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THE EFFECT OF *PROBLEM POSING* APPROACH TOWARDS STUDENTS' MATHEMATICAL DISPOSITION, CRITICAL & CREATIVE THINKING ABILITY BASED ON SCHOOL LEVEL

Adi Nurjaman[1], Indah Puspita Sari[2]

[1,2]Mathematics Education STKIP Siliwangi, Cimahi, Indonesia
[1]hendrialfianto@gmail.com, [2]chiva.aulia@gmail.com

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Abstract

The background of this study is the school of the new students of mathematics education courses came from grade *high*, *medium* and *low*. Here the writer wants to see how much influence of the school level on new students' critical thinking skills and creative mathematical. The purpose of this study was to examine differences in new students' mathematical disposition, critical & creative thinking ability through the mathematical problem posing approach based on school level (high, medium, low). The method used in this research is the experimental method, with only posttest design. The population of this study is all the students of mathematics education department in Cimahi; while the sample is selected randomly from one college. Then from this chosen college is taken two samples from random class. The instrument of essay test is used to measure students' critical and mathematical creative thinking ability; while non-test instrument is questionnaire of attitude scale. The results show that: 1) based on the school level (high, medium, and low); there is difference in students' mathematical critical thinking ability through problem posing approach. 2) based on the school level (high, medium, and low); there is difference in the students' mathematical critical thinking ability through problem posing approach. 3) based on the school level (high, medium, and low); there is difference in students' mathematical disposition.

Keywords: Critical, Creative, Problem Posing, Disposition

Abstrak

Latar belakang dari penelitian ini yaitu sekolah dari mahasiswa baru program studi pendidikan matematika berasal dari *grade* atas, menegah dan rendah disini penulis ingin mengatahui seberapa besar pengaruh level sekolah terhadap kemampuan berpikir kritis dan kreatif matematik mahasiswa baru. Tujuan penelitian ini adalah menelaah perbedaan kemampuan berpikir kritis, kreatif dan disposisi matematik mahasiswa melalui pendekatan *problem posing* berdasarkan level sekolah (tinggi, sedang, rendah). Metode yang akan digunakan dalam penelitian ini adalah metode eksperimen, dengan desain postes only. Populasi dalam penelitian ini adalah seluruh Mahasiswa program studi pendidikan matematika di Kota Cimahi, sedangkan sampel akan dipilih secara acak satu perguruan tinggi. Hasil penelitian menunjukkan bahwa 1) Terdapat perbedaan kemampuan berpikir kritis matematik mahasiswa melalui pendekatan *problem posing* berdasarkan level sekolah (tinggi, sedang, rendah). 2) Terdapat perbedaan kemampuan berpikir kreatif matematik mahasiswa melalui pedekatan *problem posing* berdasarkan level sekolah (tinggi, sedang, rendah). 3) Terdapat perbedaan disposisi matematik mahasiswa berdasarkan level sekolah (tinggi, sedang, rendah).

Kata Kunci: Kritis, Kreatif, *Problem Posing*, Disposisi

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INTRODUCTION

Criteria of secondary schools according to *Peraturan Bersama antara Menteri Pendidikan Nasional dan Menteri Agama nomor 04/VI/PB/2011 nomor MA/111/2011 tentang Penerimaan Siswa Baru* (Joint Regulation of the Minister of Education and Minister of Religious Affairs number 04 / VI / NT / 2011 number MA / 111/2011 concerning Admission) is having been graduated from SMP (junior high school)/MTs (Islamic junior high school)/ SMPLB (junior high school for the disabled)/ Program Paket B (Package B Program), having a diploma and highest age of 21 years old. In accordance with the theory of Piaget (Budiningsih, 2004), there are four stages of cognitive development, namely:

1) Stage of sensory-motor (0-2 years old)
2) Stage of Pre-operational (2-7 years old)
3) Stage of concrete operational stage (7-11 years old)
4) Stage of formal operational (11 – adult years old)

Based on the theory, it can be said that students' developmental stage at 18 years old and beyond is formal operational stage in which students can work and think effectively and systematically, analyze combination, think proportionally and generalize fundamentally on the kinds of content. When entering college courses, the students are already in the range of 18 – adult years old where the stage of thinking is different from students who are in *concrete operational stage*. STKIP Siliwangi is a higher education institution that embodies the community who want to gain knowledge and continue education to a higher one. Of course, students who enrolled in STKIP Siliwangi come from high school educational background and different areas. School background of new students study math education comes from grade *high*, *medium* and *low*. Here the writers want to see how much influence of school level towards mathematical critical and creative thinking of new students. Sumarmo (Sugandi, 2010) says, "It is important to train students High Level Mathematical Thinking Skills (KBMTT) trained the students, supported by the educational goals of mathematics that has two directions of development that meets the needs of the present and future"

The ability to think critically and creatively of students from diverse secondary school background also gives impact on the mindset of the students themselves, but it is possible if there are students coming from high schools with *lower* school levels in cognitive ability can be equal to those of schools with *high* or *moderate* school level. In addition to cognitive domain, new students' affective ability, such as disposition, will also be studied. One way to find out the influence of students' cognitive and affective ability is by using problem posing approach.

There are several terms related to mathematical thinking (Sumarmo in Hidayat & Hamidah, 2014), among others are *mathematical thinking*, *mathematical abilities*, *doing mathematic*, and *mathematical task*. Students thinking ability is not the same. There are differences in mindset; students from schools with high grade are probably better than those from schools with medium or low grade. Here the writers want to see how much influence of school level towards mathematical critical and creative thinking of new students. Critical thinking according to Johnson (Zetriuslita, Ariawan & Nufus, 2016) is a focused and clear process

used in mental activities such as solving problems, making decisions, persuading, analyzing assumptions, and conducting scientific research. In line with it, Lipman (Zetriuslita, Ariawan & Nufus, 2016) argues, critical thinking is the focus, reasons, inferences, situation, clarity and reviewing. Creative thinking can be defined as a mental activity that is used to build new ideas. According Sumarmo (Choridah, 2013), creative thinking deals with the characteristics as follows:

The characteristics of *fluency* include:

1) Sparking many ideas, many answers, a lot of problem solving, and many questions smoothly.
2) Provide lots of ways or suggestions to do various things.
3) Always think about more than one answer.

The characteristics of *flexibility* are:

1) Generating ideas, answers, or questions varied
2) An issue from diverse viewpoint.
3) Finding many alternatives or different directions.
4) Being able to change the approach or way of thinking.

Skills of sharing within the whole class can be done by pointing couples who volunteer or take turn to report on the work of their group, so about a quarter of couples already have the opportunity to report. In addition to seeing an increase in mathematical critical and creative thinking skills, we can also analyze students' mathematical disposition. Sumarmo (Hidayat & Hamidah, 2014) argues, "Through students' mathematical disposition we can see their confidence, expectations and meta-cognition, passion and serious attention in learning mathematics, persistence in facing and solving problems, high curiosity, and the ability to share opinions with other people". In line with it, Mahmudi (Sugilar, 2013) argues that attitudes and habits of thought would essentially establish and grow a mathematical disposition.

Problem posing approach emphasizes students to form or ask questions based on the information or the given situation so that students can discover and construct their own knowledge. Problem posing approach provides the opportunity for students to be more active in learning activities in the classroom. In addition, students are free to expend their ideas at the time of submitting the matters. There are three stages of problem posing as proposed by Zakaria (Afgani, Saputro & Darmayasa, 2016), namely; 1) identifying whether or not the problem can be solved, 2) identifying the category of content matter, and 3) providing score based on the students' creativity. Problem posing as proposed by Hamzah (2003) are:

1) Formulating simple math problem or reformulation of the problem that has been given through some means in order to solve complex problems.
2) Formulating of mathematical problems related to the terms of the problem to be solved in order to find alternative solutions that are relevant.
3) Formulating or asking a question of mathematics of a given situation, whether filed before, during or after troubleshooting.

Silver and Cai (1996) classify three cognitive activities in manufacturing questions as follows.

1) *Pre-posing solution*, which is making items based on circumstances or information provided
2) *Within-posing solution*, i.e. manufacturing or formulating items that are being resolved. Making items is intended as a simplification of the problem being solved

3) *Post-Solution Posing*. This strategy is also called the strategy "find a more challenging problem." Students modify or revise objectives or conditions of items that has been completed to generate more challenging new problems. Making such problems refers to a strategy of "what-if-not ...?" Or "what happen if ...".

Based on the above description, the authors want to investigate how much influence of students' previous school level towards their mathematical critical and creative thinking ability. Therefore, the authors take the title The Effect of *Problem Posing* Approach Towards Students' Mathematical Disposition, Critical & Creative Thinking Ability Based On School Level.

Based on the background above, the question for this research is whether or not there are differences in students' ability to think critically, creatively, and disposition through mathematical problem posing approach based on school level (high, medium, low)?

The purpose of this study was to examine differences in students' the ability to think critically, creatively and disposition through the mathematical problem posing approach based on school level (high, medium, low).

METHOD

The method used in this research is the experimental method, with only posttest design. The population in this study is all students of mathematics education courses in Cimahi, while samples are selected randomly at one college. Then from this chosen college is taken two samples from random class. The instrument of essay test is used to measure students' critical and mathematical creative thinking ability; while non-test instrument is questionnaire of attitude scale and observation to see the students' confidence, expectations and meta-cognition, passion and serious attention in learning mathematics, persistence in dealing with and solving problems, high curiosity, and the ability to share their thoughts with others.

The method used in this research is the experimental method, with only posttest design. The design of this research is:

A X O
A X O

In this study will also be given scale post to examine the learning with problem posing approach to the students' position with the following design:

Notes:

A: The research subjects selected randomly.

O: Posttest (test of mathematical disposition, critical & creative thinking ability).

X: Treatment of learning with posing problem approach.

RESULTS AND DISCUSSION

Results

Table 1. Recapitulation of Results of Research

Ability		Experimental Class				Control Class			
		Pretest	%	Posttest	%	Pretest	%	Posttest	%
Matemathical Critical Thingking	$\bar{x}$	6.93	34.65	16.64	83.20	6.48	32.40	15.57	77.85
	s	1.47		2.02		1.27		1.73	
Matemathical Creative	$\bar{x}$	5.69	28.45	15.52	77.60	5.71	28.55	14.57	72.85
	s	2.00		1.77		1.70		1.71	
Disposition	$\bar{x}$			72.28	60.23			69.45	57.87
	s			10.97				7.31	

Notes: SMI test of matemathical critical = 20
SMI test of matemathical creative = 20
SMI scale of mathematical disposition= 120

Table 1 above shows that in experimental group, the students' pretests mean for the category of their mathematical critical thinking ability is 6.93 and the control group's mean is 6:48. It is seen that the deviation of mean for the category of mathematical critical thinking ability of both classes is 0.45. So, it can be said that the mathematical critical thinking ability of both classes is not much different. This means that before the treatment, both classes have the same mathematical critical thinking ability. Experimental class' standard deviation of pretest for their mathematical critical thinking ability is 1.47, while control class' is 1.27. The difference between the two groups is 0.20, which means the experimental group or the control group had a relatively equal distribution of data. Furthermore, in experimental group, the students' posttests mean for the category of their mathematical critical thinking ability is 16.64 and control class' is 15.57 which shows significant difference of 1.07; meaning that there is big difference between mathematical critical thinking ability in both groups. If the mean of the two groups is changed in terms of percentage, the percentage of experimental class' pretest mean score for their mathematical critical ability is 34.65% and the control group's mean is 32.40%, which means that the percentage of mathematical critical thinking abilities for both groups is almost the same. Percentage of score is obtained from the mean score division of the ideal score multiplied by 100%. But after being treated, the percentage of students' posttest mean for their mathematical thinking ability in experimental class and control class becomes 83.20% and 77.85%, which means the percentage of mathematical critical thinking abilities in experimental group is higher than the percentage of the control group

Posttest Data Analysis of Students' Mathematical Critical Thinking Ability

Table 2. Results of Test of Two-Way ANOVA for Students' Mathematical Critical Ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Class	.836	1	.836	1.099	.298
School level * Class	4.877	2	2.438	3.204	.046

Based on Table 2, the probability is 0.000 for 0.000 < 0.05 then H_0 is rejected. Thus, by using a significance level of 0.05 then we can conclude that there are differences in students' mathematical critical thinking ability based on school level. The probability based on experimental and control class is 0298, for 0.298 > 0.05 then H_0 is accepted. Therefore, by using significant level 0.05 it can be concluded that there is no difference for both experimental and control group in the category of their mathematical critical thinking ability. The interaction between the classroom and school level generates probability of 0.046 > 0.05. So, by using significance level 0.05, it can be inferred that there is interaction between the experimental class and control class with the school level.

Results of Analysis of Students' Mathematical Creative Ability

Table 3. Results of Test of Two-Way ANOVA for Students' Mathematical Creative Thinking Ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Class	.241	1	.241	.422	.518
School level * Class	2.073	2	1.036	1.813	.170

Based on Table 3, the probability is 0.000 for 0.000 < 0.05 then H_0 is rejected. Thus, by using a significance level of 0.05 then we can conclude that there are differences in students' mathematical creative thinking ability based on school level. The probability based on experimental and control class is 0518, for 0518 > 0.05 then H_0 is accepted. Therefore, by using significant level 0.05 it can be concluded that there is no difference for both experimental and control group in the category of their mathematical creative thinking ability. The interaction between the classroom and school level generates probability of 0.170 > 0.05. So, by using significance level 0.05, it can be inferred that there is no interaction between the experimental class and control class with the school level.

Results of Analysis of Students' Mathematical Disposition Ability

Table 4. Results of Test of Two-Way ANOVA for Students' Mathematical Disposition Ability

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Class	.200	1	.200	.005	.946
School Level *	2434.861	2	1217.431	28.374	.000

Based on Table 4, the probability is 0.000 for 0.000 < 0.05 then H_0 is rejected. Thus, by using a significance level of 0.05 then we can conclude that there are differences in students' mathematical disposition ability based on school level. The probability based on experimental and control class is 0946, for 0946 > 0.05 then H_0 is accepted. Therefore, by using significant level 0.05 it can be concluded that there is no difference for both experimental and control group in the category of their mathematical disposition ability. The interaction between the classroom and school level generates probability of 0.000 > 0.05. So, by using significance level 0.05, it can be inferred that there is interaction between the experimental class and control class with the school level.

Discussion

The purpose of this study was to examine differences in new students' mathematical disposition, critical & creative thinking ability through the mathematical problem posing approach based on school level (high, medium, low). In general, the implementation of learning by problem posing approach goes as expected. Some of the things that researchers have found in the implementation of research on learning by problem posing approach include:

1) Firstly, researchers give directions to the students about learning to be carried out in accordance with the schedule of events organized. On this occasion, researchers also convey the subject to be examined with a question and answer, recalling previous relevant materials.
2) At the second meeting, the researchers Inform learning objectives in accordance with the basic competencies and approaches that will be used in learning.
3) At its next meeting, the researchers present the learning material with appropriate strategies and try to always engage the students in activities
4) At the first and second meeting, the students are still not used to follow each step of the preliminary activities.
5) At this meeting, the researchers provide opportunities for the students to ask things that are still not clear
6) Engaging the students in problem posing approach by allowing them to create questions of a given situation. The activities can be done in groups or individually.
7) At this stage, the researchers allow the students to solve problems made by their own.
8) In the final stage, the researchers direct the students to make inferences from the material already learned.

There is no difference for initial mathematical critical thinking ability in both classes. After being given the treatment of learning through problem posing approach, the mean score of experimental group for their mathematical critical thinking ability is classified as high category while control group's is middle category.

The differences in mathematical critical thinking ability based on the school level use Two-Way ANOVA. Probability of 0.000 for $0.000 < 0.05$ then H_0 is rejected. Thus, by using significance level of 0.05 then we can conclude there are differences in the ability of mathematical critical thinking based school level. Based on the probability of class experimental and control, namely 0298, for $0.298 > 0.05$ then H_0 is accepted. Therefore, by using significance level of 0.05 then we can conclude there are no differences in the ability of mathematical critical thinking for the experimental class and control class. The interaction between the classroom and school level generated probability of $0.046 > 0.05$. So, by using significance level 0.05, it can be inferred that there is interaction between the experimental class and control class with school level.

Equivalent initial mathematical creative thinking ability. After the experimental group was given problem posing learning and the control group was given conventional learning, the mean score for mathematical creative ability in each group increased. There is no difference for initial mathematical creative thinking ability in both classes. After being given the treatment of learning through problem posing approach, the mean score of experimental group for their mathematical creative thinking ability is classified as high category while control group's mean score is in middle category.

The differences in the ability to think creatively based on school level by use Two-Way ANOVA. Probability of 0.000 for 0.000 < 0.05 then H_0 is rejected. Thus, using a significance level of 0.05 then we can conclude that there are differences in mathematical creative abilities based on the level of the school. Based on the probability of class experimental and control, namely 0.518, for 0.518 > 0.05 then H_0 is accepted. Therefore, by using significant level 0.05, it can be inferred that there is no different mean score of mathematical creative thinking ability for the experimental class and control class. The interaction between the classroom and school level generated probability of 0.170> 0.05, so by using 0.05 significance level, it can be concluded that there is no interaction between the experimental class and control class with school level.

CONCLUSION

It can be concluded that there is different ability to think critically, creatively and disposition possessed by the students through the mathematical problem posing approach based on school level (high, medium, low).

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