

**Ethnomathematics-based Problem Based Learning (PBL) Model to Increase Students' Critical Thinking in Mathematics Learning**

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**Abstract**

Process of learning mathematics in the school that the researcher is aiming for tends to be theoretical, less contextual and pseudo. Applies mathematical concepts in learning with local cultural wisdom able to touch aspects in the daily lives of students. This study aims to apply the ethnomathematics-ground Problem Based Learning (PBL) model to ameliorate critical thinking in mathematics literacy. This explored was type of quasi-experimental explored (pseudo-experiment), with The Non-Equivalent Control Group type design. The population of this study was all fourth grade students at Sekolah A Bandar Lampung, totaling 121 students. The sample of this studied was determined by intentional slice fashion, which is a sample determination fashion with consideration in opting for the class to be studied and attained by as numerous as 49 students. Data collection technique used valid and dependable test instruments. The data analysis fashion uses a mated t- test with the results attained for the experimental class with a significance value of 0.000 ( $p < 0.05$ ) passing significant changes and in the control class which is not applied to the Ethnomathematics-based PBL model gets a value of 0.070 ( $p > 0.05$ ) indicating that the results of the original test and final test do not witness significant changes. Grounded on the data attained is from the results of this study, the ethnomathematics-ground Problem Based Learning (PBL) model to ameliorate thinking is significant.

**Keywords:** Problem based learning, ethnomathematics, critical thinking

## **INTRODUCTION**

Critical thinking skills in elementary school students are things that must be developed. In principle, people who are able to think critically are people who do not simply accept or reject something, they will look closely, analyze and evaluate before determining whether they accept or reject information (Susantya et al., 2019). Mathematics learning is a field of science that trains reasoning to think logically and systematically in solving problems and making decisions (Erna, 2019). The benefit of teaching critical thinking skills during learning is to increase students' enthusiasm for learning and enthusiasm for learning, and the learning process experienced by students will last a long time in their memories (Latifah & Suprihatiningrum, 2024). Therefore, learning mathematics actually requires students to think critically in a problem.

Problems that live around the terrain of students can be applied to learning in the classroom. According to Winoto & Prasetyo (2020) literacy by furnishing encouragement to students in the form of problems related to their diurnal lives will have an impact or influence on their provocation to learn. Teachers must know how to learn each student so that they can apply the right ways and strategies both in literacy and in tone-development. In this case, it's the same as the principles of constructivism proposition, which are (1) knowledge is erected by students themselves, both in private and in socially; (2) knowledge isn't transferred from teachers to students, except with the activeness of students themselves to reason; (3) students laboriously construct continuously, so that there's a change in generalities towards generalities that are more detailed, complete, and in agreement with scientific generalities; (4) the schoolteacher's part is to help give installations and situations so that the students' construction process runs easily (Masgumelar & Mustafa, 2021). The learning principle of the independent curriculum according to the Ministry of Education, Culture and Research (No. 56/M/2022) is learning that is designed according to the context, environment and culture of learners, and involves parents and communities as partners. By linking learning to the environment, daily culture, and a fun way of presenting lessons will make children comfortable with the process. One of the lessons that seems to be less attractive to students because of the monotonous process and has not linked it to the life of the students' environment is math learning.

Constructivism proposition can make learners supposed to break problems, find ideas and make opinions. Constructivism knowledge is in line with knowledge with the Problem Based Learning model. The Problem Based Learning (PBL) learning model is a knowledge model that results from a collaborative process towards problem working, where problems are given to students at the morning of the knowledge process so that students are always active in using their knowledge and instructors only as facilitators (Madyaratria et al., 2019). Agitating further related to problem- predicated knowledge or Problem Based Learning (PBL). According to Nurwahid & Shodikin (2021), Problem Based Learning (PBL) is a knowledge model that is acquainted towards the capability and chops of students in allowing to break real problems given.

Mathematics knowledge is a field of wisdom that trains sense to suppose logically and completely in working problems and making opinions (Erna, 2019). A teacher's understanding of designing mathematics learning will affect the achievement of students' mathematics learning issues. A teacher's capability to design mathematics learning is truly important. Therefore, mathematics learning in the classroom should emphasize the connection between fine generalities and the experience of students. Mathematics learning is basically a process that has been designed with the aim of creating an enabling environment for students to carry out mathematics learning activities, and the process is

centered on teaching mathematics teachers. Mathematics learning should be able to instill mathematical concepts clearly, precisely and accurately to students according to their grade level (Mawardi, 2018). The focal point of mathematics is not on a ready-made subject full of procedures and formulas. Rather, the focal point is on exertion. Mathematics as a mortal exertion (Freudenthal, 1973).

Educators must know how to learn each student so that they can apply the right techniques and strategies both in learning and in self-development. One of the learning models that can support students' understanding of mathematical concepts is the problem-based learning model. Problems that exist around the environment of students can be applied to learning in the classroom. Teachers can use problems that are developed. In addition, problem-based learning has the aim that students are accustomed to the problem-solving process because from the beginning they are given or faced with a problem, but also develop critical thinking skills and problem-solving skills as well as the ability of students themselves who can actively acquire their own knowledge (Hosnan, 2014). This model is very suitable for learning mathematics whose basic concept is logical and systematic.

Culture related to mathematical concepts is commonly called ethnomathematics (D'Ambrosio, 1985). Elements of the culture where students live can be used as a learning resource in the hope that learning will be more meaningful and memorable for students. Which is better known as ethnomathematics. Ethnomathematics can be interpreted as another form of mathematics found in formal life that studies how students can understand, integrate, process, and use ideas, concepts and practices from mathematics related to daily activities (Susantya et al., 2019). Ethnomathematics in education can be used to explore and reveal mathematical ideas found in certain cultural activities or environments so that they can be utilized in learning mathematics at school (Pratama & Nuryadi, 2022). So that in teaching mathematics at the basic education level, one of them can be done by connecting mathematics learning with the culture that exists in the surrounding community.

Critical thinking skills are needed to analyze problems, educators are tasked with developing critical thinking skills in students. Because basically the ability to think critically comes from the curiosity and imagination of students that students have had since birth. In addition, critical thinking skills and creative thinking skills will make learners see the world differently and will happily experiment to get something new (Chalkiadaki, 2018). In this study, researchers integrated the Ethnomathematics-based Problem Based Learning model to improve students' critical thinking in mathematics learning because critical thinking skills are needed and must be empowered by every student. The benefits of critical thinking skills, can increase creativity, students will get used to being easier and calmer in solving problems, can know and assess the extent of their potential problems, can find out and assess the extent of the potential possessed by themselves and can communicate well with themselves, for learning itself critical thinking is useful for achieving learning goals for learning itself, critical thinking is useful in order to achieve learning objectives and can improve achievement at the international level (Kurniawati et al., 2020).

Through initial data collection with one of the homeroom teachers of grade IV of Sekolah A Bandar Lampung on Tuesday, July 30, 2023. Some information was obtained that the methods and models used in learning mathematics are still conventional, as well as the lack of student response in the learning process so that students sometimes misinterpret a concept. Students still often rely on formulas given by the teacher or just memorize formulas without understanding the concept of the material given. To

strengthen this, researchers gave an initial test based on critical thinking indicators according to Ennis (1985) which was conducted on 121 students in class IV of Sekolah A Bandar Lampung. There are results from the recapitulation of the critical thinking skills assessment aspect test, namely for Elementary Clarification getting 28%, basic support 56%, inference 54%, Advanced Clarification 51%, and Strategies and Tactics 48%.

This can be seen that the critical thinking skills of students in class IV of Sekolah A Bandar Lampung are low, with an average percentage of 47.4%. According to Ennis (1985) there are important things about critical thinking, namely critical thinking is focused on the understanding of something that is done consciously and leads to a goal. Where one of the main goals that is very important is to help someone make the right and best decision in his life. According to Nurjaman (2021), the purpose of critical thinking is to test ideas or concepts, including making deep considerations based on the opinions presented. Therefore, students are expected to develop critical thinking skills to actively participate in problem solving and express their ideas in classroom learning activities.

Based on the conditions mentioned, the implementation of mathematics learning requires innovation and renewal. One alternative is to connect mathematics learning at school with the form of mathematics that students usually encounter in their daily lives. That is because by presenting learning materials concretely, it will make it easier for students to learn mathematical concepts. The problem-based learning model will direct students in playing their role to explore mathematical concepts owned and obtained through mathematics learning. The problem-based learning model prioritizes real problems. This problem-based learning model will be easier for students to understand if it uses problems that exist in the surrounding environment, especially the culture in Tarakan. Culture related to mathematical concepts is commonly called ethnomathematics. Elements of the culture where students live can be used as a learning resource in the hope that learning will be more meaningful and memorable for students. Which is better known as ethnomathematics.

Integrating culture into mathematics learning will lead to students' knowledge that mathematics is part of their lives so that students will find it easier to learn mathematics (Pratama & Nuryadi, 2022). In a culture, there are values and elements of mathematics. Ethnomathematics is a mathematics science that is closely related to culture (Zaenuri, 2019). The concept of mathematics in community activities can be used as a tool that has a positive impact on teachers, as well as opening students' insights that mathematics is always related to life in various activities (Firdaus, 2020). The link between the Problem Based Learning (PBL) model and ethnomathematics is explained by Nur (2023) who states that the PBL model with ethnomathematics will have an influence on the learning process because this learning model facilitates students in problem solving skills that are integrated with other fields. This combination can occur by incorporating cultural elements into mathematics learning. Ethnomathematics-based learning is carried out by posing a problem related to the relevant culture. In this study, researchers took a more prominent embodiment, namely using culture as a context with a focus on the culture in Lampung.

Problem Based Learning itself has several steps in the literacy process. The way or syntax of this model relate to Nur (2023), which consists of. 1) Phase 1, videlicet orientating students to the problem, 2) Phase 2 Organizing students to learn, 3) Phase 3 Guiding individual and group examinations, 4) Phase 4 Developing and presenting results, 5) Phase 5 assaying and assessing the problem-working process. The following is a table of Problem Based Learning model syntax according to Nur (2023). Based on

these steps, the application of this PBL model to the problem of the cultural context of Lampung Traditional Houses.

Condition of the problem above, it is hoped that the Ethnomathematics-based Problem Based Learning model will fix the students' critical thinking. With the experimental method of quasi experiment type, non-equivalent design and calculation of data analysis, namely paired sample t test hypothesis.

## **METHOD**

The type of conducted using a quantitative approach with aquasi-experimental exploration design (Quasi-Experiment Design) type The Non-Equivalent Control Group. The Non-Equivalent Control Group type design is nearly the same as the retest- post-test control group design, only in this design the experimental group and control group (Sugiyono, 2020). This research design named the 4th grade of Sekolah A Bandar Lampung. Likewise, one class of the group was treated with mathematics learning with an Ethnomathematics-based PBL model and the other control class was not. O1 and O3 are mathematics learning before there's critical thinking treatment in mathematics learning with an Ethnomathematics-based PBL model. O2 is after critical thinking treatment in mathematics learning with an Ethnomathematics-based PBL model. O4, which isn't treated with critical thinking in mathematics learning with an Ethnomathematics-based PBL model. So, looking for the effect of adding critical thinking in mathematics learning with an Ethnomathematics-based PBL model is (O2- O1)-(O4-O3).

The population in this study were teachers and all fourth grade students in the 2023/2024 academy time as numerous as 121 students divided into five classes. The sample is part of the population that becomes the object of exploration, with consideration in choosing the class to be studied where all classes are considered homogeneous or the same (Sugiyono, 2020). This slice is grounded on the consideration of the subject schoolteacher in determining the experimental and control classes. The samples in this study were two classes. The experimental class of 25 students, videlicet the class that entered the Ethnomathematics-based PBL model treatment and the control class of 24 students, videlicet the class that didn't this study consists of independent and dependent variables. The independent variable is the Problem Based Learning Model grounded on Ethnomathematics (X), and the dependent variable is critical thinking (Y).

The instrument used in this study is a critical thinking capability test question predicated on the PBL model with ethnomathematics. The critical thinking chops test instrument that was tested on 49 students was also tested for validity, responsibility, question insulation, and question difficulty. The data analysis fashion used in this disquisition is quantitative data analysis fashion. The data attained from the pre-test and post-test results in the experimental class and control class were reused and analyzed through the data normality test, homogeneity, concinnity test, and paired sample t-test thesis test.

## **FINDINGS AND DISCUSSION**

This research focuses on critical thinking skills. Critical thinking can encourage students to come up with new ideas or thoughts about a problem. Learners will be trained in expressing opinions or ideas rationally and relevantly. According to Mardiana & Sumiatun (2017) the purpose of critical thinking is to test an opinion or idea, including

making considerations or thoughts based on opinions. Students' critical thinking skills in learning mathematics are needed to understand and solve a problem or mathematical problem that requires reasoning, analysis, evaluation and interpretation of the mind. Mathematics that requires reasoning, analysis, evaluation and interpretation of the mind. Glaser also expressed critical thinking as a skill to apply logical methods of examination and reasoning. Skills critical thinking skills are very important to be mastered by students so that students are learners to be better trained in formulating an opinion, checking the credibility of sources, or making decisions. Make decisions. One of the tools to develop critical thinking skills is mathematics (Kurniawati et al., 2020).

Critical thinking is closely related to Mathematics, especially in solving problems. Data on students' critical thinking skills are obtained in the form of pre-tests and post-tests, in this case with the type of research quasi experimental design non-equivalent. The instrument used in this study is a test, which is a test in the form of 10 description questions that are useful for seeing the critical thinking skills of students including interpretation, analysis, evaluation, inference, ability to explain and self-regulation. This test was given to students in class IV-A as an experimental class and IV-B as a control class at Sekolah A Bandar Lampung to determine the application of the Ethnomathematics-based Problem Based Learning (PBL) model to improve students' critical thinking skills in mathematics learning. This exploration was conducted in class IV of Sekolah A Bandar Lampung, with one experimental class and one control class. The findings of this study indicate that the Ethnomathematics-based Problem Based Learning (PBL) model is designed to ameliorate students' critical thinking chops. The subject matter banded in this study is "Flat structures and Their Characteristics" in indeed semester. The ensuing stages are described.

In this study, two tests were carried out, namely pre-test (before treatment) in experimental and control classes, then for the experimental class given treatment and the control class without treatment, followed by post-test (after treatment for experimental and control classes) which was carried out at the end of the meeting which aims to determine the critical thinking ability of students. The selection of sample objects carried out on students is by purposive sampling, which is a sampling technique with consideration in choosing the class to be studied where all classes are considered homogeneous or the same (Sugiyono, 2020). This sampling is based on the consideration of the subject teacher in determining the experimental class and control class. Problem Based Learning (PBL) is a learning model used to make it easier for students to follow learning by using problems. In this case, PBL is based on ethnomathematics, which means that mathematics learning is combined with culture. The culture taken by the researcher is the Lampung traditional house. Learners are given a problem case by the teacher regarding Flat Buildings and their characteristics, and students analyze the shape of the Lampung traditional house that has been combined to determine the increase in critical thinking of students.

The results of the validity test of pre-test and post-test questions have reached a significant level of 0.005. In the reliability test the test results for the pre-test were 0,629 declared sufficiently fixed and in the post-test 0.750 declared fixed / good. Furthermore, the test of the difficulty level of the problem with the results, namely 2 questions, namely item numbers (6 and 9) identified with the "difficult" level with a difficulty index of 0.00 - 0.25, and 8 questions, namely question numbers (1,2,3,4,5,7,8, and 10) identified with

a “medium” level with a difficulty index of 0.26 - 0.75. Finally, the validator test was obtained by analyzing the differentiating power, namely, there are 5 questions with good criteria, 4 questions with sufficient criteria, and 1 question with insufficient criteria.

**Descriptive data of Pre-test, Post-test in Control and Experiment Classes**

Table 1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-Test Experiment	25	56	77	67.04	6.328
Post-Test Experiment	25	72	92	81.12	4.324
Pre-Test Control	24	55	81	66.42	6.990
Post-Test Control	24	40	84	61.92	10.818
Valid N (listwise)	24				

Source: Research Results 2024

Table 1 shows that the average pre-test scores of the control class and experimental class were 66.42 and 67.04 with the smallest and loftiest scores not much different, videlicet 55 and 56. The post-test results in the control class were 61.92 with the smallest score of 40 and the loftiest score of 84. In the experimental class, the average post-test score was 81.12 with the smallest score of 72 and the loftiest score of 92. It can be seen that overall after being given different treatments between the 2 classes the results look advanced in the experimental class than the control class.

**Normality Test of Pre-test, Post-test of Control and Experiment Classes**

The following is the data from the Pre-test and Post-test normality test results in the Control and Experiment Classes can be seen in Table 2.

Table 2. Tests of Normality

Classes	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Learning Experiment Pre-Test Results (PBL Based on Learners Ethnomathematics)	.120	25	.200*	.950	25	.245
Experiment Post Test (PBL Based on Ethnomathematics)	.179	25	.137	.955	25	.329
Control Pre-Test (Conventional)	.154	24	.145	.957	24	.373
Control Post-Test (Conventional)	.195	24	.119	.931	24	.100

Source: Research Results 2024

Based on the Table 2, it can be seen to be normal if sig. Kolmogorov-Smirnova obtained from the test results is greater than  $\alpha$  (0.05).

**Homogeneity Test of Pre-test, Post-test of Control and Experiment Classes**

The homogeneity test is used to determine whether the data has uniformity of variance and the samples taken from the same population. Data can be said if it meets the  $\text{sig} > \alpha$  (0.05) criteria. The homogeneity test in this study used SPSS version 27 and was assisted by the F test using excel, with the results seen in Table 3.

Table 3. Homogeneity Test

Statistic	Value	Conclusion
$\alpha$	0,05	Sig > $\alpha$ (data comes from homogeneous groups) Sig 0.15)
Sig	0,15	
$F_{\text{count}}$	0,16	$F_{\text{count}} \leq F_{\text{table}}$ (data comes from homogeneous groups)
$F_{\text{table}}$ ( $\alpha=0.05$ ; db1=1; db2)	0,501	

Source: Research Results 2024

**Hypothesis Paired Sample T-Test of Pre-test, Post-test of Control and Experiment Classes**

The paired t- test was used by experimenters to see the enhancement of critical thinking chops ahead and after using the Ethnomathematics-based PBL model with the test thesis, videlicet:

$H_0$ : There was a significant increase in critical thinking skills of students who learned with the ethnomathematics-based PBL model and students who learned did not apply the ethnomathematics-based PBL model.

$H_a$ : There's a significant increase in students' critical thinking chops in using the Ethnomathematics-based PBL model to ameliorate students' critical thinking in mathematics literacy. There was not significant improvement in critical thinking skills of students who learned with the ethnomathematics-based PBL model.

Guidelines for decision making in the paired sample t-test test grounded on the significance value (Sig.) of the affair results using SPSS, are as follows.

- 1) If the Sig value. (2-tailed) < 0.05, then  $H_0$  is rejected and  $H_a$  is accepted.
- 2) Conversely, if the Sig value. (2-tailed) > 0.05, then  $H_0$  is accepted and  $H_a$  is rejected. (Santoso, 2014)

The following are the results of the mated t test conducted using the IBM Statistical Passage for the Social Science (SPSS) v27 for windows software in Table 4.

Table 4. Paired Differences

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pre-Test Experiment Post-Test Experiment	-14.080	7.692	1.538	-	-10.905 17.255	-9.153	24	.000
Pair 2	Pre-Test Control Post-Test Control	4.500	11.591	2.366	-.394	9.394	1.902	23	.070

Source: Research Results 2024

Referring to the Table 4, it can be seen that in the experimental class where the ethnomathematics-based PBL model was applied, the significance value (2-tailed) was 0.000 ( $p < 0.05$ ) indicating that the results of the original test and final test endured significant changes, so  $H_0$  was rejected and  $H_a$  was accepted. And in the control class where the Ethnomathematics-based PBL model wasn't applied, the significance value (2-tailed) was 0.070 ( $p > 0.05$ ) indicating that the results of the original test and final test didn't witness significant changes, so  $H_0$  was accepted and  $H_a$  was rejected.

### ***Effect of Ethnomathematics-Based PBL Model Can Improve Students' Critical Thinking Ability***

In the learning process taking place using the ethnomathematics-based Problem Based Learning (PBL) learning model, students find it easier to understand the learning material at each meeting because students are directly involved in actively solving each problem and looking for new information. This is also evidenced by the theory of constructivism theory that students can think to solve problems, find ideas and make decisions. Learners are expected to engage in a research process that requires them to identify problems, collect data, and use the data to solve problems (Rusmono, 2014). One of the abilities needed by students in the 21st century is the ability to think critically, which can encourage students to come up with new ideas or thoughts about a problem of critical thinking ability. Critical thinking in this study refers to indicators according to Ennis (1985), namely elementary clarification, basic support, inference, advance clarification, strategy and tactics.

Based on the results of the analysis obtained by researchers during the research, the low critical thinking ability of students is due to educators not applying the learning model optimally during class learning activities and still sticking to conventional teaching materials which are also limited in number so that students become passive. The choice of learning model greatly affects the achievement of learning objectives. One of the learning models that can improve students' critical thinking skills is the ethnomathematics-based PBL learning model, because the application of the ethnomathematics-based PBL learning model requires students to be active and think critically in seeking and finding their own knowledge. The results of the analysis attained by the experimenter show that there are differences in the position of critical thinking capability of grade IV students at Sekolah A Bandar Lampung which can be seen from the accession of the chance of each critical thinking index during the pre-test and post-test. This studied compare with the research is Ethnomathematics' Research in Indonesia during 2015-2020 with result are to be carried out is to apply ethnomathematics-based mathematics education (Hidayati, 2022). With the success of this research, operation of the Ethnomathematics-based Problem Grounded literacy (PBL) model with each critical thinking index is 88.8 (Elementary Clarification), 87.8 (Basic Support), 84 (Inference), 68.8 (Advanced Clarification), 58.8 (Strategy And Tactics) for the experimental class, with the difference in the control class being 59.2 (Elementary Clarification), 66.8 (Basic Support), 60 (Inference), 48 (Advanced Clarification), 48.4 (Strategy and Tactics).

### **CONCLUSION**

The application of the ethnomathematics-based PBL model in learning has proven effective in improving students' critical thinking skills, this can be seen from the improvement in students' critical thinking skills test results. Based on the research that has been done, it can be concluded that: With the difference in the average critical thinking ability of the two classes, namely through the experimental and control classes,

that the critical thinking ability of the experimental class is much greater than that of the control class, this shows that there is an effect of applying the Ethnomathematics-based Problem Based Learning (PBL) model on improving students' critical thinking ability. The results of the hypothesis through the paired t-test test that the experimental class applied the ethnomathematics-based PBL model with a significance value (2-tailed) of 0.000 ( $p < 0.05$ ) showed that the results of the initial test and final test had significant changes, so that  $H_0$  was rejected and  $H_a$  was accepted. And an increase in critical thinking skills by getting an average percentage of 77.64%.

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