

# Development of basic school mathematic teaching materials to improve the analysis ability of primary teacher education students on innovative learning models

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**Abstract.** The background of this study is the lack of ability of PGSD Siliwangi PGSD students to analyze innovative mathematics learning models. The purpose of this study was to improve the analysis and implementation skills of PGSD students regarding creative mathematics learning. The specific target to be achieved in this study is the formation of appropriate and efficient teaching materials in the implementation of elementary school mathematics learning internships. This study uses a quantitative approach and uses a quasi-experimental method. The population in this study were primary teacher education students of IKIP Siliwangi, while the sample consisted from 70 students are divided into 35 students in class A1 class of 2017 as an experimental group and 35 most students in class A2 class 2017 as a control group. The instrument used consisted of a written test regarding learning models, innovative, observation, and interviews. The results show that there is an increased ability to analyze student by using model-model innovative learning better than usual learning.

## 1. Introduction

Primary School Teacher Education students are required to become professional elementary school teachers. There are four teacher competencies that must be instilled in prospective elementary school teacher students, including pedagogic, social, professional, and personality competencies [1]. Teacher competency is related to the authority to carry out their duties, in this case using the field of study as learning material which acts as an educational tool, and pedagogical competence related to the function of the teacher in paying attention to the learning behavior of students [2].

In equipping PGSD students, we must provide learning about innovative learning models so that later, when they go to elementary school, they are adept at implementing innovative learning models. This will be the principal capital in teaching in elementary schools because innovative learning will spearhead the achievement of basic competencies in all subjects, including mathematics. In mathematics learning the teacher usually uses conventional learning is direct instruction, explaining in front of the class, students work on the problem and the teacher corrects [3–5]. It always goes like that; students are only described and are not allowed to discover mathematical concepts themselves. This is due to a lack of understanding and experience in implementing innovative mathematical learning models. To improve students' ability to analyze and implement innovative mathematics learning models, we must design effective and applicable teaching materials in mathematics internships.

The students 'analytical skills are students' ability to explain existing relationships and combine elements into one unit [6]. This analytical ability requires students to be able to understand and re-explain the relationships that exist in the steps of mathematics learning. In each learning model, there



are steps and characteristics in implementing the model. In this case, the student must be able to explain the actions of the learning again, identify the learning model, and find out the differences between each learning model.

Innovative mathematics learning can be done by applying mathematical models such as contextual learning, discovery learning, and problem-based learning. Contextual learning is a learning concept that can help teachers associate material taught with real-world situations and encourage students to make connections between their knowledge and their application in their lives as family members and society [7]. A distinctive feature of contextual learning that must stand out in the implementation of learning, one of which the teacher associates material with real situations in order to encourage students to relate directly to the knowledge that he has and can apply it in daily life [8,9]. Discovery is a way from the unknown to the known by the learners themselves [10]. This opinion means that discovery is a way in which those who do not know become aware of their way. The development was simply a way that someone did to find out things they did not know beforehand. If previously we did not know what integers are, then when we find out about numbers and ultimately find out what integers are in our way that is called discovery. Problem Based Learning is progressive active learning and learning centered on unmeasured problems that are used as a beginning in the learning process [11]. Problem Based Learning as learning obtained through a process towards understanding the resolution of a problem [12,13].

The specific objectives in this study are identifying concepts, strategies, teaching materials, approaches, evaluations, and media used by lecturers in mathematics internships, the availability of teaching resources for mathematics internships and the availability of mathematics apprenticeship textbooks.

## 2. Method

This study uses quantitative and qualitative approaches using quasi-experimental methods and descriptions. The quantitative approach is used as an approach in this study because the purpose of this study is to measure many variables, test many hypotheses, and conclude questions about behavior, experience or characteristics of a phenomenon. The research method used is the experimental method. This method aims to see the causal relationship (causal) between one or several variables, from a treatment (treatment) that is tried on objects, certain conditions, by looking at the results of the treatment. Then the effects of the procedure are distinguished with results that are not treated anything (control). Researchers research by selecting a treatment on the subject being observed and choosing with the same object / without not given any treatment.

The steps of the research activities will be carried out as follows (a) formulate problems, develop an assessment of the ability to analyze and implement innovative mathematical learning models, (b) provide an overview of the research activities to be carried out, (c) reflect and discuss various learning activities, (d) arrange instruments by conducting field validation and expert validation, (e) implementation of learning activities using teaching materials, (f) evaluation of learning activities using teaching materials with written tests, observations, and documentation carried out at the pretest, implementation, and posttest, and (g) drawing conclusions from the results of analysis and processing of data obtained in this study.

The population in this study were all 6th-semester PGSD students. While the sample in this study were 70 PGSD students divided into two classes, the location of this research that will be used is the IKIP Siliwangi PGSD Study Program. The variables observed or measured in this study was the ability to analyze the innovative mathematical learning model of PGSD students that were found at the time of pretest, implementation, and during the posttest.

## 3. Result and Discussion

### 3.1 Result

The following are the results of the descriptive statistics of the pretest and posttest scores the ability to analyze the innovative mathematical learning model of the experimental class is presented in table 1.

**Table 1.** Recapitulation of the Ability to Analyze the Innovative Learning Model Score (N=35)

Statistic	Learning Using Teaching Materials			Learning Ordinary		
	Pretest	Posttest	N-Gain	Pretest	Posttest	N-Gain
$\bar{x}$	55,69	75,69	0,50	63,44	64,73	0,03
%	55,69	75,69	49,89	63,44	64,73	3,17
<b>Sd</b>	19,34	17,08	0,22	18,49	16,74	0,18

Based on the data in table 1, the number of samples is an experiment of 35 students. On the average posttest score, the ability to analyze the innovative mathematical learning model of the experimental class has an average value of 75.69 and is higher than the average pretest score which only has an average value of 55.69. The average difference between the two scores is 20.00, which is converted into the percentage of posttest score achievement is 75.69% or 20.00% higher than the achievement of the pretest score which only gets 55.69%. The difference in achievement between the pretest score and posttest score already looks high.

On the average posttest score, the ability to analyze innovative mathematics learning models in the control class has an average value of 64.73 and is higher than the average pretest score which only has an average value of 63.44. The average difference between the two scores is 1.29, which is converted into the percentage of achievement of posttest scores is 64.73% or 1.29% higher than the achievement of the pretest score, which only gets 63.44%. The difference in achievement between the pretest score and posttest score already looks low.

On average gain scores, the ability to analyze innovative mathematics learning models in the experimental class has an average gain of 0.50 and is higher than the gain average of the control class which only has an average value of 0.03. The average difference between the two classes is 0.47. The maximum gain score in the control class is 1.00, while the maximum gain score in the experimental class is 0.93. The minimum gain score in the control class is -1.31, while the minimum gain score in the experimental class is 0.15. The difference in gain scores between the experimental class and the control class is relatively moderate so that the two categories have gain scores the ability to analyze innovative early mathematics learning models that are relatively different. Gain score data processing ability to interpret this innovative mathematical learning model begins with how to do a normality test in the experimental class and the control class.

The data processing of the pretest and posttest scores the ability to analyze innovative mathematical learning models in this experimental class begins with the way of conducting a normality test. The purpose of the normality test is to see the data obtained is normally distributed or not. If normal, it can be continued on the homogeneity test to see the uniformity of variance [14], and the last test was carried out on the difference in the average of the two classes to see the differences in the initial abilities of the two classes. An explanation of data processing can be presented in table 2.

**Table 2.** Recapitulation of Statistical Tests Score Pretest Ability to Analyze Innovative Mathematics Learning Models

Class	Statistical Test Results			Information
	Normality	Homogeneity	T test	
Experiment	0.065	0.557	0.916	There is no difference in posttest scores in the ability to analyze innovative mathematics learning models in the experimental class and the control class
Control	0.200			
decision	Normal	Homogenous variance	$H_0$ rejected	

Based on the Table 2 shows that the pretest score of the ability to analyze innovative mathematics learning models in the experimental class for the Kolmogorov-Smirnov normality test has a P-value score (Sig) = 0.065 > 0.05 so that  $H_0$  is accepted at the significance level = 0.05. That is the pretest score of the ability to analyze the innovative mathematics learning model of the experimental class is

normally distributed. The pretest score of the ability to analyze the innovative mathematics learning model of the control class for the Kolmogorov-Smirnov normality test has a P-value score (Sig) = 0.20 > 0.05 so that  $H_0$  is accepted at the significance level = 0.05. That is the pretest score of the ability to analyze the innovative mathematical learning model of this control class is normally distributed. Based on the results of the Kolmogorov-Smirnov normality test, the pretest score of the ability to analyze innovative learning models is normally distributed. So that data processing can be continued with homogeneity tests. The table shows that the results of the homogeneity test of the pre-test score ability to analyze innovative mathematics learning models of the students of the two classes have P-value (Sig)  $0.577 \geq \alpha = 0.05$  and thus  $H_0$  is rejected at the significance level  $\alpha = 0.05$ . That is the pre-test score of the ability to analyze innovative mathematics learning models in the control class and homogeneous variance experiments. The table shows the results of the t-test with the P-value score (Sig. 2 tailed) = 0.975 at the significance level  $\alpha = 0.05$  because it was tested in two directions so that  $0.916 > 0.05 = \alpha$ , the condition  $H_0$  is accepted, there is no difference the significant pretest score was the ability to analyze innovative mathematics learning models of students in the control class and the experimental type.

**Table 3** Recapitulation of Test Statistic Scores Posttest Ability to Analyze Innovative Mathematics Learning Models

Class	Statistical Test Results			Information
	Normality	Homogeneity	T test	
Experiment	0.200	0.465	0.000	There are differences in posttest scores in the ability to analyze innovative mathematics learning models in the experimental class and the control class
Control	0.177			
decision	Normal	Homogenous	$H_0$ accepted	

Table 3 shows that the posttest score of the ability to analyze the innovative mathematics learning model of the experimental class for the Kolmogorov-Smirnov normality test has a P-value score (Sig) = 0.200 > 0.05 so that  $H_0$  is accepted at the significance level = 0.05. That is, the pretest score of the ability to analyze innovative mathematics learning models of this experimental class is normally distributed. The posttest score of the ability to analyze the innovative mathematics learning model of the control class for the Kolmogorov-Smirnov normality test had a P-value score (Sig) = 0.177 > 0.05 so that  $H_0$  was accepted at the significance level = 0.05. That is the posttest score of the ability to analyze the innovative mathematical learning model of this control class is normally distributed. Based on the results of the Kolmogorov-Smirnov normality test, both scores on the ability to analyze innovative mathematical learning models in the experimental class were normally distributed. So that data processing can be continued with homogeneity tests. The table shows that the results of the posttest score homogeneity test the ability to analyze innovative mathematical learning models both classes have P-value (Sig)  $0.463 \geq \alpha = 0.05$ , and thus  $H_0$  is rejected at the significance level  $\alpha = 0.05$ . That is, the pre-test score of the critical thinking ability of the experimental class and control is homogeneous. The table shows the results of the t-test with the P-value score (Sig. 2 tailed) = 0,000 at the significance level  $\alpha = 0.05$  because it is tested in two directions so 0,000 divided by 2 results =  $0,000 < 0.05 = \alpha$ , such conditions  $H_0$  is rejected that is, there is a significant difference in the posttest score in the ability to analyze innovative mathematics learning models in the experimental and control classes.

Table 4 shows that the gain score of the ability to analyze innovative mathematics learning models in the experimental class for the Kolmogorov-Smirnov normality test has a P-value score (Sig) = 0.057 > 0.05 such that  $H_0$  is accepted at the significance level = 0.05. That is, the gain score of critical thinking ability of the experimental class is normally distributed. The table shows that the gain score is the ability to analyze the innovative mathematics learning model of the control class. There is also the result of the normality score gain test the ability to analyze the innovative mathematics learning model of the control class for the Kolmogorov-Smirnov normality test has a P-value score (Sig) = 0.00 < 0.05

such that  $H_0$  is rejected at the significance level = 0.05. That is, the gain score is the ability to analyze the innovative mathematical learning model of this control class with the nonnormality distribution.

**Table 4.** Recapitulation of Statistical Tests N-Gain Score Ability to Analyze Innovative Mathematics Learning Models

Class	Statistical Test Results			Information
	Normality	Homogeneity	T test	
Experiment	,057			There is a difference in the N-gain Score ability to analyze innovative mathematics learning models in the experimental class and the control class
Control	Normal ,000 nonnormal		,000  $H_0$ accepted	

Based on the results of the Kolmogorov-Smirnov normality test the experimental class has a gain score the ability to analyze innovative mathematical learning models that are normally distributed, while the control class has a gain score the ability to analyze innovative mathematical learning models that are nonnormality distributed. So that data processing can be continued with Mann Whitney nonparametric tests. Table 4 shows the results of Mann Whitney difference in average gain ability to analyze innovative mathematics learning models in the experimental class and control class with a significance level of  $\alpha = 0.05$  with a P-value score (Sig. 2 tailed) = 0,000 at the significance level  $\alpha = 0,05$  because it is tested in one direction so that 0,000 divided by 2 results = 0,000 < 0,05 =  $\alpha$ , such conditions  $H_0$  is rejected meaning, there is a significant difference in gain score ability to analyze innovative mathematical learning models in the experimental class and control class.

## Discussion

Learning in experimental class and control class are done six times in mathematics internships. At each student meeting directed to learn an innovative mathematical learning model, among others, Contextual Teaching and Learning, Recovery Learning, Inquiry, Realistic Mathematics Education, Problem Based Learning, and Project-Based Learning. After that, the student is directed to study examples of Learning Implementation Plans from each model. In this RPP, the main focus is learning steps that are by the syntax of each learning model. After learning RPP, students are invited to pay attention to learning videos from each learning model.

In the study, initially, students in control and experimental classes were given pretensions to find out their initial abilities in analyzing. The experimental class is given treatment with innovative learning models, while the control class is given treatment with learning as usual. Furthermore, at the end of the learning, students in control and experimental classes were given posttest to see whether there were achievement and improvement in analytical skills in the experimental class better or not compared to the control class. After processing the data, it turned out that the analytical skills in the experimental class were better after innovative learning was applied compared to the control class. One of them is in line with research on the RME approach that has been conducted by Murni [15] who said that the achievement and improvement of mathematical creative and creative thinking skills of students who learn using the RME approach are better than students who use ordinary learning.

In addition, Muhammad [16] in his research stated that discovery learning models could improve students' mathematical and self-confidence abilities as well as better than students who get conventional learning. Likewise with the research conducted by Rais [17] and stated that the Project-Based Learning model developed contains learning material, learning scenarios, learning guidelines for the Project-Based Learning model, and student worksheet formats that have met the acceptance criteria, which cover aspects: usability, accuracy and feasibility, and there are differences in the average score of the pretest and posttest for knowledge of machine design. The average pretest score is 62.3, and the posttest score is 81.58. The difference in the average score of this score shows a significant increase in terms of student academic achievement.



Also, research Siagian & Nurfitriyanti [18] states that there is a significant effect between the results of Inquiry learning methods and the results of conventional learning methods on students. Likewise, with the learning model Contextual Teaching and Learning researched by Ruqoyyah [19] who said that the achievement and improvement of mathematical communication skills of students who learn using the CTL approach are better than students who use ordinary learning. In line with the learning model above, in [20] opinion states that there is an increase in student learning outcomes using the Problem Based Learning learning model. From the statement above, it can be concluded that the use of innovative learning models can improve student learning outcomes and be better than those using ordinary learning.

### Conclusion

Based on data analysis, the results show that there is an increased ability to analyze student by using model-model innovative learning better than usual learning.

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