Developing Mathematical Modeling Ability Students Elementary School Teacher Education through Ethnomathematics-Based Contextual Learning

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Abstract

This study focuses on the development of mathematical modeling capabilities students Elementary School Teacher Education through ethnomathematics-based contextual learning terms all students, educational backgrounds and cultural origins of the research subject is semester students 1, 3, 5, and 7 academic year 2012/2013 at a State University in West Java and Banten, in the development of teaching materials prepared by the method of didactical design research (DDR). Were tested in the experimental stage. The instrument used a posttest. Experimental study with a posttest only control group design was used 135 study subjects 1st semester students were divided into 3 groups. 2 The experimental group made teaching DDR, non-DDR , and 1 control group.

Mathematical modeling capabilities among students who get ethnomathematics-based contextual learning (DDR and non-DDR) better than students who do not. There is interaction between the model of learning and cultural origin groups in the mathematical modeling capabilities, there is no interaction in group educational background.

Keywords: Contextual Learning-Based Ethnomathematics, Mathematical Modeling Ability, Didactical Design Research.

1. Introduction

Learning of mathematics in primary school teaching is still dominated by the expository method, one-way and the students only see his lecturer explained without active students in finding their own concept will understand. The diversity of student educational background elementary school teacher education students, that is, they come from various majors, good science, social studies and language became one of the inhibiting factors in the students attending mathematics. Students still having trouble understanding the math courses he considered the most difficult and unpleasant. Expression, communication and mathematical thinking skills among students is still lacking. In addition, elementary school teacher education students tend to please the questions are shaped so that when given a routine matters that are not routinely they tend to be difficult. In general, the ability of primary school teacher education students in mathematical problem solving can be said to be medium and low, rarely high-ability students, as well as the atmosphere of learning activities of students primary school teacher education students tend to be less active (Supriadi, 2010).

Learning mathematics would be more fun if the student is active in connecting between a real phenomenon with an understanding that would be obtained student math. One of the main ways to realize that learning is by mathematical modeling. This modeling allows students to rediscover concepts or mathematical laws ever discovered by the experts before, can create a mathematical model that is simple enough at first, then gradually the students can test, formalize, and generalize (Turmudi, 2009). Mathematical modeling process designed Blum led to mathematical modeling capabilities that will be used in this research. Mathematical modeling capabilities according to Blum and Kaiser (in Maas, 2006) are as follows: a) Structuring, b) mathematization, c) Solving d) Interpreting, and e) validating.

Learning approach that will be used is contextual learning, learning approach that emphasizes learning meaningful and contextualized learning in mathematics classes in a real situation, so much emphasis on the process of knowledge discovery is not the final result. Real situation in contextual learning that will be used in this study is ethnomathematics-based contextual learning with Sundanese culture. Ethnomathematics definition comes from the word that refers to the ethno cultural social context made up of language, jargon, codes of conduct, myths and symbols. Mathema means explain, find out, understand activities such as encoding, measure, classify, summarize and modeling. Tics means technique, in other words ethno refers to members of the group in the cultural environment are identified by their cultural traditions, code symbol, myth and special way used to think and to conclude (Rosa and Orey, 2007). Cultures to be used in teaching mathematics is Sundanese, Sundanese culture is a culture that possessed by most students of a primary school teacher education a public university located in the province of West Java and Banten province, Indonesia. Learning math by using Sundanese culture is expected to grow the confidence that mathematics would be taught effectively and meaningfully with the culture or to connect with students on an individual basis, students feel more comfortable and confident in discussing mathematical concepts, encouraging the creation of knowledge, and learning of mathematics can assist in promoting the values of the culture.

Based on the above background, it would require an instructional materials that meet the characteristics ethnomathematics-based contextual learning. Teaching materials are designed in accordance with the mathematical modeling capability indicator to be developed. Teaching materials will be prepared containing Sundanese culture problems that occur at this time and is equipped with Sundanese cultural values developed in learning. Preparation of teaching materials using methods didactical Design Research (DDR) to further optimize the quality of teaching materials. After that success is tested through a test instrument that measures the ability of mathematical modeling with experimental research methods.

Above background prompted researchers to see the development of mathematical modeling ability elementary teacher education students through ethnomathematics based contextual learning with all students in terms of Sundanese culture, educational background (science, and Non-Science) and the origins of culture (Sundanese and Non Sundanese). To deepen this research study, also revealed an interaction between etnomathematics based contextual learning with educational background (science and non science) and the origins of culture (Sundanese and Non Sundanese) in the mathematical modeling ability.

2. Methods

This study was conducted in two stages, namely: 1) Preparation and 2) Implementation Phase. During the preparation stage research development by using didactical design research (DDR) in making teaching materials ethnomathematics based contextual learning with DDR is a methodology developed Suryadi (2010) which consists of three stages, namely: 1) Analysis of the didactic situation; 2) Analysis metapedadidactic; and 3) Analysis retrosfective. The initial phase of this study, the research subjects were undergraduate students of primary school teacher education program semesters 1, 3, 5, and 7 academic year 2012/2013 at a state university in the city of Serang, Banten. and Sumedang, West Java, Indonesia. The preparation phase is considered completed after the study was obtained: 1) instructional materials with ethnomathematics based contextual learning; 2) Test the ability of mathematical modeling that have met the requirements: validity, reliability, level of difficulty, and distinguishing features. The following chart preparation phase:

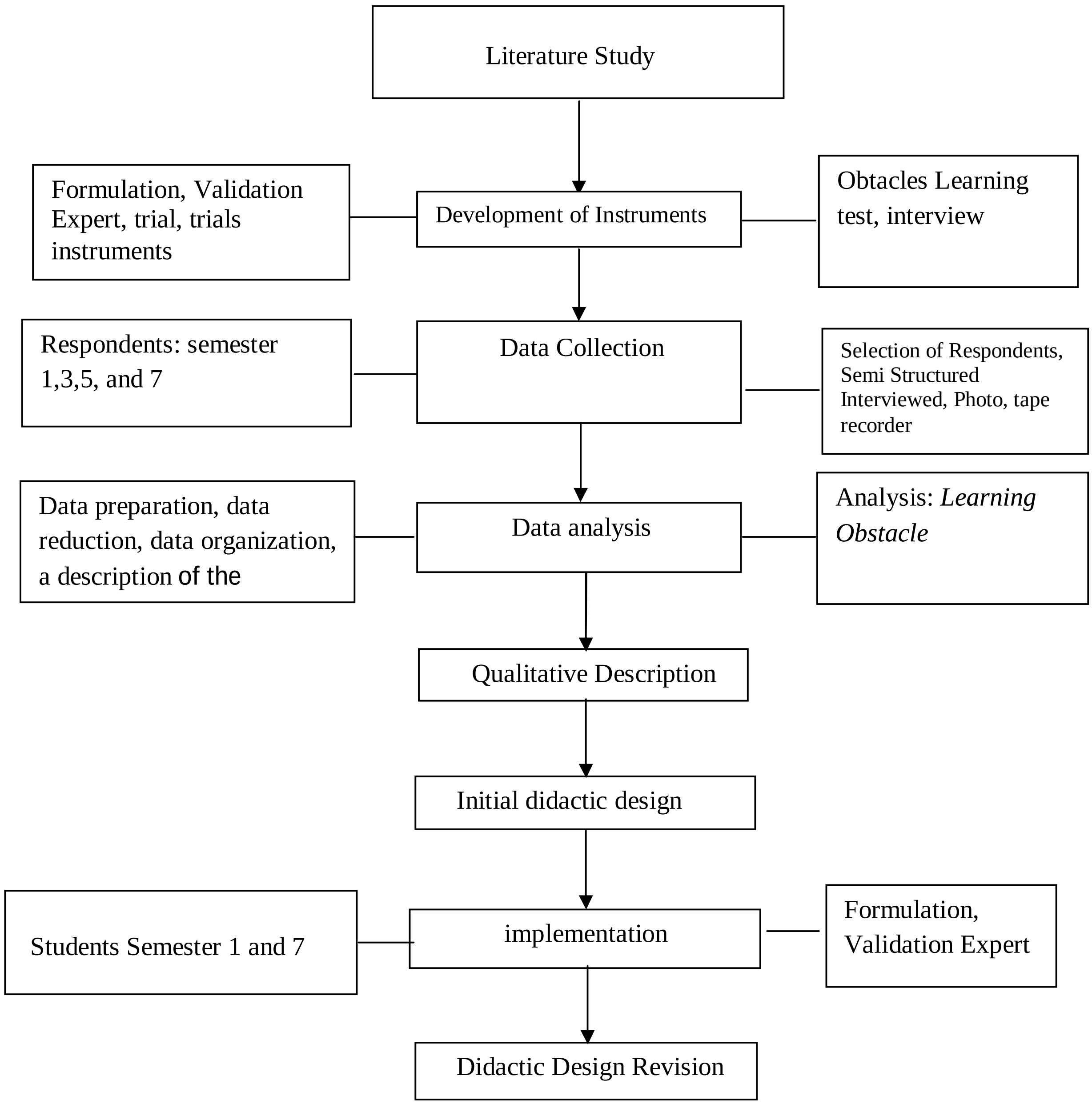

Figure 1. Chart Preparation

The next stage is the implementation phase of research using experimental research methods with posttest only control group design. This study was conducted to see causal relationships through manipulation of independent variables and test the changes caused by manipulation before, but the subject is not grouped randomly (Ruseffendi, 2005). The results of the manipulation of the independent variables can be seen from the dependent variable in the form of the development of mathematical modeling ability of students. The treatment in this study is the learning of mathematics by using ethnomathematics based contextual learning as independent variables. Observations were made after learning the first time called posttest.

In this study, the study sample was not randomly selected, the sample was divided into 3 groups: 2 experimental groups and 1 control group. Postes performed in 3 groups. In the experimental group treated with the learning gain using ethnomathematics based contextual learning while gaining control group treated with conventional learning.

Based on the above, the research design used was quasi-experimental posttest only control group design is briefly described as follows:

X1 0

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X2 0

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0

Description:

0 : Posttest

X1 : Ethnomathematics Based Contextual Learning -DDR

X2 : Ethnomathematics Based Contextual Learning - Non DDR

To look more closely at the effect of the use of ethnomathematics-based contextual learning on mathematical modeling ability of students, so in this study involved a whole category of students, educational background, and cultural origin. Educational background of students who had previously owned while in high school may be a factor that affects learning ability in mathematics, so it is important to analyze the extent of its influence in the learning of mathematics. Educational background are divided into groups of science and non-science. Science is a student group first half of high school graduates who choose science majors, while non-science majors other than science.

While the group is a group of cultural origin Sundanese and non-Sundanese. This grouping is done because the original group of Sundanese culture has a high number at the State University where the research was conducted. Sundanese culture is derived from the local culture of West Java-Banten. For students from Sundanese culture of this grouping will give students the value of benefits in sensitivity in preserving the original culture, while for non-students can make it easier to interact Sundanese, Sundanese culture to adapt and learn. The group is divided into Sundanese culture of origin and non Sundanese. Sundanese group is the first semester students are acknowledging himself the Sundanese and recognized by others as the Sundanese. Someone else was good students from Sundanese own and student non-Sundanese. Meanwhile, a group of non Sunda, apart from Sunda group itself. The following flowchart implementation stage of research:

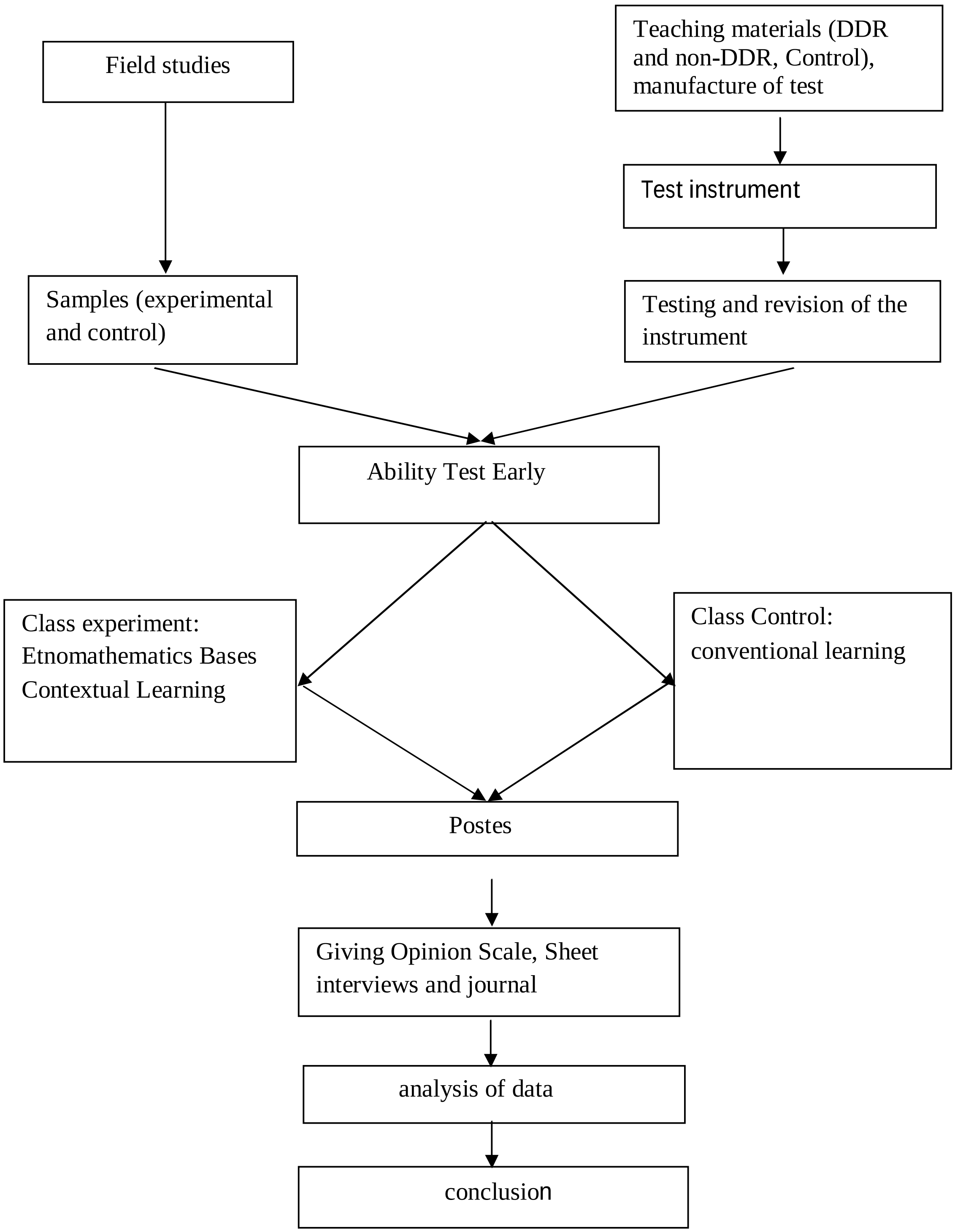

Figure 2. Chart Implementation Phase

Based on issues that have been disclosed, the population in this study were all students of level 1 semester at a State University in Indonesia, which consists of the central campus and regional campuses spread across two provinces, namely West Java and Banten. All students are high school graduates who have obtained the same tests and the same passing grade anyway, it is assumed that the basic ability of all students can be the same. In other words, all members of the population in this study have the same basic capabilities. Therefore, samples taken in this study were 3 classes from all class members of the population, used as experimental class 2 and class 1 class again used as a control class.

In the experimental class performed mathematics instruction using ethnomathematics based contextual learning, while the control class learning mathematics implemented using conventional approaches. Classes were selected to be the experimental class and the control class is the basic concept of math class 1st semester at the State University, Serang, Banten, Indonesia.

3. Results

Phase Preparation

Learning obtacles acquired through learning obstacles test on the material and the presentation of statistical data and the regression equation of a straight line:

a. Student difficulty in answering the questions in the form of knowledge in defining a statistical concept for the definition they do not get recalled. So the question arises researcher, memorization why concepts in mathematics difficult to be remembered by the students.
b. Students have a concept image that models draw bar charts there is only one type of the vertical type, because of their learning experience during this new to that type.
c. Students interpret a difficulty providing statistical data model.
d. Students connection difficulties associated with the concept of a straight line equation given problem context.
e. Students of the difficulties related to the information given about the matter so that they can not develop the activity in solving the given problem.
f. Students of the difficulty in differentiating the equation straight line with a regression line.
g. Students have a tendency to choose to answer a math problem than the question of the attitude towards cultural values.

Based Learning Obtacles obtained from then drafted an initial didactic design consisting of a lecturer metapedadidactic anticipation didactic and anticipation pedagogic in the development of didactic design early:

Anticipation Didactic does is provide additional information about the form of memorization as an aid for students to provide ease in recalling the definition. Provide information on the information contained in the matter for which less information is known by the students, such as farming techniques which have not known, given a complete explanation. Lecturer gives matter for some type of bar chart that concept image can be resolved. Lecturers provide problem-solving schema modeling the material straight line equation and the equation of the regression line so that students will get help early in the finish. Questions relating to the interpretation of statistical data, the lecturer gives the images the help of modifiers to the data presented, so that students will easily understand the data presented. Lecturer change of opinion on the question of cultural values Sunda converted to preliminary information to be used as an initial relationship between the students in connecting the cultural problems that occur with the noble values of Sundanese culture.

Anticipation Pedagogic done is students who had trouble reading a philosophy of Sundanese culture values the faculty appoint another student to help her trouble. Group formation in learning may not be homogeneous, because the students in each class only has the number of male students who numbered below while the remaining five female dominated, so it tends to be when a select group of all homogeneous, making it appear less active groups. Based on the observation that all groups of men tend to be less active. Solutions that are carried lecturer arranged for each group there are male students and female. Because ethnomathematics based contextual learning Sundanese culture containing mathematical modeling activity and creativity in mathematical modeling, the model is not completed student assignments used in the home and in the classroom are discussed at the next meeting.

Once implemented lecturers do retrosfective the results of the initial didactic design. At this stage it is obtained there are still some obstacles such as students who make mistakes in the calculation because the are too quickly solve the problem, students still find it difficult to interpret the resulting model thus not meet the completeness of a correct answer. Based on this information to anticipate didactic lecturer and pedagogic in revising the initial didactic design. Anticipation didactic done is to modify the problem by giving the table so that these obstacles can be overcome. Anticipation pedagogic: Lecturer motivate students to always check back answers (models) produced in order to avoid errors in calculations. Lecturers give more aid to students who are still difficulties to understand the problems, whereas students who already understand a lot designated forward to presenting the answer.

Once revised, then implemented again in a different class to produce new didactic situation. Based on the observation of the lecturer, after the learning process ends obtained suitability predictions made by the faculty that the student response teaching materials produced in accordance with the needs of the students. In addition, the steps in ethnomathematics based contextual learning with Sundanese culture to run smoothly, so that will be generated optimal learning results.

Phase Experiments

Before the lesson given in the experimental class and the control class, conducted tests to see the beginning of a student's ability. From the analysis of the data showed that there was no difference in initial ability students who will obtain ethnomathematics based contextual learning and conventional learning. Due to the materials provided are new, and the values are not the maximum of the third class. Based on these findings, the researchers did not provide pretest in the third grade, as predicted will achieve the same results with the test early mathematics ability. Based on overall test scores in the experimental group I, experimental II and control can be seen in the following table

Table 3.1 Mean and Standard Deviation of Student Mathematical Modeling Ability Based Educational Background, On the Origin of Regional and Overall

Group	Data	Mathematical Modeling Ablity		
		EBCL-DDR (Experimental I)	EBCL-NON DDR (Exsperimental II)	CONVENSIONAL (Control)
Science	n	34	28	34
	$\bar{x}$	31,52	26,89	22
	SD	6,3	6,78	6,55
Non Science	n	11	17	11
	$\bar{x}$	25,9	22,58	20,18
	SD	6,64	5,62	5,5
Sundanese	n	21	21	20
	$\bar{x}$	30,95	24,85	18,55
	SD	6,9	6,13	6,22
Non Sundanese	n	24	24	25
	$\bar{x}$	29,45	25,62	23,96
	SD	6,76	7,10	5,34
Overall	n	45	45	45
	$\bar{x}$	30,15	25,26	21,55
	SD	6,79	6,5	6,3

Description:
$\bar{x}$ = mean
n = sum of students
SD = standard deviation
EBCL =Ethnomathematics Based Contextual Learning
DDR= *Didactical Design Research*
Ideal score Mathematical Modeling Ablity = 51

Table 3.1 shows the average value of mathematical modeling ability in terms of overall student can be said that the ability of mathematical modeling of the three classes are not homogeneous, and the average ability of mathematical modeling for students who use ethnomathematics based contextual learning is higher than the students who used conventional study. In addition, the average ability of students to use mathematical modeling ethnomathematics based contextual learning through DDR higher than students who made teaching without going through the DDR.

Based on the average value of mathematical modeling capabilities can be said that a group of students of science and non-science that uses contextual-based learning ethnomathematics has a higher mean than the students who used conventional study. The mean ability of students to use mathematical modeling ethnomathematics based contextual learning through DDR higher than students who made teaching without going through the DDR. Science in each grade group in experiments I, II and controls had a higher mean than the group of non-science.

Based on the average value of mathematical modeling ability can be said that a group of students Sundanese and non-Sundanese which uses ethomathematics based contextual learning have a higher mean than the students who used conventional learning. The mean ability of students to use mathematical modeling ethomathematics based contextual learning teaching material through with

DDR higher than students who made teaching without going through the DDR. Group of students in the experimental class I Sunda higher than the non-student group Sundanese, but in other classes of Non-Sunda group of students tends to be higher than in Sundanese.

From the analysis of mathematical modeling ability score data, the data obtained that the three classes are normally distributed and homogeneous. Thus, to test the mean difference can be done with parametric statistical one way anova test. The results of the calculation of the mean difference test mathematical modeling ability, can be seen in the following table:

Table 3.2 Anova Test Score Average for Mathematics Modeling ability in Experiment I, Experiment II and Control

Groups	Sumber	Sum of Squares	df	Mean Square	F	Sig
Science	Between groups	1544,090	2	772,045	17,990	0,000
	Within groups	3991,149	93	42,916		
	Total	5535,240	95			
Non Science	Between groups	182,414	2	91,207	2,625	0,86
	Within groups	1250,663	36	34,741		
	Total	1433,077	38			
Sundanese	Between groups	1575,736	2	787,868	19,016	0,000
	Within groups	2444,474	59	41,432		
	Total	4020,210	61			
Non Sundanese	Between groups	387,210	2	193,605	4,631	0,013
	Within groups	2926,543	70	41,808		
	Total	3313,753	72			
Overall	Between groups	167,504	2	837,252	19,295	0,000
	Within groups	5727,822	132	43,393		
	Total	7402,326	134			

According to the table 3.2 it can be concluded that the ability of mathematical modeling in science group, Sundanese, non Sundanese and overall have unequal variances. While the non-science group does not have a difference. Based on the conclusion, followed by Scheffe test to see which are the most significant differences between the three classes. The following results can be seen from the following table:

Table 3.3 Mean Scores Scheffe Test for the Ability of Mathematical Modeling Experiment I, Experiment II and Control.

Groups	Groups (I)	Groups (J)	Mean Difference (I-J)	Sig
Science	Experiments I	Experiment II	4,636	0,025
		Control	9,529	0,000
	Experiments II	Control	4,892	0,017
Sundanese	Experiment I	Experiment II	6,095	0,013
		Control	12,402	0,000
	Experiment II	Control	6,307	0,011
Non Sundanese	Experiment I	Experiment II	3,833	0,129
		Control	5,498	0,015
	Experiment II	Control	1,665	0,668
Overall	Experiment I	Experiment II	4,888	0,003
		Control	8,600	0,000
	Experiment II	Control	3,711	0,031

Based on Table 3.2 ANOVA and Scheffe 3.3, the overall ability of students studying mathematical modeling using ethnomathematics based contextual learning better than students studying with conventional learning. In addition, for the special experimental class distinguished by the teaching materials used. The ability of students to use mathematical modeling teaching materials through DDR better than students using teaching materials without the use of DDR.

Mathematical modeling ability based on educational background group concluded that science students who learn to use ethnomathematics-based contextual learning is better than a group of students who studied science with conventional learning. Group of science students in the experimental class with teaching materials through DDR better than group science experiments in the classroom with teaching materials without going through the DDR.

The ability of mathematical modeling based on cultural origin Sundanese concluded that the group of students who learned using ethnomathematics-based contextual learning better than the group of students who learn with conventional learning. Sunda group in the experimental class students with instructional materials through DDR better than the Sunda group in the experimental class with teaching materials without going through the DDR.

The ability of mathematical modeling based on cultural origin concluded that the group of students who learned using ethnomathematics based contextual learning Sundanese culture with DDR-based teaching is better than a group of students who studied with Non Sundanese conventional learning. However, a group of students in a class of Non Sunda experiments with teaching materials without going through the DDR is not better than the group in the Sunda Non conventional classroom. Mathematical modeling capabilities in both the experimental class did not have a difference.

From the analysis of score data modeling capabilities of third grade mathematics showed that the three classes of data, normal distribution and homogeneous. Thus, to examine the interaction between the learning model used by the educational background of the students in the mathematical modeling capabilities can be anova two way. The results of the calculations can be seen in the following table :

Table 3.4 Anova Scores of Mathematical Modeling Ability on Background Education and Learning Model

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2160,514[a]	5	432,103	10,634	0,000
Intercept	66326,341	1	66326,341	1632,279	0,000
Learning model	967,974	2	483,987	11,911	0,000
Background Education	411,424	1	411,424	10,125	0,002
Learning model * background education	**62,289**	**2**	**31,144**	**0,766**	**0,467**
Error	5241,812	129	40,634		
Total	96286,000	135			
Corrected Total	7402,326	134			

According to the table 3.4 there is no interaction between the model of learning and group educational background (science and non-science) in the mathematical modeling ability.

Provided that the data of the three classes, normal distribution and homogeneous. Thus, to examine the interaction between the learning model used by cultural origin students in mathematical modeling ability can be anova two way. The results of the calculations can be seen in the following table:

Table 3.4 Anova Score of Mathematical Modeling Ability on Background Culture Origin and Learning Model

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2031,309[a]	5	406,262	9,758	.000
Intercept	87620,774	1	87620,774	2104,458	.000
Learning Model	17794,955	2	897,478	1,962	.000
Background Culture	81,684	1	81,684	21,555	0,164
Learning Model * Background Culture	**276,184**	**2**	**138,092**	**3,317**	**0,039**
Error	5371,017	129	41,636		
Total	96286,000	135			
Corrected Total	7402,326	134			

According to the table 3.4 there was an interaction between the model of learning and a group of local origin in the mathematical ability.

4. Discussion

Based on the results shown that the ethnomathematics based contextual learning better than conventional learning. This is possible because of learning by using a contextual approach this ethnomathematics based learning is an approach that puts more emphasis on the activity of the students to be able to reconstruct their own knowledge, through real problems that provided in the form of cultural problems in the community and of course the issue is closely related to the student's life itself. This is in line with the opinion Jhonshon (2002) and Nurhadi (2002) that contextual learning is learning that promotes the activity of linking between the material being studied with the real situation (context) are given, so that learning is more meaningful.

Discussions between groups, followed by class discussion, allowing students to make their own discoveries in a given contextual problem solving. Activities between the groups on student learning will increase with the variation in terms of gender, one group in contextual learning may not all women or men, because it will hinder optimal learning situation, so the need for anticipation pedagogic done by making the scheme consists of a group of students male and female student. Discussion on learning activity allows students to socialize with each other, interact expression, asking, responding to other people's opinions, explain their own thoughts through generated modeling to solve problems. In theory, Vygotsky claimed that learning can not be separated from action (activity) and the interaction because of the perception and activity go hand in hand in dialogue Thus, there is increased interaction between students, the students themselves are not directly have to build a learning community due to the interaction.

Mathematical modeling ability with indicators: structuring, mathematization, solving, interpreting, and validating combined with contextual learning as a process modeling in this learning principle. Learning mathematics would be more fun if the student is active in connecting between a real phenomenon with an understanding that would be obtained student math. One of the main ways to realize that learning is by mathematical modeling. The process of mathematical modeling provide adequate space for students to develop their creativity, encourage activities such as experiments and investigations that lead to the proof of the conjecture made the students as well as a willingness to do the exploration and investigation of mathematics (Turmudi, 2009). So ethnomathematics based contextual learning with mathematical modeling activities to excite students in learning mathematics, develop creativity and discovery process that is consistent with the principles of contextual learning.

For interaction analysis anova test two way, data showed that the learning model is used to group educational background there is no interaction. Being the cultural origin of the mathematical modeling capabilities no significant interactions. Ethnomathematics based contextual learning Sundanese culture will have more influence on student mathematical modeling capabilities of the Sunda group filled with teaching materials that suit the needs of students

5. **Conclusion**

Based on the analysis and discussion of the previous chapter, it can be concluded as follows: mathematical modeling ability between students who received mathematics instruction using contextual learning based etnomatematika Sundanese significantly better than students using the conventional learning. Students mathematical modeling capability science, the Sunda and Non Sunda get the learning of mathematics by using a contextual-based learning etnomatematika Sundanese significantly better than students using the conventional learning. As for the non-science group is not better. There is no interaction between the model of learning with group educational background of the ability of mathematical modeling. There is interaction between the model of learning with cultural groups from the mathematical modeling capabilities.

Based on these results, it can be argued some of the implications of the research conclusions as follows: Application ethnomathematics based contextual learning DDR and Non-DDR helped improve student mathematical modeling abilities. Ethnomathemacs-based contextual learning more DDR produce optimal learning results compared to non-DDR. Discussions between groups, followed by class discussion, allowing students to make their own discoveries in a given contextual problem solving. Activities between the groups on student learning will increase with the variation in terms of gender, one group in contextual learning may not all women or men, because it will hinder optimal learning situation, so the need for anticipation pedagogic done by making the scheme consists of a group of students male and female students. Discussion on learning activity allows students to socialize with each other, interact expression, asking, responding to other people's opinions, explain their own thoughts memalui generated modeling to solve problems. Culture of learning by using a positive effect on students in the formation of character, culture is learned not hinder the learning of the students even from different cultures.

Ethnomathematics-based contextual learning can be used as a model to develop the ability of learning mathematics and mathematical modeling mathematical creative thinking abilities in students elementary school teacher education environment. Lecturers need to pay attention students elementary school teacher education teaching materials presented. Good teaching materials are instructional materials that address the needs of students. Contextual learning will get better results if it is supported by good teaching material. Metapedadidactical thought process, didactic and pedagogic Anticipation is very important to understand the lecturers give lectures students elementary school teacher education especially in mathematics.

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