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THE IMPLEMENTATION OF MATHEMATICS TEACHING WITH OPEN-ENDED APPROACH TO UIN SUSKA RIAU MATHEMATICS STUDENT'S ABILITY OF MATHEMATICAL CREATIVE THINKING.

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Abstract

Creative thinking and analytical thinking are both important ability in solving mathematical problems. But in most of the current formal education of mathematics, learning mathematics often focuses on developing analytical thinking skills only, while creative thinking skills are often overlooked, including in higher education. Therefore, it takes an effort to improve the creative thinking abilities of students by providing learning activities that can support the development of their creative abilities. *Open-ended* learning approach is one of learning approaches that allows students to cultivate creative thinking skills and make them actively involved in learning activities in lectures. *Open-ended* approach uses *open-ended* questions as a learning tool.

An experimental study was conducted to find out the difference of creative mathematical thinking ability of students in the learning discrete mathematics by using *an open-ended* approach and their attitude toward learning. The research was conducted by using *control group pretest-posttest* design. The population of this research was students who took discrete mathematics subject in academic year of the Department of Mathematics Education of UIN Suska Riau, while the samples in this study were class A and B students who were randomly selected from all students as the control class and experimental class. The instrument used to collect data consisted of creative mathematical test contained math questions to measure ability of students' mathematical creative thinking. In addition, questionnaire on students' attitude with Likert-scale model to find out the students' attitudes towards learning by using *open-ended* approach.

Based on analysis of data from the post-test results and findings of this research, it can be concluded that students' mathematical creative thinking skills learned by using *open-ended* approach is better than mathematical creative thinking ability of students who obtain regular learning. Based on questionnaire responses on the students' attitudes, students have a positive attitude towards learning by using *open-ended* approach

Keywords: Creativity, Creative Thinking, Open-ended approach.

A. Preliminary

Creativity is often a neglected topic in teaching. Most people assume that creativity and learning has nothing to do with one another. Educators strongly disagree with such views. They argued that according to their experience of flexibility capability is one component of creative thinking is the ability of the most important to successful problem solvers (Pehkonen, 1997).

Seeing the lack of attention to creative thinking ability in learning and implications, thus it is necessary to pay more attention to this ability in learning today. This is because the creative thinking skills along with critical thinking and analytical skills are very important skills in learning activities. But in practice the development of creativity in the field are still ignored. This is in accordance with the statement Munandar (in Dahlan, 2004) that in some cases the class tends to hamper creativity, among others, by developing the stiffness of the imagination.

One approach to learning that can provide flexibility to students to think actively and creatively is an open-ended approach. This statement is based on the opinions Heddens and Speer (1995:30) states that open-ended approach is useful to improve the way students think. Open-ended approach is one approach that helps students to do creative problem solving and respect for diversity of thought that may arise during the process of solving the problem. Referring to the

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opinion that the open-ended approach that can give students the opportunity play an active role and encourage ways of thinking students (Shimada, 1997, Heddens & Speer, in Enden (2006)), it can be expected that this approach can be a facilitator in developing and stimulate thinking skills creative students. Learning with open-ended approach was chosen in this study to see effects on students' creative thinking abilities. In fulfilling this purpose, the researchers took the title "The Influence of Learning with the Open-Ended Approach to Creative Thinking Ability and Teacher Training Students Faculty Tarbiyah UIN Suska Riau".

B. Creativity and Creative Thinking

Discussion understanding creative thinking will not be apart from the topic of creativity. At the beginning of research on creativity, the term is usually associated with the attitude of someone who is regarded as creative. In the literature there are many definitions of creativity but it seems no general definition of the same, every scientist has its own definition according to its version of each. According to Silver in Dahlan (2004) there are two views on creativity. First sight view of creativity is called genius. According to this view is seen as a creative act of mental traits are rare, produced by exceptional individual talent through the use of extraordinary thought process, rapid, and spontaneous. This view says that creativity can not be influenced by learning and creative work is more a sudden event rather than a long process to complete as is done in school. So in this view is no limit to apply creativity in education. First sight it has been widely questioned in recent studies, and no longer represents the views of creativity that can be applied to education. The second view is a new view of creativity that emerged from recent studies, contrary to the views of genius. This view states that creativity is closely related to a deep understanding, flexible in content and attitude, so that can be associated with working in a long period of recollection. So, creativity is not only a quick ideas and extraordinary. According to this view of creativity can be embedded in learning activities and environment.

Torrance in Enden (2006) generally defines creativity as a process in understanding a problem, seeking solutions that possible, interesting hypotheses, test and evaluate, and communicate results to others. According to Torrance in the process of creativity results include original ideas, different perspectives, breaking the chain of problems, combining the ideas or seeing new relationships among those ideas. Torrance described the four components of creativity that can be assessed as follows:

1. Fluency (Fluency); ability to generate a number of ideas
2. Flexibility or flexibility (flexibility); ability to generate diverse ideas
3. Detail or elaboration (Elaboration); ability to develop, embellish, or out of an idea
4. Originality (Originality); ability to generate ideas among the most unusual or rare.

Haylock (1997) suggests creativity in general as is widely understood that include cognitive style, job categories, and the types of work. Cropley in Enden (2006) suggests there are at least two ways of using the term creativity. First of creativity which refers to certain types of thinking or mental function, this type is often called divergent thinking. Second, creativity is seen as making products that are considered keatif such as works of art, architecture, or music. For learning in school Cropley take the first term creativity, and adapting the establishment was that creativity is the ability to obtain ideas, especially the original, nature discovery and new.

Harris (1998) in his article said that creativity can be viewed as an ability, attitudes and processes. Creativity as an ability is the ability to generate new ideas by combining, changing or implementing the ideas that already exist. Creativity as self-attitude is the ability to see change and newness, a willingness to play with ideas and possibilities, flexibility of views, enjoy the goodness of nature, while looking for ways to improve it. While creativity as a process is an ongoing activity to improve ideas and solutions, by making gradual changes and improve the previous works.

Rhodes (in Munandar, 1999:25), which has analyzed more than 40 definitions of creativity concludes that creativity can be formulated in terms of personal (person), processes and products. Creativity can also be viewed from the personal and environmental conditions that encourage the (press). Rhodes called the fourth type of definition of this creativity as "the Four P's of creativity: Person, Process, Press, and Product". The four P are inter-related: creative personalities who

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engage in the creative process with the support and encouragement (press) from the environment, generate creative product.

Operationally, creativity can be interpreted as reflecting the ability of smoothness, flexibility (flexibility) and originality in thinking, as well as the ability to elaborate, develop, enrich, refine an idea. As revealed by Munandar (1990) that creative ability is the result of learning is revealed in verbal creative thinking abilities and creative attitudes. Creative thinking skills can be defined as the level of thinking ability of children to discover as much as possible, seberagam possible and relevant, the answer to a problem, flexible, original and detailed, based on data and information available.

Creativity is related to cognitive factors and affective. Cognitive has the characteristics of aptitude (intelligence), while the affective has the characteristics of non-aptitude. Aptitude characteristics include: Current thinking skills, skills, flexible thinking, original thinking skills, skills elaboration / detailing and evaluating skills. Non aptitude characteristics of creativity are traits associated with attitudes and feelings. The characteristics of non-aptitude include curiosity, be imaginative, to feel challenged by the diversity, the nature of taking a risk and appreciate nature. According Munandar (1999:12) Developing one's creativity does not just pay attention to the development of creative thinking ability but also fertilizing the attitude and creative personality traits.

C. Creative Thinking in Learning

In general, people assume that arithmetic such as mathematics, statistics and creativity has nothing to do with one another. And if we see a mathematician who produces formula / new results in mathematics it can not be overlooked creative potential. Creative is not a trait that is only found on an artist or a scientist, but also a part of everyday life. According Grai in Dahlan (2004) is actually knowledge of mathematics that grows, changes, were created (some say discovered) by a human. Through history, the creative individuals forming so-called science is mathematics.

Classical view of mathematical discovery and creation in mathematics is expressed by Poincare (1952) and Hadamard (1945). They discuss creative problem solving math in 4 phases: preparation (become familiar with the matter), incubation stage (let your mind do the problem), stage illumination (when the idea that led to the settlement of a problem is obtained), and stage of verification (checking that the response right). At the time of transfer from stage to stage of incubation illumination often occurs in a way that no unexpected or new way of looking at problems. Like the birth of Fuchcian functions of Henri Poincare, French mathematician, was preceded by incubation for days until a sudden inspiration came during his recreation.

Bishop (in Pehkonen, 1997) says that in mathematics a person needs two kinds of thinking complement each other is creative thinking that is equated with intuition and analytical thinking is equated with the logic. Intuition is associated with visual and logic associated with the verbal.

Krutetskii in Dahlan (2004) equates creativity with math giftedness. According Krutetskii, creativity in solving mathematical problems characterized by the ability of students to formulate mathematical problems independently, are discoveries and new. The ideas are in line with ideas such as flexibility, fluency (Fluency), create new associations, and generate divergent responses related to creativity in general. According Krutetskii flexibility is a key component in the creative ability of students of mathematics at school.

Haylock (1997) made two approaches to recognize creative thinking in mathematics. First by observing the responses of students in solving problems that is cognitive processes considered as characteristic of creative thinking. This approach is considered one of the key cognitive processes in solving mathematical problems creatively is overcome stiffness (Overcoming fixation). The second approach is to determine the criteria for a product which is indicated as a result of creative thinking or called divergent products (divergent products). Various types of questions divergent product can be made in learning. This means not only the learning of arithmetic such as mathematics and statistics but also social sciences such as research methodology. These questions generate answers that can be judged by criteria such as flexibility, originality, and suitability (appropriateness). Understanding fluency (Fluency), flexibility, and originality (new) in general is adapted and applied creativity in mathematics education by Balka

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(1974). In his research Balka asked subjects of the study to propose mathematical problems that can be answered based on available information in a story about real life. By analyzing the responses of subjects, Balka said that Fluency relates to the number of answers or questions generated, flexibility is associated with a number of different categories of questions generated, and authenticity associated with different correct answers or rare among all the answers. Thus, based on research Balka, creativity can actually be explored in math. Problems that are used to measure the general creative thinking ability, was first introduced by American researchers that Guilford (1959) and Torrance in Enden (2006) in the 50s and 60s. In the matter of this kind are given open-ended stories are stories that make a lot of right answers. Mathematical problems that allow students to show divergent or creative thinking process has been developed by researchers (Pehkonen, 1992, Singh, 1992).

Silver in Dahlan (2004) says that learning activities containing solving problems (problem solving) and the submission of a problem (problem posing), including the matter-because to help students to develop their creative abilities. These abilities are Fluency (fluency), flexibility (suppleness or flexibility), and novelty (novelty). Next Silver gives an overview of the link problem solving (problem solving) and the filing of mathematical problems (problem posing) with three components of creativity (see Table 2.1). Stanic and Kilpatrick in Enden (2006) reinforces this view, that problem solving is closely related to the original nature of the activity (count), mathematics, and these activities provide a strong guarantee for students to develop their creative abilities in mathematics and statistics.

Based on the understanding of creativity and its relation to creative thinking in mathematics and statistics and research methodology, the researchers took the understanding that these aspects of creative thinking skills can be assessed in problem solving capabilities include aspects of fluency, flexibility, and elaboration and novelty. The ability of fluency is characterized by the ability to produce a number of correct answers with lots of ideas or allegations. The ability of flexibility is characterized by the ability to provide an alternative way of answer or solution. Ability to clearly specify the answer is called as the ability of elaboration. While the novelty characterized as students' ability to produce new and different answers with the answers of other students in general.

D. Open-Ended Test

Along with the use of open-ended approach since the 70s, the questions open-ended had been developed by teachers in Japan. Problems are widely used in mathematics from elementary through high school (Shimada, 1977). Problem is defined as open-ended questions that have multiple correct answers or have some way to solve the problem correctly. The questions open-ended questions are often used as an assessment because in answering questions like that every student not only asked to show his work but also must explain how he obtained the answer and why it chose the method he uses (Schoenfeld, 1985).

According to Hancock (1995:496) about the open-ended is a matter which has more than one correct way of settlement, have more than one correct answer and students can answer it in its own way without having to follow the process of an existing one. Likewise, Berenson and Garter in Dahlan (2004) identified the problem as a type of open-ended problem solving and have many many ways of settlement. Coxford and Seenmark (in Hancock, 1995: 497) suggested that the value of the questions open-ended, not only in the format and material contained in the matter, but is determined by the procedure, the atmosphere and the solution. Thus based on the above opinions, the most important feature of open-ended question is the availability of the possibility of multiple answers and available flexibility for students to wear a number of methods it deems most appropriate in resolving the matter.

Types of problems used in learning through open-ended approach are the problem that is not routine and are open. While the basis of openness (openness) can be classified into three types, namely: process is open, end products are open, and Ways to develop are open. This means open process is a matter of a given type have various ways of solving the right. The end result is open, the intention is a matter of a given type have a lot of answers (multiple). The purpose of subsequent development of an open way is when students have completed their initial resolve to solve new

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problems by changing the conditions of the first problem (the original). Thus this approach in addition to making students can solve problems but also to develop new problem (from problem to problem).

Answers from open questions are varied and unpredictable. Open questions that are asked can lead to a hypothesis, estimates, opinions expressed, and draw conclusions (Ruseffendi, 1991:256), provides the opportunity for students to gain new insights (new insight) in their knowledge (Hancock, 1995). With this type of open question teachers the opportunity to assist students in understanding and elaborating the ideas of mathematics students as far and as deep as possible (Enden, 2006) and allows students to think more freely, comprehensive without losing the context (Badger (1992:1)

Sawada (in Shimada, 1977) describes five benefits of open-ended problem-solving. Five advantages are:

1. Students participate more actively in lessons and more easily express their ideas. Open-ended problem solving provide a free learning environment, responsive, and supports as many correct answers so that every student has the opportunity to obtain their own answers. Thus students have the desire to know the answers to others, and they can compare and discuss their solutions. Because students are very active then it will bring all students in an interesting conversation in class.
2. Students have more opportunity to wear a comprehensive knowledge and mathematical skills. Because many different solutions, all students can choose their favorite way and create their own solutions.
3. Each student can respond to questions in several different ways according to his own way. Problem of open-ended to give every student the opportunity to find the answers themselves.
4. Giving students experience of reasoning through comparison and discussion in class, students are highly motivated to give the reason of his answers to other students. This event is an opportunity to develop their thinking.
5. There is a rich experience for students to enjoy the pleasure of finding and receiving approval from her classmates. Because the students have their own answer then the student will be interested to know the answers to his friends.

Pehkonen (1997) mentioned that the learning approach that is closely associated with creative ability is an open-ended approach. Feldmann (2001) provide criteria for evaluating student responses in resolving a matter that is open-ended. In the Feldmann criteria provide an assessment of seven aspects of comprehension, fluency, flexibility, originality, elaboration, generalization, and expansion. The seven aspects are related to the components in the ability to think creatively.

In an effort to develop creative thinking abilities of students, researchers chose an open-ended approach in teaching mathematics based on the opinion that the learning approach that can be used to enhance the ability of mathematical creativity in the school environment is an open-ended approach (Hashimoto, 1997, Pehkonen, 1997, Nohda, in Enden 2006). Thus researcher believe that the open-ended approach in teaching mathematics to give students the opportunity to develop creative thinking skills in an optimal mathematical. Creative thinking skills of mathematics that will be measured in this study is understood as the abilities that include the ability of fluency, flexibility, elaboration, extension and generalization.

E. Conceptual Framework / Theoretical Research

Shimada in Enden (2006) stated that open-ended approach to learning is an approach that presents a problem that has a method or solution that more than one. Open-ended approach can be done by combining the knowledge which is and has been studied students in solving problems, the truth of the settlement not only depend on the final result, but also depends on its path in the process of finding that solution.

Open-ended approach is a learning approach that gives students the freedom to think actively and creatively in solving a problem. Therefore this approach was chosen as a means of improving students' creative abilities in solving problems. This statement is based on the opinions

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Heddens and Speer (1995:30) states that open-ended approach is useful to improve the way students think.

Operationally, creativity can be interpreted as reflecting the ability of smoothness, flexibility (flexibility) and originality in thinking, as well as the ability to elaborate, develop, enrich, and refine an idea. As revealed by Munandar (1990) that creative ability is the result of learning is revealed in verbal creative thinking abilities and creative attitudes. Creative thinking skills can be defined as the level of thinking ability of children to discover as much as possible, seberagam possible and relevant, the answer to a problem, flexible, original and detailed, based on data and information available. Problems that used to allow students to show divergent or creative thinking process has been developed by researchers (Pehkonen, 1992, Singh, 1992)

F. Design Research

This research is aimed as a research experiment because the researchers wanted to know the effect of a treatment to a variable. The treatment in this study is learning with open-ended approach, whereas the observed variable is the creative thinking abilities of students. The research design used is the design of the control group pretest-posttest.

This study used college students are students of the Faculty and Teaching UIN Tarbiyah Suska who took a course of discrete mathematics. Students who used the sample were students who took a course that the average class ability homogeneous so that samples can be representative of the population of this research.

G. Instruments and Development

The instrument used to collect data in this study consisted of test creative in discrete mathematics and student attitudes towards learning questionnaire. As for learning activities created teaching materials that accompanied the questions open-ended

H. Procedure Research

The procedure is designed to facilitate research in implementation. The procedures implemented by the following stages:

1. Giving pretest. Pretest results were analyzed to see whether early second-class capabilities are similar or not
2. Provision of treatment.
3. Giving the final test (posttest). Final test given to samples of class experimental and control classes.
4. Giving students the attitude questionnaire. Questionnaires distributed to the subject of an experimental class. The results of student answers are reviewed to see how the response attitude towards learning a new student is given.
5. Comparing the results of final tests.

I. Data Analysis Techniques

Data analysis aimed to gain meaning from the data that has been collected. Analysis of methodology undertaken was as follows:

1. Overview of Creative Ability Students

General description of the creative abilities of students in the form of data creative mathematical ability test scores of students in the experimental group and control group were analyzed descriptively on the basis of percentage.

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Tabel 1 Criteria of Creative Thingking

No.	Criteria	Predicate
1	80% - 100%	High
2	60% - 79%	Middle
3	< 60%	Low

2. Normality Test

Normality test performed to determine whether the data that we can have normal distribution or not. Normality of data needed to determine two different tests mean that will be investigated. Normality test used is a compatibility test (Chi-Square).

3. Homogeneity Test

Homogeneity test intended to determine whether the two distributions on experimental group and control group have the same variance-variance or not. Fcount compared with Ftable or αFdk1, dk2 with stage significance $\alpha = 0.05$ and degrees of freedom dk1 and dk2.

a. Average Test Two Test average to test two hypotheses using t-test formula after learning that the data have normal distribution and homogeneous. (Sudjana, 196:241)

b. Hypothesis Testing The research hypothesis being tested is the null hypothesis (H0) or hypothesis methodology. H0 is the hypothesis which states that the average student scores between experimental classes and control classes did not differ. Hypothesis than the null hypothesis (Ho) is an alternative hypothesis (HA), namely the hypothesis that will be accepted if the null hypothesis is rejected. Null hypothesis and alternative hypothesis can be written as follows:

$$H0: \mu e = \mu k$$
$$HA: \mu e \neq \mu k$$

Where μe is the average score in the experimental group, and μk is the average score in the control group.

J. RESULTS / FINDINGS RESEARCH

1. Data Preliminary Test Results Discrete Mathematics Creative Ability

Experimental class consisted of 37 students and the control class consisted of 37 students. Based on the results of the acquisition of student scores on creative ability, picture Discrete Mathematics students' creative abilities in general between the experimental group and control group can be seen in Table 2 below.

Table 2 Mean and Standard Deviation Scores Initial tests

Class	Discrete Mathematics			
	SMI	Mean	Variant	% of Score Maximum
Experiment	40	12,97	1,485	37,55
Control	40	13,06	1,769	37,35

The table above shows the general cost test score early in the experimental class achieved a mean score of 12.97 (the maximum value 40) or 32.42% of the maximum score. While in the control class obtained a mean score is 13.06 or 32.65% of the maximum score.

To test whether there is a difference of two mean, first tested for normality and homogeneity data. X2 calculation results can be seen in Table 3

Table. 3 Value (Chi-Square) for the Distribution of Initial Test Score Data

Class	χ^2_{hitung}	χ^2_{tabel}	Note
Experiment	2,7235	3,81	Normal
Control	1,5252	3,81	Normal

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According to the table above shows that for both groups is smaller than the data. Thus the distribution of data from both groups has normal distribution. After normality tested, then we tested homogeneity data. The calculation result F between the variance of the control and experimental classes for $\alpha = 0.05$ can be seen in Table 4.

Table. 4 Variance F value between Initial Test Data Distribution

Class	Varians (S^2)	$F = \frac{S^2_{besar}}{S^2_{kecil}}$	F_{label} dk1=38 dk2=38	Value
Experiment	2,118	1,5202	1,744	Homogen
Control	3,980			

Based on the equality of variance test, the results showed that F value is less than the value. This means that the distribution of initial test score data of two groups is homogeneous. From the results of initial test score data analysis of two groups, found that both groups have normal distribution and homogeneous data. Thus, to test the mean difference in the two tests can be performed with parametric methodology. From the calculation is 0.2153 whereas tcount ttable with $\alpha = 0.05$ and df = 72 is 1.9932. This means tcount, <ttable which means that the hypothesis test the null hypothesis accepted. Thus the test methodology can be concluded that both classes have the same diangggap in the early ability students. With this assumption, the treatment of Discrete Mathematics learning with open-ended approach in this study departs from the same class situation.

2. Data Final Test Results Discrete Mathematics Creative Ability

After obtaining Discrete Mathematics learning with open-ended approach, the creative abilities of students re-evaluated on Discrete Mathematics. The ability of students in the experimental class compared with students' ability to control class. Overall percentage of students based on the qualifications of the creative ability of low, medium and high-end test score data can be seen in Table 5 below.

Table 5. Percentage of Students Creative Ability Based on Qualification of Low, Medium, and High on Final Test

Class	Qualification of Creative Thinking	Percentage of Student
Experiment	High (>80%)	35,50
	Medium (60% - 80%)	58, 20
	Low (<60%)	6,3
Control	High (>80%)	2,75
	Medium (60%-80%)	52,42
	Low (<60%)	44,83

As with the analysis of data on initial test scores, data is first checked for normality and homogeneity as a condition of hypothesis testing can be performed with the parametric test methodology. Table 7 shows the result of the acquisition of student scores based on the mean value and standard deviation scores in the two groups studied. According to Table 14, shows that the mean score for Discrete Mathematics in class about the experiment is 30.05 or 75.12% of the ideal maximum score (SMI) 40. The mean experimental group score higher when compared with the mean grade score of 22.25 or 55.625% control of the maximum value.

Table 6 Mean and Standard Deviation Score Final Test

Class	Discrete Mathematics				
	SMI	Mean	Variant	Score Maximum	Score Minimum
Experiment	40	30,05	4,327	38	22
Control	40	22.25	4,3504	33	15

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Furthermore, population data were tested homogeneity. Based on calculations, the value of F from the final test score data consists of two groups. According to the analysis of homogeneity, obtained the value of M is 1.0032 less than Ftable namely 1.744 for $\alpha = 0.05$ level of significance. Thus the final test score data distribution, both groups are homogeneous. Based on test results of normality and homogeneity of data distribution of the final test scores of experimental group and control group were normally distributed and homogeneous. Thus, hypothesis testing can be performed with the parametric test methodology. The hypothesis was tested by using two test mean that using the formula t-test. Based on data analysis tcount ttable is 6.2673 and the value is 1.993 for the level of significance $\alpha = 0.05$ and degrees of freedom df = 72 (from 37 + 37-2).

According to the analysis result that tcount> ttable which means that in testing the null hypothesis (H0), then H0 is rejected. So based on the similarity of two-test showed that average between experimental and control groups there are differences in Discrete Mathematics creative ability caused by the differences of treatment. Discrete Mathematics Views creative abilities based indicators of comprehension, fluency, flexibility, expansion, and generalization of the results of final tests on two groups can be seen in full in Table 21. Overall, the creative ability of each indicator in an experimental class is higher than the control class.

Table 7 Percentage of Students By Category Creative Ability Beginner, Normal, Smart, and Special

Mathematics Creative Ability		% Students who Entry in Category				Percentage difference in the above category Regular
		Beginner	Regular	Smart	Special	
Generalization Ability	Experiment	29,70	35,12	24,35	10,83	35,18
	Control	62,20	37,80	0,00	0,00	
Expansion Capability	Eksperiment	21,03	13,41	46,95	10,91	52,46
	Control	70,27	24,32	2,70	2,70	
Ability Smoothness	Eksperiment	21,42	8,15	32,63	37,78	41,64
	Control	36,13	37,28	26,02	2,75	
Flexibility Ability	Eksperiment	0,05	16,26	40,49	43,20	56,62
	Control	18,91	54,00	21,62	5,45	
Comprehension Ability	Eksperiment	5,4	8,1	45,94	40,54	18,93
	Control	29,74	2,7	18,92	48,64	

Table 7 illustrates aspects of creative thinking abilities of students based on the percentage of students who entered the novice category, unusual, clever and special. Chart 4 presents the difference in the percentage of students belonging to the categories above normal in the experimental class and control class. Percentage of the most striking difference is the ability of flexibility where the experimental group 56.76% higher than the control group. Small percentage difference occurs in the ability different understanding where only 18.92%. Percentage of students viewed by student answers to each question that represents indicators of creative ability. The result of test analysis two the mean for each indicator creative ability average indicate that the difference between the two groups.

3. Discrete Mathematics Student Attitudes toward Learning Course with the Open-Ended

Student views on learning with open-ended approach viewed through the statement number 1, 3, 5, as a positive statement and number 2, 4, 7 as a negative statement. Based on the calculation, the average score of student attitudes towards learning with open-ended approach is 3.675 larger than the mean score of 2.977 which means a neutral attitude of students showed positive attitude towards learning with open-ended approach.

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Indicators of student preference of learning provided through the statement number 1 that "learning is given makes me happy to learn this subject" to get a positive response from students. Based on Table 22 shows that of 37 student 6 student (16.2%) stated strongly agree, 26 students (70.3%) agree, 5 students (13.5%) states did not agree and no one has expressed strongly disagree . While student response to the negative statement number 2 that "learning provided teachers seem boring" attitude of students showed 24 (64.90%) students claimed not agree, 9 students (24%) stated strongly disagree, 3 (8.10%) students agree and 1 student (2.70%) stated strongly agree.

Approval of student learning activity represented by the statement given numbers 6, 8, 10, and 12 for positive statements and number 9 for a negative statement. Questionnaire results showed that students attitudes toward learning activities were positive. Statement number 6 which states that "while studying this subject I dare to ask" got a positive response from students, 25 students (67.6%) agree, 3 students (8%) stated strongly agree, only 9 students (24.4 %) which states do not agree.

Tabel 8 Distribution of Student Attitudes Questionnaire Answers to the Learning with Open-Ended Approach

Sikap	Indikator	No. problem	Students answers				Proposition			
			SS	S	TS	STS	SS	S	TS	STS
Against Learning with open-ended approach	Method	1	6	26	5	0	0,2	0,7	0,14	0,0
		3	5	30	2	0	0,1	0,81	0,05	0,0
		5	10	27	0	0	0,3	0,73	0.0	0,0
		2	1	1	26	9	0,0	0,03	0,7	0,2
		4	1	10	23	3	0,0	0,27	0,62	0,1
		7	1	7	24	5	0,0	0,19	0,65	0,1
	Students' activities	6	3	25	9	0	0,1	0,68	0,24	0,0
		8	11	24	2	0	0,3	0,65	0,05	0,0
		10	7	29	1	0	0,2	0,78	0,03	0,0
		11	3	28	6	0	0,1	0,76	0,16	0,0
		9	1	7	27	2	0,0	0,19	0,73	0,1

K. Discussion

1. Students Creative Thinking Ability

The result of the acquisition of initial test scores and average the results of the analysis of two tests on an experimental class and control class both on discrete mathematics course and the methodology showed that there was no difference in initial ability between the two groups. Therefore, it can be assumed that prior learning is given the treatment both groups had similar abilities based on test methodology. With this assumption, hypothesis testing for the effect of learning with open-ended approach can be based on final test results.

Based on the results of the acquisition of final test scores, obtained that the average scores of students who obtained an open-ended approach to learning is higher than the average score of students who obtain regular learning. The result of test analysis two the mean indicate that the difference between the creative abilities of students who obtained a mathematical learning with open-ended approaches with students who obtain regular learning. Thus, students who obtain an open-ended approach to have learning creative ability of discrete mathematics as well as students who obtained an open-ended approach to have learning creative capabilities of research methodology better than students who received regular learning.

Based on the qualification level of creative abilities of high, medium, and low, found that the percentage of students in the course of discrete mathematics including medium and high grade qualifications obtained on open-ended approach to learning is greater (80%) than the percentage of students in the class who get regular learning (54.05%). Creative mathematical ability differences between the two groups was also strengthened by the differences in the ability of students to every aspect of creative skills such as comprehension skills, fluency, flexibility, expansion, and

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generalization. The data show that for every aspect of ability, students who obtain learning with open-ended approach has a better ability than students who received regular learning.

The difference percentage of students who enter the category of creative ability on the high plain lies in the ability of flexibility, while the lowest difference lies in the ability of understanding. Aspect of the ability of flexibility is an aspect that shows the ability of students in the search for alternative answers or ways of settlement. Learning with open-ended approach allows students to give answers that are not just fixated on what is taught by lecturers. Through this lesson students can develop the ability to generate alternative answers or settlement in resolving the problem. The ability is related to the ability of flexibility is an important aspect of creative ability (Krutetskii, 1976). Thus the open-ended approach to learning enables students to have the ability to better flexibility than the students who get regular learning. This is in accordance with the result that the difference in the percentage of students who entered above category the ordinary creative ability between the two groups, the highest lies in the ability of flexibility.

For the aspect of comprehension ability, the percentage of students who enter the category above the ordinary creative ability in the class achieved control over 60% of students in classroom experiments and achieved over 85% of the students. For the standard class, ordinary learning basically still can give a good effect on the ability of understanding but still modest compared with that class to obtain open-ended approach to learning. Although the lowest percentage differences but based on test results mean difference of the two methodologies shows that there are differences in the ability of understanding between the two groups of students. Thus the overall creative mathematical ability of students who obtained an open-ended learning are better than students who received regular learning. These lessons can give a better effect on creative thinking abilities of students.

2. Student Attitudes toward Learning

Based on the answers of students to student attitude questionnaire, in general, students showed positive attitude towards learning with open-ended approach was given during the learning process. More than 70% of the students showed positive attitudes towards learning open-ended approach.

In an atmosphere of learning with open-ended approach, students feel the joy with the lessons given, motivated to follow the lesson and felt challenged by the questions given during the learning process. Thus, learning with open-ended approach to provide fun learning environment that allows students more flexibility in developing thinking skills, especially ability to think creatively.

L. CLOSING

1. Conclusion

After the different treatment between the two sample groups namely experimental group who received lessons with an open-ended approach and a control group who received normal [illegible] and based on the results of data analysis to test the hypothesis, the conclusions from the findings obtained are as follows:

a. Based on the average value of the final test, the methodology of creative thinking ability of students to obtain research on learning with open-ended approach is better than students who received regular learning.
b. Based on the average value of the final test, discrete mathematics creative thinking sk[illegible] students who gain learning with open-ended approach is better than students who re[illegible] regular learning.
c. In general, students showed positive attitudes towards discrete mathematics and research methodology, towards learning with open-ended approach, and on creative tests given.
d. Conclusion on item a) is also supported by the findings of the creative ability of less qualified, moderate, and high. Percentage of students who entered the medium and high qualification in classes that gain learning with open-ended approach is higher than regular classes to obtain learning.
e. Other findings that support of this research is based on the indicators of creative ability creative abilities such as understanding, flexibility, smoothness, extension and generalization.

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Percentage of students who enter the category above ordinary creative ability in the class who get learning with open-ended approach is higher than students who received regular learning. The greatest difference lies in the ability of flexibility, while the smallest difference lies in the ability of understanding.

2. Suggestion

View and pay attention to the findings and conclusions of research, it is no exaggeration to say that learning with open-ended approach has positive benefits for both lecturers and students. Learning with open-ended approach is based on theoretical framework to enhance the ability to think, based on this research can improve students' creative abilities.

In practice, the open-ended approach requires good timing because in the learning process students are required to always solve the problem without first being given the concept. For students who are familiar with conventional teaching (usual) this requires an adjustment that takes time and sometimes require extra effort to encourage student teachers to participate actively. Thus, effective time management is essential.

Students who used as sample are taken from student and teacher and faculty tarbiyah according to the research that learning with open-ended approach to improve the creative ability of students to faculty tarbiyah mathematics and teacher training. Furthermore, the research can be performed on other faculty students, so the generalization of research results can be widened to include all students.

Future studies can also be done on university students but different characteristics such as the Institute of Technology, college / Diploma, High School which have different characteristics with student faculty tarbiyah in an atmosphere of learning and studying their habits. Thus it will be interesting to examine their creative abilities after receiving learning with open-ended approach.

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