

# The impact of problem based learning toward the students' creative thinking in complex function subject

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**Abstract.** The research was carried out to find out the impact of problem based learning toward the students' creative thinking in complex function subject. Experiment research was carried out to The population of this study was the fifth semester students of Mathematics Education Study Program in 2018/2019. The result showed that the achievement of students 'creative thinking that joined in problem-based learning class was better than the ones from conventional learning class of the drill method.

## 1. Introduction

Mathematics is a difficult subject and requires a lot of time to solve it. Many reasons state that mathematics is difficult especially in solving problems. People tend to prefer lessons that are easily predictable and do not need to use a lot of ways to solve a problem. Mathematics is a lesson whose materials are calculating, analyzing, and evaluating a problem, one of which is through creative thinking.

Creative thinking is a form of high-level thinking [1-2]. Related to creativity, Johnson [3] stated that creativity was basically an emotional process, which required elements of irrationality and emotion in order to improve intellectual processes. Furthermore, in Hidayat, Wahyudin and Prabawanto [4] states that creative thinking is a creative process, namely feeling difficulties and information gap problems, missing elements and disharmony, defining problems clearly, making hypotheses and possible improvements, re-testing or even redefining problem and finally communicating the results. If this ability develops, students will be able to produce new ideas, different perspectives, and be able to solve the chain of problems; moreover they can recombine ideas or see new correlation among the ideas [5].

One of the advantages Problem-based learning is showing the students that each subject is basically a way of thinking and something that must be understood by the students, and there are number of activities that must be done by students including active thinking and communication. The initial activity of this learning is to orient students towards the problem, by introducing students to the problem, students will be able to understand and interpret mathematical ideas. Furthermore, students are organized to be able to connect mathematical ideas according to the conditions of the problem and use various strategies to solve the problem. The next step students are guided to solve the problem in detail and coherently according to mathematical procedures. In addition, students must also be able to develop and present solutions of problems that are different from the usual ones. The final step is analyzing and evaluating, at this stage students are expected to be able to draw conclusions from the completion process either in written, verbal, or in other visual forms smoothly. On the contrary, in conventional learning of drill method applied at school after the teacher delivers the material, the



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students are then given routine exercises. Although in practice the teachers provide guidance, yet the purpose of this learning is to increase the students' skill rather than the ability to think creatively and mathematically. Due to its easiness, this learning model can survive until now even though it is not included in the learning approach of the 2013 curriculum.

## 2. Method

The method used in this study is the method of documentation, observation, and testing. The population of this study was the fifth semester students of Mathematics Education Study Program in 2018/2019, which consisted of 3 classes namely class A, class B, and class C. While the sample of this study used cluster random sampling technique, which was taking sample members in the form of groups from the population randomly. The sample was taken two classes randomly, one class as an experimental class that problem-based learning implemented, while one other class as a control class that was given conventional learning of the drill method.

## 3. Result and Discussion

### 3.1. Analysis of Preliminary Data

The preliminary data used in this study were in the Mid Test score of mathematics subject in first Semester. Before further research procedures were carried out, the preliminary data analysis was carried out which aimed to test both sample classes from the same initial ability or did not use the homogeneity test. The results of the homogeneity test using the SPSS 23.0 program (Table 1).

**Table 1.** Test of homogeneity of variances

Levene Statistic	df1	df2	Sig.
0.305	1	48	0.583

Table 1 show the significance level of the two sample classes was 0.583, which meant that it was greater than 0.05 ( $\alpha$  value) or  $H_0$  was accepted. In other words, the data of Mid test score in the academic year of 2018/2019 showed that the two sample classes were homogeneous or the two sample classes came from the same initial ability, so that when they were given different treatments and different results were occurred, the differences were the result of different treatment.

### 3.2. Analysis of the Test Instruments

Analysis of the test instruments was carried out after the tests were conducted in the classes except the sample class, class C. This was due to the class C had learned about Limit and Derivative material. The results of the analysis were as followed.

The validity of each item was tested using the SPSS 23.0 program with product moment correlation and the question was stated to be valid if the significance value indicated  $\text{Sig.} \leq 0.05$ . The test results were presented in the following Table 2.

**Table 2.** Results of validity analysis of evaluation test questions

Question Number	Sig.	Criteria
1	0.001	Valid
2	0.001	Valid
3	0.002	Valid

After the questions were tested for the validity, the next step was to test the reliability using the SPSS 23.0 program with Cronbach's alpha and the questions were categorized to be reliable if the cronbach's alpha coefficient was greater than 0.70.

Based on data analysis, the cronbach's alpha coefficient showed 0.764. As the Cronbach's Alpha coefficient of the two test instruments was greater than 0.70, the test instrument was reliable. Since all the items of the test were valid and reliable, they were then used as evaluation tests to obtain the final data from the experimental and control classes.

### 3.3. Analysis of Final Data

The results of evaluation tests from the experimental class and the control class were presented in Table 3.

**Table 3.** Results of evaluation test in experimental class and control class

Group of Data	N	Max Score	Min Score	Mean	Standard of Deviation
Experimental Class	25	80	30	54.294	74.81
Control Class	25	74	43	49.412	48.33

Table 3 show that the average score of the students' creative thinking ability that followed problem-based learning (experimental class) in the post-test reached 54.294. This was indicated by the results of observations during the research, where in the first stage of problem-based learning application the students were oriented to the problem of complex limit functions, the active students asked questions because they had obtained limit material before in the subject of Differential Calculus and Multivariable Calculus. The difference was in the type of function but the concepts or definitions of limits were both the same. Then in the second stage, students were organized to study. In this stage, the students were divided into six groups. In the third stage, the students were guided to carry out individual and group investigations related to the problem of the limits of complex variable functions. In this stage, group work raised an investigation process to solve problems. The problems were presented in the form of mathematical questions displayed on the LCD screen.

The students had a discussion by expressing their opinions, so that they were more creative in finding ideas for solving the problems and they were enthusiastic in overcoming the presented problems. The results of students' work were based on the indicators of creative thinking ability, namely fluency (working using two ways with different concepts). The work on that overview was in accordance with the intended indicator that was the students used the concept of a broad triangle when they were asked to work in other ways. The next stage was the fourth stage; developing and presenting the work. Here the students were guided in order to achieve the expected solutions as the result of discussion, then the representatives of each group presented the results of the discussion in front of the class. After the results of the discussion were presented, the next stage was the fifth stage, which is analyzing and evaluating the problem solving process. In this stage, the students from other group members were given the opportunity to analyze the results of the discussion, so that the students who think actively would defend their opinions. Then, the students and the lecturers evaluated the results of the discussion to get the final results according to the concept [6-7].

Furthermore, based on Table 4 it could be seen that the average score of students' creative thinking who followed conventional learning of the drill method (control class) in the post test reached 49.412. This was shown from the results of observations during the study that the students were less enthusiastic in overcoming the presented problems. In addition, the students also had not shown the ability of creative thinking, for example when they were given routine practices, they were still confused in using mathematical concepts so that they only stuck on an old concept commonly used. The results of students' work in the control class were based on indicators of creative thinking ability, namely fluency (working using two ways with different concepts). Both had not stimulated the ability of creative thinking with indicators of fluency as only one method was used [8-10].

## 4. Conclusion

Based on the research results and discussion, the conclusions can be drawn as The average score of students' creative thinking who joined in problem-based learning class in the post test reached 54.294.

The outcome of students' creative thinking in the class using conventional learning of the drill method indicated the average score of 49.412 in the post test. Furthermore, based on the hypothesis test through independent right-hand test samples, a significance value of 0.0395 was obtained which was less than the alpha value of 0.05. The test results showed that the achievement of students' creative thinking that joined in problem-based learning class was better than the ones from conventional learning class of the drill method.

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