained through a creative thinking ability test instrument given at the last meeting. The test questions consist of 8 (eight) item description questions with flat shape materials developed based on 4 (four) indicators: (1) fluency; (2) flexibility; (3) Originalit; (4) elaboration (Suparman, T., & Zanthy, L. S., 2019). The preparation of test questions is carried out by following the following rules and stages: (1) analysis of the validity of the items; (2) test reliability analysis; (3) analysis of differentiating power, and; (4) analysis of difficulty level.

Quantitative data obtained from the results of the pretest and posttest were first subjected to a prerequisite test, namely a normality test to find out whether the data came from a normally distributed population or not, and a homogeneity test was carried out to find out whether the sample has a homogeneous variance or not (heterogeneous). Furthermore, data analysis was carried out using appropriate statistical tests to reach the two conclusions as expected for the purpose of this study. The alternative statistical tests were selected based on the results of the prerequisite tests, including the t-test, t'-test and the Mann Whitney test (see table 1). The first conclusion will be obtained after analyzing the posttest data. The second conclusion will be obtained after analyzing the data from the pretest and posttest results. The hypotheses and alternative statistical tests that can be used are presented in Table 1.

Table 1. Hypotheses and Alternative Statistical Tests

Hypothesis	Prerequisite Test Results	Statistics Test
To reach the first conclusion: The students' mathematical creative thinking ability who received the eliciting activities (MEAs) learning model was better than students who received the conventional learning model.	Normal and Homogeneous	*t*-test
To reach the second conclusion: The increase in students' mathematical creative thinking abilities using the Eliciting Activities Model (MEAs) was significantly higher than students using conventional learning models.	Normal and Not Homogeneous	*t'*-test '
	Abnormal and Not Homogeneous	*The Mann Whitney*-test

Data analysis in this study was processed using Microsoft Office Excel and SPSS software. The test criteria in making decisions on the results of the normality test and homogeneity test are if Sig. (p-value) < α (α=0,05) then H_0 is rejected or in other words H_1 is accepted. The decision-making criteria for the average similarity test and the average difference test are if the significance value ≥ α (α=0,05) then H_0 is accepted or H_1 is rejected.

RESULT AND DISCUSSION

The stages of the research described in this section consist of (1) analysis of the results of the development of mathematical creative thinking test questions; (2) analysis of the results of implementing MEAs, and; (3) analysis of posttest results to achieve the first research objective, and; (4) Analysis of pretest and posttest results to achieve the second research objective. Explanation of each stage as follows:

Analysis of Test Question Development Results

The pretest and posttest questions used consisted of 8 descriptive questions, each item representing an indicator of students' creative thinking ability. Question development procedures include; (1) arrangement of grids; (2) preparation of test questions and answer keys; (3) Test the theoretical validity through expert judgment; (4) empirical trials to determine: (a) the validity of the test; (b) test reliability; (c) the discriminating power of the test, and; (d) the difficulty level of the test. Overall, the 8 items on the creative thinking test developed to achieve the objectives of this study are in a fairly good category and all items can be used to collect research data carried out through pretest and posttest.

Results of MEAs Implementation Analysis

Learning in the experimental class and control class was carried out in 4 meetings each. Each meeting consists of 2 hours of lessons or 2 x 45 minutes. The pretest was facilitated by the local mathematics teacher outside the 4 meetings, namely one day before the researcher started the first meeting. This is intended so that researchers can utilize the allocation of time provided for research more optimally.

At the first meeting the researcher explained in advance about the MEAs learning stages to all students, in which the stages had been arranged in detail in a student discussion sheet. Furthermore, students who have received an explanation are grouped into small groups, each consisting of 5 students. Each student will continue to be in the same group until the four meetings are over. The following is an explanation of each stage in the MEAs learning observed by researchers starting from the first meeting to the fourth meeting

a. Identification Stage

At this stage students are trained to think independently in identifying and looking for alternative solutions to a given problem. The ability to identify is shown by students by writing down what is known and what is asked. The students' ability to provide alternative solutions is demonstrated by bringing together solution ideas that each student raises in a group.

The results of the teacher's observations at this first meeting showed that students were still very unfamiliar with the MEAs learning process that the researcher was trying to apply. The habit of receiving information in only one direction, namely only focusing on what the teacher conveys is the reason students need adjustments when asked to think independently. However, the results of the researchers' observations at the second, third, and fourth meetings showed that students began to understand the importance of problem identification processes carried out independently or with other students when they had to solve a mathematical problem.

b. The Create Model Stage

The learning activity carried out by students is to make a mathematical model of a problem that is presented in the student discussion sheet. Furthermore, students are encouraged to find quadrilateral concepts that originate from everyday problems. At the create model stage, students get a lot of stimulus to develop their creative thinking processes.

The results of the researchers' observations at the first meeting found that most students still did not understand the term mathematical model. However, after being given an explanation, students can understand the mathematical model in question, which is an image that represents the problem presented. An example of the results of students' creative thinking at the create model stage is shown in Figure 2.

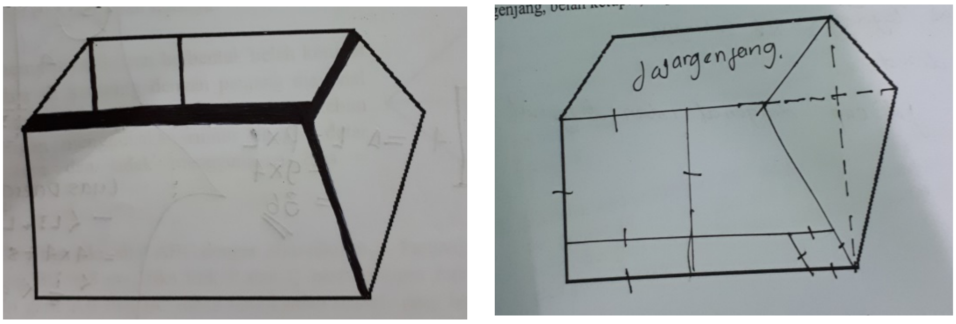


Figure 2. Shows students have been able to create flat shapes

c. Model Transformation Stage

In the model transformation stage, students in one group jointly conduct an analysis of the mathematical model that has been made before. The analysis process is carried out by relating it to real life objects. Then students are invited to solve problems in the form of different problems, namely students are asked to associate a problem related to quadrilaterals. Next, students are asked to find the formula for a quadrilateral but using another quadrilateral approach. Figure 3 shows the results of student discussions at the model transformation stage.

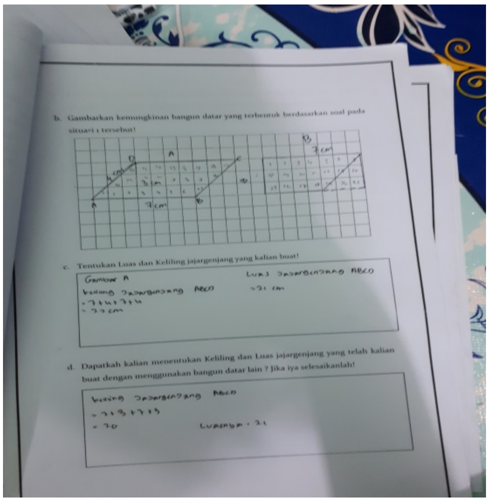


Figure 3. Student Discussion Results at the Model Transformation Stage

Figure 3 shows the results of student discussions when students were asked to find a parallelogram formula by applying the concept of a rectangle or square. This shows students' creative thinking skills in associating a concept with other concepts. The results of the researchers' observations at the first meeting showed that students still needed to be guided to carry out the transformation model, but at the second, third, and fourth meetings, students began to get used to it.

d. Model Interpretation Stage

At the model interpretation stage, students are asked to draw conclusions and re-examine each of their answers on the student discussion sheet. Next, they were asked to present the results of the discussions that had been carried out. Figure 3 shows student activities at the model interpretation stage.

Figure 3. Student Activities in the Model Interpretation Stage

Figure 3 shows the presentation process carried out by groups of students and the role of the teacher at this stage is to make the learning atmosphere always happy and there is no pressure whatsoever. The goal is that students are free to express all opinions and create their answers.

The whole series of learning within the framework of this research ended with the provision of posttest questions. The experimental class and the control class carry out the posttest at the same time so that the confidentiality of the questions can be maintained and to fulfill the principles of learning evaluation.

The Results of the Analysis of The average Similarity Test

The average similarity test was carried out to find out which learning model has a better effect on increasing students' creative thinking skills. The analysis was carried out using the data obtained after the treatment, namely the posttest value. The posttest scores for the experimental class and the control class are presented in Table 3.

Table 3. Posttest Results for Creative Thinking Ability

Class	Posttest	
	Average	Standard Deviation
Model Eliciting Activities (MEAs)	26,56	3,95
Conventional Model Learning	19,67	6,16
Ideal Maximum Score	32	

Table 3 shows that the average posttest score for the experimental class is 6.89 higher than the average posttest score for the control class. However, this difference cannot be used as a basis for concluding that MEAs learning has a better effect on students' creative thinking abilities. The conventional model of learning that is applied to the control class also has the opportunity to have the same effect. So researchers need to know whether between the two learning models there is a significant difference or not in terms of influencing the test results of students' creative thinking skills. If there is no significant difference, then both models are said to have a positive influence, and it cannot be said that MEAs learning is better than conventional learning models. Conversely, if there are significant differences between the learning models, it can be concluded that MEAs learning has a better effect on increasing students' creative thinking abilities.

To show whether or not there is a significant difference between the two models, it is necessary to carry out an average similarity test preceded by a normality test and a homogeneity test as a prerequisite test. The results of the normality test, homogeneity test, and average similarity test were carried out with the help of SPSS 20 for Windows software. The explanation is as follows:

a. Posttest Data Normality Test

The normality test was carried out using the Shapiro-Wilk test. The test results are presented in Table 4.

Table 4. Normality Test Results

Class	*Saphiro Wilk*			Information
	Statistics	*df*	*Sig.*	
Model Eliciting Activities (MEAs)	0,926	25	0,071	Normal
Conventional Model Learning	0,943	24	0,191	Normal

Table 4 shows the distribution of posttest results of students' creative thinking abilities in the experimental class and the control class which are all normally distributed.

b. Posttest Data Homogeneity Test

The homogeneity test was carried out using the Levene statistical test. The test results are presented in Table 5.

Table 5. Homogeneity Test Results

Levene Statistic	df1	df2	Sig.	Information
4,902	1	47	0,032	Heterogeneous

The results of the homogeneity test in Table 5 show that the variance of the posttest data is heterogeneous. Thus, based on the results of the prerequisite test, it can be seen that the data to be analyzed further comes from normally distributed data with heterogeneous data variances. Next, an average similarity test will be carried out using a statistical test that is appropriate to these conditions, namely the t-test (t-test for equality of means).

c. Average Similarity Test

This average similarity test will show whether or not there is a significant difference between the average learning outcomes of students who carry out MEAs learning and students who carry out conventional learning models. The t'-test (t'-test for equality of means) is carried out with the following hypothesis:

H_0 : There is no significant difference between the average post-test scores for students' mathematical creative thinking skills who receive Eliciting Activities (MEAs) learning models and students who receive conventional learning models.

H_1 : There is a significant difference between the average post-test scores for students' mathematical creative thinking skills who receive Eliciting Activities (MEAs) learning models and students who receive conventional learning models.

The results of the average similarity test using the t-test for equality of means are presented in Table 6.

Table 6. Average Similarity Test Results

t-Test For Equality of Means			Conclusion	Information
T	*Df*	Sig.(2-tailed)		
4,634	38,95	0,000	H_0 rejected	There are differences

In Table 6 it can be shown that H0 is rejected or in other words there is a significant average difference between the average test scores of students in the experimental class and control class students. So at this stage it can be concluded that MEAs learning has a better effect on students' creative thinking abilities than conventional learning models. This is because the syntax or learning stages of MEAs have succeeded in encouraging students to think creatively.

The average similarity test in this section only concludes which model has a better effect on students' creative thinking abilities. Furthermore, an effectiveness test will be carried out to find out which learning model is more effective in increasing the average test score of students' creative thinking skills. Students' initial mathematical abilities obtained from the pretest results are used as a control variable.

Analysis of the Effectiveness Test Results of MEAs Implementation

The effectiveness test was carried out using the N-Gain mean difference test for the two independent groups. The effectiveness test is preceded by a normality test and homogeneity test as a prerequisite test. The results of the prerequisite test and effectiveness test are described as follows:

a. Pretest and Posttest Data Normality Test

The normality test for samples with a number of < 100 will be carried out using the Shapiro-Wilk test. The decision making criterion is if the value is Sig.(p-value) then H0 is rejected, and if the value is Sig. (p-value) then H0 is accepted. The results of the Shapiro-Wilk test are presented in table 7.

Table 7. Pretest and Posttest Data Normality Test Results

Class	*Saphiro Wilk*			Conclusion	Information
	Statistics	*Df*	*Sig.*		
Model Eliciting Activities (MEAs)	0,949	25	0,233	H_0 accepted	Normal
Conventional Model Learning	0,926	24	0,079	H_0 accepted	Normal

The results of the normality test in Table 7 show that the data from the two classes tested all come from normally distributed data. The next step is the homogeneity test.

b. Pretest and Posttest Data Homogeneity Test

Homogeneity test was carried out using the Levene statistical test. The test criteria used are if the value is Sig.(p-value) then H0 is rejected, and if the value is Sig. (p-value) then H0 is accepted. A summary of the results of the homogeneity test is presented in Table 8.

Table 8. Pretest and Posttest Data Homogeneity Test Results

Levene Statistic	*df1*	*df2*	Sig.	Conclusion	Information
3.075	1	47	0,086	H_0 accepted	Homogen

The results of the homogeneity test in Table 8 show that the variance of the data analyzed has a homogeneous variance. The next step is to test the effectiveness of MEAs implementation in improving students' mathematical creative thinking skills.

c. N-Gain Mean Difference Test

The difference test of the average N-Gain value aims to determine the average difference in the increase in the mathematical creative thinking ability of students who take MEAs learning with students who take conventional learning models. The application of MEAs learning is said to be more effective if the average increase in students' creative thinking skills is significantly higher. The hypothesis test used is as follows:

H_0 : The average increase in students' mathematical creative thinking skills who take MEAs learning is not significantly higher than students who take conventional learning models.

H_1 : The average increase in the mathematical creative thinking ability of students who take MEAs learning is significantly higher than that of students who take conventional learning models.

The decision making criterion is if the value is significant then H0 is accepted and if the value is significant then H0 is rejected. The results of the N-Gain mean difference test are summarized in Table 8.

Table 8. N-Gain Mean Difference Test Results

t-Test For Equality of Means			Conclusion	Information
T	*Df*	Sig.(2-tailed)		
4,804	47	0.000	H_0 rejected	Significantly higher

The results of the average difference test in Table 8 show that H0 is rejected, so the test decision is: the average increase in the creative thinking skills of students whose classes apply MEAs learning is significantly higher than those whose classes apply conventional learning models.

Thus the stages of research and data analysis that have been passed can show 2 facts, namely: (1) MEAs learning has a better effect on creative thinking skills than conventional learning models, and; (2) the average increase in students' creative thinking skills in the experimental class is significantly higher than the students' creative thinking abilities in the conventional learning model class. This finding is also in line with the results of previous research which concluded that there was a positive impact from implementing MEAs on increasing students' creative thinking skills (Istianah, E., 2013; Handajani et al., 2018). The increase in students' creative thinking skills in the experimental class was, among other things, stimulated by an increase in problem-solving activities when doing modeling. This does not happen to students in conventional learning classes.

CONCLUSION

Based on the results of data analysis it can be shown that: (1) MEAs learning has a better effect on students' critical thinking skills than conventional learning models, and; (2) MEAs learning is more effective in improving students' creative thinking skills than conventional learning models. So it can be concluded that the stages of MEAs learning can provide a stimulus to students in the experimental class to improve their creative thinking skills. This does not happen to students who carry out learning with conventional models.

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