**Journal of Educational Research and Evaluation**
Volume 8, Issue 1, 2024, pp. 163-172
P-ISSN: 2597-422x E-ISSN: 2549-2675
Open Access: https://doi.org/10.23887/jere.v8i1.69805

# The Problem-Based Learning Model Assisted with the Ethlaf Application Contains Ethnomathematics to Improve Students' Conceptual Understanding Capability

**Henry Suryo Bintoro[1*], Richa Aulya[2], Savitri Wanabuliandari[3]**

[1,2,3] Mathematics Education, Universitas Muria Kudus, Kudus, Indonesia

**ARTICLE INFO**

**Article history:**
Received November 01, 2023
Accepted January 12, 2024
Available online February 25, 2024

***Kata Kunci :***
Problem-Based Learning, *ETHLAF Apps*, *Pemahaman Konsep*, *Etnomatematika*

**Keywords:**
Problem-Based Learning, ETHLAF Apps, Understanding Concepts, Ethnomathematics



***ABSTRAK***

*Pembelajaran matematika memegang peranan penting dalam dunia pendidikan. Namun tingginya tuntutan penguasaan matematika tidak sesuai dengan hasil belajar siswa saat ini. Hal ini disebabkan karena pembelajaran bersifat langsung sehingga kemampuan pemahaman konsep siswa rendah. Tujuan penelitian ini adalah untuk menguji rata-rata kemampuan pemahaman konsep siswa dengan menerapkan model problem-based learning bermuatan etnomatematika yang didukung dengan ETHLAF APPS lebih baik dibandingkan menerapkan model pembelajaran langsung. Jenis penelitian ini adalah kuantitatif, dengan menggunakan metode eksperimen semu dan desain kelompok kontrol nonequivalent pretest-posttest. Teknik pengambilan sampel menggunakan purposive sampling. Penelitian ini dilaksanakan di kelas X Sekolah Menengah Atas. Teknik pengumpulan data menggunakan tes dan instrumennya menggunakan soal tes pemahaman konsep. Analisis data meliputi uji normalitas, uji homogenitas, uji kemiripan dan analisis data akhir yaitu uji t sampel independen. Hasil penelitian menunjukkan bahwa rata-rata kemampuan pemahaman konsep siswa pada saat diterapkan model problem-based learning berbasis etnomatematika berbantuan ETHLAF APPS lebih baik dibandingkan saat diterapkan model pembelajaran langsung. Kesimpulan penelitian ini adalah kemampuan pemahaman konsep siswa dengan menggunakan model problem-based learning berbasis etnomatematika yang didukung ETHLAF APPS lebih baik dibandingkan dengan menggunakan pembelajaran langsung. Kemampuan pemahaman konsep merupakan tujuan utama dan faktor penting dalam pembelajaran matematika.*

**ABSTRACT**

Mathematics learning plays an important role in the world of education. However, the high demands for mastery of mathematics are not in accordance with current student learning outcomes. This is because learning is direct, so students' ability to understand concepts is low. This research aims to test the average ability of students to understand concepts by applying a problem-based learning model containing ethnomathematics supported by ETHLAF APPS, which is better than applying a direct learning model. This type of research is quantitative, using quasi-experimental methods and a nonequivalent pretest-posttest control group design. The sampling technique uses purposive sampling. This research was carried out in class X of Senior High School. The data collection technique uses tests, and the instrument uses concept understanding test questions. Data analysis includes the normality test, homogeneity test, similarity test, and final data analysis, namely the independent sample t-test. The research results show that the average ability of students to understand concepts when applying the problem-based learning model based on ethnomathematics assisted by ETHLAF APPS is better than when applying the direct learning model. This research concludes that students' ability to understand concepts using the ethnomathematics-based problem-based learning model supported by ETHLAF APPS is better than using direct learning. The ability to understand concepts is the main goal and important factor in learning mathematics.

## 1. INTRODUCTION

Education is very necessary in all countries in the world to meet the needs of their citizens, because whether we realize it or not, education plays an important role in preparing and improving human resources (Alpian et al., 2019; Gal et al., 2020). Education in Indonesia has been declared a right of all citizens. This is stated in Article 31 paragraph (1) of the 1945 Constitution which states that every citizen has the right to education. The importance of education in Indonesia, which is a pillar of national development, is clearly stated in the 4th paragraph of the preamble to the 1945 Constitution, namely education for the life of the nation. Not just prioritizing education in Indonesia but also understanding how to realize the concept of education through training, coaching, and empowering Indonesian society or human resources in an integrated and sustainable manner (Inanna, 2018). Basic education that has a big

*Corresponding author.
E-mail addresses: henry.suryo@umk.ac.id (Henry Suryo Bintoro)

influence on improving human resources is mathematics learning (Henry et al., 2021; Buckley et al., 2018; Khaesarani & Hasibuan, 2021). Mathematics is a science that is taught in stages, from concrete to abstract, and to learn it you need to understand the concepts clearly (Purwaningrum & Bintoro, 2018). Learning mathematics helps students think systematically, logically, and critically (Anggraeni et al., 2020). The benefits of mathematics lie in developing students' abilities, intelligence, and skills (Henry et al., 2022; Irawati et al., 2021). Mathematics learning has an important role in the world of education and even in everyday life. Mastery of mathematical material is necessary because it remembers the importance of learning mathematics. However, the high demands for mastering mathematics material are not in line with students' current mathematics learning outcomes. Ironically, in mathematics subjects, the quality of education in Indonesia is very low (Kamid et al., 2021; Masjaya & Wardono, 2018). This can be shown from the 2018 PISA Indonesia results in the mathematics ability category. Indonesia got an average score of 379, ranked 73rd, behind Thailand at 58th and Malaysia at 48th, while Singapore was ranked 2nd (Hewi & Shaleh, 2020). This is reinforced by the results of Moreno's research which shows that students do not understand mathematical concepts clearly and their relationship with other concepts, which causes students to have difficulty solving mathematical problems (Moreno, 2018). This can be seen from the score of students who have not yet reached the KKM of 75, while the average score achieved by students is only 52.97. Only 26.32% of students completed, the rest have not yet completed. Considering the importance of learning mathematics, it is hoped that students' ability to understand concepts can be improved. However, in reality this shows that students' ability to understand mathematical concepts is relatively low (Fahrudhin et al., 2018 ; Aristawati et al., 2019).

The mathematics assignments presented are slightly different from the learning conditions at SMA N 1 Bae Kudus. A preliminary study conducted by researchers at SMA N 1 Bae Kudus found that the concept comprehension ability test scores of class X SMA N 1 Bae Kudus students in mathematics class were still low. This is because students do not understand the concepts being taught and only use a system of memorizing content when learning. The material taught at the Junior High School (SMP) level was retested on class X students of SMA N 1 Bae Kudus to determine the level of understanding of the concept. The results of pre-learning tests carried out by researchers on all students in the class show students' ability to understand concepts with a percentage of re-expressing a concept 15.28%, classifying objects based on certain properties that are comparable to the concept 72.22%, sharing examples and non-examples of a concept 63.89%, presenting the concept in various forms of mathematical representation 61.67%, developing necessary or sufficient conditions for a concept 53.33%, using, exploiting and determining certain methods 53.33%, implementing concepts in solving problems 66.67%. From the results of the concept understanding ability test, it can be seen that the average score of some students has not yet reached the KKTP (Learning Goal Achievement Criteria), the average achieved by students only reached 58. Only 27.78% of students achieved the KKTP while the other students still have not yet reached the KKTP.

Based on the results of interviews conducted by researchers with one of the mathematics teachers who teaches in class X SMA N 1 Bae Kudus, namely Mrs. Dyah Kusumaning Utami, S.Pd. stated that the low ability of students to understand concepts is caused by several inhibiting factors, namely: (1) teachers do not utilize technology in the learning process, (2) students are less active when learning mathematics, because mathematics is considered a difficult subject, (3 ) time for the learning process is limited, (4) lack of interest in learning media, and (5) prerequisite material taught at the previous teaching level is less than optimal, causing obstacles so that if not addressed immediately it will affect students' academic achievement and ability to understand concepts. In connection with the problems above, a learning design is needed to improve the ability to understand the concept of a three-variable linear equation system. One alternative learning design is a learning model. A learning model is a model or design that is useful for developing a curriculum or long-term learning plan, providing tutoring in the classroom or outside the classroom, and designing learning materials (Andriah & Amir, 2021; Julaeha & Erihardiana, 2022). The learning model used in the learning process will influence student learning outcomes. Problem-based learning is a learning model that can improve understanding of concepts.

Problem-based Learning is a learning model that focuses on action to solve problems, then students will actively analyze the problem to find answers to the problems posed by the teacher (Kardoyo et al., 2020; Yulianti & Gunawan, 2019). In this case, the teacher acts as a guide and mediator whose job is to help students build knowledge. Problem-based learning can improve students' understanding of applying mathematical concepts (Darhim et al., 2020; Yulianti & Gunawan, 2019). The advantages of the problem-based teaching model include (1) easier mastery of lesson content through problem-solving in problem-based learning, (2) showing satisfaction and challenges of students' problem-solving abilities in the learning process, (3) improved learning activities through problem-based learning, (4) help students understand problems in everyday life, (5) help students take responsibility for their learning and develop knowledge, (6) not only understand learning from books but also help students understand the nature of learning as a

way of thinking, (7) Problem-Based Learning provides an atmosphere that students like and a fun learning environment, (8) allows for application in the real world, and (9) encouraging students to learn continuously (Bosica et al., 2021; Yulianti & Gunawan, 2019). Apart from using learning models, learning media are also used to support students' acquisition of concept-understanding skills. With learning media, it is hoped that students can adapt when the learning process takes place after this pandemic. Students become more enthusiastic and understand learning with learning media because learning media is interactive and certainly not boring (Hilman & Mainaki, 2020; Maryani, 2021; Nurrita, 2018).

The innovation of this research lies in the learning media in the form of an Android-based application called ETHLAF APPS (Ethnomathematics Linear Algebraic Functions Applications). The ETHLAF APPS application-based on Ethnomathematics is a learning application created to improve students' ability to understand interactive concepts when studying three-variable linear equation systems. One of the special features of this application compared to other applications is that it is based on ethnomathematics. Ethnomathematics is a mathematics learning method that exists and grows according to the culture of the local community (Soebagyo et al., 2021). The application of ethnomathematics in this learning activity is an effort to improve students' ability to understand concepts through the actual culture of the surrounding community, consistent with a problem-based learning model that can solve problems in the environment. The ethnomathematics-based application in this research carries the theme *Culture of Kudus City* in the form of Kudus City Monuments, Kudus Traditional Clothing, Kudus Special Foods, Kudus Traditional Ceremonies, and others. This theme is applied to the questions and appearance in this application.

The purpose of choosing the theme *Culture of Kudus City* is because nowadays teenagers are more familiar with foreign cultures which makes them forget about their own culture. Therefore, through this application, it is hoped that it can increase students' interest in learning mathematics and learning about the culture of Kudus City. By combining problem and media-based learning models in the form of learning applications, it is hoped that the quality of students' understanding in solving problems and expanding knowledge will increase, thereby making students interested in learning and developing their knowledge through understanding concepts. Therefore, by combining problem and media-based learning models in the form of learning applications, it is hoped that understanding of concepts can be improved. The aim of this research is to analyze the influence of the problem-based learning model assisted by the ETHLAF application based on ethnomathematics on the ability to understand concepts in high school students. Problem-based Learning model Learning assisted by the ETHLAF APPS application based on ethnomathematics aims to improve the conceptual understanding of Class X SMA N 1 Bae Kudus students to gain in-depth knowledge during the learning process. The novelty in this research is the ETHLAF APPS application based on ethnomathematics (Culture of Kudus City) which systematically organizes mathematics learning using the steps of the Problem-based Learning model.

## 2. METHODS

The research conducted in this study is a quantitative research using quasi-experimental research methods. The design of this research is a nonequivalent pretest-posttest control group design. This research was conducted in classes XE5 and XE6 of SMA N 1 Bae Kudus with a sample of 70 students. The dependent variable of this research is the ability to understand concepts while the independent variable is the problem-based learning model supported by ETHLAF APPS-based on Ethnomathematics. The data collection technique used was a test. The sampling technique used was purposive sampling. Purposive sampling is a sampling technique with consideration (Lestari & Yudhanegara, 2015). By using a purposive sampling technique, two classes were obtained as sample classes, namely class XE5 as the control class and class XE6 as the experimental class. In this study, the researcher chose this class because the characteristics of the students in the two classes were homogeneous or relatively homogeneous, the students were taught by the same teacher, and the average score of the students in the odd mid-semester assessment for the 2022/2023 school year between the two classes was average. the lowest average of the entire population in class X SMA N 1 Bae Kudus.

The design of this research is a nonequivalent pretest-posttest control group design. For the design, two groups were created, namely the treatment group which was the experimental group, and the group that was not given treatment, namely the control group. A pre-test was carried out on the experimental group and the control group to determine the initial conditions before receiving treatment, then after the treatment a post-test was carried out to obtain test results. In this plan, samples are taken non-randomly (completely random) in both the experimental class and the control class. The sampling technique was carried out by purposive sampling (Sukestiyarno, 2020; Budiyono, 2019; Creswell, 2014).

The data collection technique in this research is a concept understanding test obtained from the results of learning the questions asked in the experimental class and control class. The data collection tool

used in this research is a concept understanding test to collect data on students' concept understanding test scores on three-variable linear equation systems. The experimental class and control class test questions are both pre-test and post-test questions. The pretest is given before students receive treatment, while the posttest is given after students receive treatment. To determine students' ability to understand concepts can be based on pre-tests and post-tests. The dependent variable of this research is the ability to understand concepts while the independent variable is the Problem-based Learning model Learning assisted by the ETHLAF APPS application-based on Ethnomathematics.

Instrument validation uses content validity which is carried out through expert judgment which contains 15 statement items. The next analysis of the test question instrument is an analysis of the validity of the question items, reliability, level of difficulty and distinguishing power. The content validity grid is presented in Table 1.

**Table 1.** Content Validity Grid

| Number | Observed Aspect |
|---|---|
| | **A. Material** |
| 1 | Fill in the questions according to the level and grade level |
| 2 | Suitability of the question items |
| 3 | Clarity in distributing material |
| 4 | The boundaries of the questions and expected answers are clear |
| 5 | Grille fittings |
| 6 | Conformity of questions to the grid |
| 7 | uitability of the questions to the level of students' ability to understand concepts |
| | **B. Construction** |
| 8 | Load the student identity column |
| 9 | Formulation of sentences in the form of question sentences or command sentences that require detailed answers |
| 10 | Contains clear instructions on how to answer test questions on the ability to understand the concept of material on systems of linear equations in three variables |
| 11 | There are appropriate scoring guidelines |
| 12 | Answer keys according to the questions |
| 13 | Question items do not depend on previous questions |
| | **C. Language** |
| 14 | The appropriateness of the language used clearly does not contain double meanings |
| 15 | Simplicity of sentence structure that is easy to understand |

Table 1 shows the content validity grid which consists of three aspects, namely material, construction and language. A question item is said to be valid if the minimum score is in the sufficient category. The results of expert validation show that the average value on the content validity index of the test questions for the ability to understand concepts with interpretation is very valid.

Techniques used in this research are divided into two, namely initial data analysis techniques and final data analysis techniques. The first data analysis technique uses pretest results in the experimental and control classes. These results were tested by carrying out a normality test, homogeneity test, and similarity of averages test. Meanwhile, the final data analysis technique uses post-test results from the experimental class and control class. The results were tested by carrying out a normality test, homogeneity test, and two independent sample tests to test whether students had an average ability to understand the concept. with a problem-based learning model learning supported by the ETHLAF APPS application-based on Ethnomathematics is superior to the direct learning model.

## 3. RESULT AND DISCUSSION

### Results

Before testing the problem formulation for a two-sample independent t-test, a prerequisite test is carried out first. The prerequisite test used is the normality test Kolmogorov-Smirnov, the homogeneity test, and the mean similarity test. The data analysis techniques used in this research are. This research uses SPSS software for initial data analysis. Initial data analysis includes hypothesis testing and answering the problem formulation. The first data analysis is the normality test, homogeneity test, and mean similarity test. The normality test determines whether the experimental class and control class data are normally

distributed. The data used in the normality test is in the form of pretest scores on students' conceptual understanding abilities. Data from the normality test analysis results are presented in Table 2.

**Table 2.** Normality Test Kolmogorov-Smirnov

| Class | Kolmogorov-Smirnov | | |
|---|---|---|---|
| | Statistic | df | Sig. |
| Experimental Class | 0.139 | 35 | 0.086 |
| Control Class | 0.144 | 35 | 0.065 |

Based on the prerequisite tests in Table 2, sig. the experimental and control classes were 0.086 and 0.065. Because this value is greater than 0.05, it can be concluded that the experimental class and control class data are normally distributed. The purpose of the Homogeneity Test is to check whether data has a homogeneous variance. The homogeneity of variance test between the control and experimental groups was carried out using Levene's test. Based on data analysis, the sig value was obtained. in the experimental and control classes was 0.058. Because this value is greater than 0.05, it can be concluded that there is a homogeneous variance in the experimental and control class data. The average similarity test was carried out to determine the average value of students' conceptual understanding abilities. Analysis of differences in average conceptual understanding abilities was tested using the posttest results of two independent samples, namely the experimental class and the control class, is presented in Table 3.

**Table 3.** Average Equality Test

| | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|
| | | t | df | Sig. | Mean Difference | Std. Error Difference |
| Learning model | Equal variances assumed | -0.577 | 68 | 0.566 | -1.914 | 3.316 |
| | Equal variances not assumed | -0.577 | 65.398 | 0.566 | -1.914 | 3.316 |

Based on the prerequisite tests in Table 3, the sig. the experimental and control classes reached 0.566. This value is greater than 0.05. It can be concluded that there is no difference in the average ability to understand students' initial concepts between the experimental class and the control class. Final data was obtained from the post-test results of the experimental and control classes. Analysis of final data was carried out based on these two class data. The final data analysis carried out consisted of normality tests, homogeneity tests, and problem formulation analysis. A normality test is used to determine whether the data in the experimental and control classes are normally distributed. The data used in the normality test is in the form of post-test scores for students' conceptual understanding. Data from the normality test analysis results are presented in Table 4.

**Table 4.** Normality Test Kolmogorov-Smirnov

| | Kolmogorov-Smirnov | | |
|---|---|---|---|
| | Statistic | df | Sig. |
| Experimental Class Posttest | 0.145 | 35 | 0.061 |
| Control Class Posttest | 0.126 | 35 | 0.173 |

Normality test in Table 4, the sig values for the experimental class and control class were 0.061 and 0.173. Because this value is greater than 0.05, it can be concluded that the experimental class and control class data are normally distributed. The homogeneity test aims to find out whether the data has a homogeneous variance. The homogeneity of variance test between the control and experimental groups was carried out using Levene's test. Based on the homogeneity test, the sig. the experimental and control classes obtained 0.283. Because this value is greater than 0.05, it can be concluded that the experimental class and control class data have homogeneous variances. Analysis of this research shows that the average ability of students to understand concepts when applying the problem-based learning model with the support of the ETHLAF APPS application based on ethnomathematics is higher than when applying a learning model directly. The data analysis technique used is the t-test on two samples independent because the amount of data to be tested is not specified and the data is based on a proportion scale. The data used for the independent sample t-test were the post-test results of the control and experimental classes. The results of the independent sample t-test are presented in Table 5.

**Table 5.** Independent Sample T-Test

| | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|
| | | **t** | **df** | **Sig.** | **Mean Difference** | **Std. Error Difference** |
| Learning Model | Equal variances assumed | 3.338 | 68 | 0.001 | 11.686 | 3.500 |
| | Equal variances not assumed | 3.338 | 63.765 | 0.001 | 11.686 | 3.500 |

Based on the two independent sample t-tests in Table 5 above, the sig value is obtained. = 0.001,. Because of the sig value. ≤ 0.05. Therefore, it can be concluded that the average ability of students to understand concepts when applying the Problem-based Learning model supported by the ETHLAF APPS application-based on Ethnomathematics is better than when applying the direct learning model. By implementing a Problem-based Learning model supported by the ETHLAF APPS application-based on Ethnomathematics, the experimental class obtained an average post-test score for understanding students' concepts of 81.80 and the control class obtained an average post-test score conceptual understanding of 70.11. This means that the Problem-based Learning model assisted by the ETHLAF APPS application-based on Ethnomathematics in the experimental class is better than the control class which uses a direct learning model. These results were obtained using a Problem-based Learning model supported by ETHLAF APPS application-based on Ethnomathematics which guides students to understand the subject of the concept of a three-variable linear equation system.

**Discussion**

Learning in the experimental class uses a problem-based learning model supported by ETHLAF APPS application-based on Ethnomathematics. The learning process begins when the teacher poses a problem through the ETHLAF APPS application-based on Ethnomathematics which contains questions about a three-variable linear equation system and students are asked to observe and understand the problems presented in the ETHLAF APPS application-based on Ethnomathematics. The teacher then supervises the students and ensures that the students can understand their respective assignments and study the problems presented in ETHLAF APPS application-based on Ethnomathematics together with their group members. The teacher then monitors each group's discussion and ensures the participation of each student in the group during the investigation. Students discuss and exchange ideas or opinions with each other to solve problems involving systems of linear equations in three variables. After that, the teacher calls students to present the results of their discussions in front of the class and guides class discussions to clarify students' understanding of the material they have studied, students routinely present the results of their discussions in front of the class. Each group analyzes the other group's presentation regarding the results of their problem-solving, and the teacher allows the other group to provide answers to the other group's presentation regarding the results of their discussion. Then, the teacher helps students complete the lessons they have learned.

Learning in the control class lasted for four sessions using the same material as the experimental class. Learning in the control class uses a teacher-centered direct learning model. By using a direct learning model, many students feel bored and lose enthusiasm for learning mathematics. Most students only listen to the teacher or read the textbook given by the teacher so that learning becomes less interesting and less effective, and students cannot understand the material presented by the teacher. Apart from that, many students don't want to ask questions while studying. This affects students' ability to understand concepts. Because there are differences in treatment in the experimental class which uses a problem-based learning model supported by the ETHLAF APPS application based on ethnomathematics and the control class which uses a direct learning model, this will certainly have a significant impact on student learning outcomes. This can be proven by the average learning outcomes of the experimental class being better than those of the control class.

Several obstacles were found during the learning process (Hutauruk & Sidabutar, 2020; Kumari et al., 2021). These obstacles are caused by external factors, such as the facilities and infrastructure used for learning, and internal factors, such as low learning activity, the first meeting, or the start of learning. This is because teachers and students are initially involved in the teaching and learning process, and students are not yet familiar with the activities and situations that occur. However, activities at the first meeting can be improved with learning at subsequent meetings. The next meeting allows teachers and students to familiarize themselves with each other. This has a positive impact on the teaching and learning process. However, the learning that takes place at every meeting at SMA N 1 Bae Kudus increases students' enthusiasm for learning and improves their ability to understand concepts during learning. However, there are still differences between the experimental class and the control class.

Based on the results of research that has been conducted, show that the indicators of the ability to understand concepts in the experimental class are better than those in the control class. One of the advantages of the experimental class compared to the control class is that the experimental class uses a "problem-based learning" learning model in its learning process. This is supported by the ETHLAF APPS application based on ethnomathematics. Learning design is needed to improve the ability to understand concepts. One alternative learning design is a learning model (Dwiqi et al., 2020; Julaeha & Erihardiana, 2022). The learning model used in this research is problem-based, namely a learning model that focuses on actions to solve problems in everyday life. Students then actively carry out problem analysis to find answers to questions given by the teacher (Manishimwe et al., 2023; Nguyen & Pham, 2020; Yulianti & Gunawan, 2019). In this case, the teacher acts as a guide and mediator whose job is to help students build knowledge. Applying the problem-based learning model to mathematics learning can help students understand the concept of a three-variable linear equation system better than using a direct learning model because, with this type of learning, students have the opportunity to solve real-life problems. The use of a problem-based learning model compared to a group of students who study with a direct learning model, application of the problem-based learning model allows students to participate actively so they can apply it in learning practice (Riswari & Bintoro, 2020; Miller & Krajcik, 2019; Lidinillah et al., 2022).

Apart from choosing and implementing the right learning model, the use of learning media in learning also influences students' ability to understand concepts. Apart from that, the existence of ethnomathematics, especially culturally relevant mathematics, can also facilitate learning the concept of three-variable linear equation systems. Through cultural values, it will have a positive impact on the formation of the nation's cultural values (Bintoro & Zuliana, 2015; Bintoro et al., 2021; Wanabuliandari, 2017). This can help students improve their conceptual understanding so they can gain a deeper understanding of abstract mathematical concepts. Therefore, learning does not start with understanding, theorems, and examples. However, students are encouraged to re-explore concepts through real-world problems. The average conceptual understanding of students who use Pocket Book learning media based on local wisdom is better than the average conceptual understanding ability of students who use the lecture learning model (Yuwana, et al, 2018).

Students will be enthusiastic about learning by choosing and implementing appropriate learning models and using learning media to support learning in class. Apart from using learning models, learning media are also used to support students' acquisition of concept understanding skills (Afrianti & Musril, 2021; Arisantiani et al., 2017; Nurrita, 2018). The existence of learning models and materials allows students to adapt as learning progresses beyond this pandemic. Students become more enthusiastic and understand learning with learning media because learning media is interactive and certainly not boring (Zuliana et al., 2020; Nurrita, 2018). The conceptual understanding of students who receive the problem-based learning model assisted by Geogebra software is significantly better than learning using the lecture learning model (Maryani, 2021). The existence of media in the form of learning applications increases students' interest and motivation in learning so that their ability to understand concepts will also increase (HS Bintoro et al., 2021; Darmaji et al., 2019; Tang & Yu, 2018).

ETHLAF APPS was chosen as an ethnomathematics-based learning media to increase students' understanding of concepts. The ETHLAF APPS application based on ethnomathematics has several advantages that can improve students' conceptual understanding of the three-variable linear equation system material. First, students can use this application to learn independently and form their understanding. Second, the appearance of this application has cultural elements that make it more interesting and make students enthusiastic about learning. Third, this application can be used flexibly anywhere and at any time because it does not require an internet connection. Fourth, the cultural elements in this application will help students understand the material on three-variable linear equation systems. Fifth, this application also provides knowledge about the culture in Kudus City. Sixth, prerequisite material related to culture can increase students' knowledge before starting to study three-variable linear equation systems.

Mathematical problems are associated with Kudus batik cloth. The batik cloth motif is made into a story problem which is solved using a mathematical formula. Kudus culture which is close to students is expected to foster motivation to learn mathematics. A culture that is close to students is expected to make it easier for students to understand mathematics material so that their ability to understand concepts increases. The seventh advantage is that each subchapter of material in this application is easy for students to understand. Eighth, some problems are by students' conceptual understanding abilities. Finally, this application is also equipped with a final evaluation after students have studied the system of linear equations in three variables. With ETHLAF APPS, students have the opportunity to solve contextual problems effectively. From the analysis above, it can be concluded that the average student's conceptual

understanding ability increases when applying the Problem-Based Learning learning model with the help of the ethnomathematics-based ETHLAF APPS application compared to the direct learning model.

## 4. CONCLUSION

Based on the results of research and discussions that have been carried out, by applying the Problem-based Learning model supported by the ETHLAF APPS application-based on Ethnomathematics, it is known that the average post-test score on conceptual problems in the experimental class is better than the direct learning model. This shows that the average ability of students to understand concepts when applying the problem-based learning model with the support of the ETHLAF APPS application-based on Ethnomathematics is better than when applying the direct learning model, meaning that the problem-based learning model can be used. Supported by ETHLAF APPS application-based on Ethnomathematics have an impact on students' ability to understand concepts. It can be concluded that the presence of a problem-based learning model supported by the ETHLAF APPS application-based on Ethnomathematics has a good impact on student's ability to understand concepts.

## 5. ACKNOWLEDGE

Researchers would like to thank the Institute for Research and Community Service at Muria Kudus University for providing financial support in the form of research grants. We would also like to thank the students of SMA 1 Bae Kudus who have become research subjects. Finally, thanks to the Dean of the Faculty of Teacher Training and Education, Muria Kudus University for the support of facilities and infrastructure in carrying out research.

## 6. REFERENCES

Afrianti, S., & Musril, H. A. (2021). Perancangan Media Pembelajaran TIK Menggunakan Aplikasi Autoplay Media Studio 8 di SMA Muhammadiyah Padang Panjang. *Jurnal Informatika Upgris*, *6*(2), 2–7. https://doi.org/10.26877/jiu.v6i2.6471.

Alpian, Y., Anggraeni, S. W., Wiharti, U., & Soleha, N. M. (2019). Pentingnya Pendidikan Bagi Manusia. *Jurnal Buana Pengabdian*, *1*(1), 66–72. https://doi.org/10.36805/jurnalbuanapengabdian.v1i1.581.

Andriah, A., & Amir, M. F. (2021). Mobile Learning Based on Procedural and Conceptual Knowledge on Fractional for Elementary School. *Jurnal Ilmiah Sekolah Dasar*, *5*(4), 567. https://doi.org/10.23887/jisd.v5i4.40819.

Anggraeni, D., Bintoro, H. S., & Purwaningrum, J. P. (2020). Penggunaan Model Diskursus Multy Reprecentacy Berbantuan Media Kelubang Tarif Untuk Meningkatkan Kemampuan Pemecahan Masalah. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, *9*(5), 625–633. https://doi.org/10.33578/jpfkip.v9i5.8000.

Arisantiani, N. K., Putra, M., & Ganing, N. N. (2017). Pengaruh Model Pembelajaran Children's Learning in Science berbantuan Media Audio Visual terhadap Kompetensi Pengetahuan IPA. *Journal of Education Technology*, *1*(2), 124–132. https://doi.org/10.23887/jisd.v2i3.16150.

Aristawati, N. K., Sadia, I. W., & Sudiatmika, A. A. I. A. R. (2019). Pengaruh Model Problem Based Learning Terhadap Pemahaman Konsep Belajar Fisika Siswa SMA. *JPPF*, *8*(1). https://doi.org/10.23887/jjpf.v8i1.20573.

Bintoro, H S, Zaenuri, & Wardono. (2021). Application of information technology and communication-based lesson study on mathematics problem-solving ability. *Journal of Physics: Conference Series*, *1918*(4), 042105. https://doi.org/10.1088/1742-6596/1918/4/042105.

Bintoro, Henry Suryo, Rahayu, R., & Murti, A. C. (2021). Design of Ethnomathematics Mobile Module To Facilitate Students Mathematical Thinking Ability. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 2362. https://doi.org/10.24127/ajpm.v10i4.4169.

Bintoro, Henry Suryo, Sukestiyarno, Y. L., Mulyono, M., & Walid, W. (2022). The spatial thinking process of the field-dependent students in reconstructing the geometrical concept. *Internasional Journal of Evaluation and Research in Education (IJERE)*, *11*(3), 1116–1124. https://doi.org/10.11591/ijere.v11i3.22399.

Bintoro, Henry Suryo, Sukestiyarno, Y. L., Mulyono, & Walid. (2021). The Spatial Thinking Process of the Field-Independent Students based on Action-Process-Object-Schema Theory. *European Journal of Educational Research*, *10*(4), 1807–1823. https://doi.org/10.12973/eu-jer.10.4.1807.

Bintoro, Henry Suryo, & Zuliana, E. (2015). Pembelajaran Realistic Mathematics Education (RME) Ditinjau Dari Kreativitas Belajar Matematika Siswa Terhadap Prestasi Belajar Matematika Siswa. *Refleksi*

*Edukatika*, *4*(1). https://doi.org/10.24176/re.v4i1.428.
Bosica, J., S.Pyper, J., & MacGregor, S. (2021). Incorporating problem-based learning in a secondary school mathematics preservice teacher education course. *Teaching and Teacher Education*, *102*, 103335. https://doi.org/10.1016/j.tate.2021.103335..
Buckley, J., Seery, N., & Canty, D. (2018). A Heuristic Framework of Spatial Ability: a Review and Synthesis of Spatial Factor Literature to Support its Translation into STEM Education. *Educational Psychology Review*, *30*(3), 947–972. https://doi.org/10.1007/s10648-018-9432-z.
Budiyono. (2019). *Pengantar Metodologi Penelitian Pendidikan*. UNS Press.
Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed). Sage.
Darhim, Prabawanto, S., & Susilo, B. E. (2020). The effect of problem-based learning and mathematical problem posing in improving student's critical thinking skills. *International Journal of Instruction*, *13*(4), 103–116. https://doi.org/10.29333/iji.2020.1347a.
Darmaji, Kurniawan, D. A., Astalini, Lumbantoruan, A., & Samosir, S. C. (2019). Mobile learning in higher education for the industrial revolution 4.0: Perception and response of physics practicum. In *International Journal of Interactive Mobile Technologies* (Vol 13, Number 9). https://doi.org/10.3991/ijim.v13i09.10948.
Dwiqi, G. C. S., Sudatha, I. G. W., & Sukmana, A. I. W. I. Y. (2020). Pengembangan Multimedia Pembelajaran Interaktif Mata Pelajaran IPA Untuk Siswa SD Kelas V. *Jurnal Edutech Undiksha*, *8*(2), 33. https://doi.org/10.23887/jeu.v8i2.28934.
Fahrudhin, A. G., Zuliana, E., & Bintoro, H. S. (2018). Peningkatan Pemahaman Konsep Matematika Melalui Realistic Mathematic Education Berbantu Alat Peraga Bongpas. *Anargya: Jurnal Ilmiah Pendidikan Matematika*, *1*(1), 14–20. https://doi.org/10.24176/anargya.v1i1.2280.
Gal, I., Grotlüschen, A., Tout, D., & Kaiser, G. (2020). Numeracy, adult education, and vulnerable adults: a critical view of a neglected field. *ZDM - Mathematics Education*, *52*(3), 377–394. https://doi.org/10.1007/s11858-020-01155-9.
Hewi, L., & Shaleh, M. (2020). Refleksi Hasil PISA (The Programme For International Student Assesment): Upaya Perbaikan Bertumpu Pada Pendidikan Anak Usia Dini). *Jurnal Golden Age*, *4*(1). https://doi.org/10.29408/goldenage.v4i01.2018.
Hilman, I., & Mainaki, R. (2020). Advantage of Map As Geography Learning Media To Enhance Students Spatial Intelligence. *International Journal of GEOMATE*, *18*(68), 225–232. https://doi.org/10.21660/2020.68.ICGEO30.
Hutauruk, A., & Sidabutar, R. (2020). Kendala pembelajaran daring selama masa pandemi di kalangan mahasiswa pendidikan matematika: Kajian kualiatatif deskriptif. *Journal of Mathematics Education and Applied*, *02*(01), 45–51. https://doi.org/10.36655/sepren.v2i1.364.
Inanna. (2018). Peran Pendidikan Dalam Membangun Karakter Bangsa Yang Bermoral. *Junal Ekonomi dan Pendidikan*, *1*, 27–33. https://doi.org/10.26858/jekpend.v1i1.5057.
Irawati, I. D., Wanabuliandari, S., & Sumaji. (2021). Pengembangan Aplikasi Kreasi Berbasis Local Wisdom Untuk Siswa Kelas VII. *Jurnal Ilmiah Pendidikan Matematika*, *7*(1), 55–71. https://doi.org/10.26877/jipmat.v7i1.11719.
Julaeha, S., & Erihardiana, M. (2022). Model Pembelajaran Dan Implementasi Pendidikan HAM Dalam Perspektif Pendidikan Islam Dan Pendidikan Nasional. *Religion Education Socia Laa Roiba Journal*, *4*(1), 133–144. https://doi.org/10.47467/reslaj.v3i3.449.
Kamid, K., Rohati, R., Rahmalisa, Y., Anggo, M., Septi, S. E., Azzahra, M. Z., & Nawahdani, A. M. (2021). Engklek Game in mathematics: How difference and relationship student attitude towards science process skills? *Cypriot Journal of Educational Sciences*, *16*(6). https://doi.org/10.18844/cjes.v16i6.6500.
Kardoyo, Nurkhin, A., Muhsin, & Pramusinto, H. (2020). Problem-based learning strategy: Its impact on students' critical and creative thinking skills. *European Journal of Educational Research*, *9*(3), 1141–1150. https://doi.org/10.12973/EU-JER.9.3.1141.
Khaesarani, I. R., & Hasibuan, E. K. (2021). Studi Kepustakaan Tentang Model Pembelajaran Think Pair Share (TPS) Dalam Meningkatkan Hasil Belajar Matematika Siswa. *Jurnal Matematika, Sains, dan Pembelajarannya*, *15*(3), 37–49. https://doi.org/10.23887/wms.v15i3.38716.
Kumari, W., Lamirin, & Putra, P. D. (2021). Analisis Kendala Guru Dalam Mendidik Siswa Melalui Pembelajaran Daring Selama Masa Pandemi Covid-19 Di Kingston School Medan. *Jurnal Pendidikan Buddha dan Isu Sosial Kontemporer*, *3*(2), 52–62. https://doi.org/10.56325/jpbisk.v3i2.45.
Lestari, K. E., & Yudhanegara, M. R. (2015). *Penelitian Pendidikan Matematika*. PT. Refika Aditama.
Lidinillah, D. A. M., Rahman, R., Wahyudin, W., & Aryanto, S. (2022). Integrating Sundanese Ethnomathematics Into Mathematics Curriculum and Teaching: a Systematic Review From 2013 To 2020. *Infinity Journal*, *11*(1), 33. https://doi.org/10.22460/infinity.v11i1.p33-54.

Manishimwe, H., Shivoga, W. A., & Nsengimana, V. (2023). Enhancing students' achievement in biology using inquiry-based learning in Rwanda. *International Journal of Evaluation and Research in Education*, *12*(2), 809–817. https://doi.org/10.11591/ijere.v12i2.23375.

Maryani, E. (2021). Meningkatkan Kemampuan Pemahaman Matematis Melalui Model Problem Based Learning Menggunakan Software Geogebra Dan Dampaknya Terhadap Kemandirian Belajar Siswa SMK. *Vocational: Jurnal Inovasi Pendidikan Kejuruan*, *1*(1), 48–57. https://doi.org/10.51878/vocational.v1i1.81.

Masjaya, & Wardono. (2018). Pentingnya Kemampuan Literasi Matematika Untuk Menumbuhkan Kemampuan Koneksi Matematika Dalam Meningkatkan SDM. *PRISMA: Prosiding Seminar Nasional Matematika*, *1*, 568–574. https://doi.org/10.24127/ajpm.v11i2.4882.

Miller, E. C., & Krajcik, J. S. (2019). Promoting deep learning through project-based learning: a design problem. *Disciplinary and Interdisciplinary Science Education Research*, *1*(1), 1–10. https://doi.org/10.1186/s43031-019-0009-6.

Moreno, L. (2018). Penerapan Model Pembelajaran Group Investigation (GI) Pokok Bahasan Transformasi Geometris Untuk Meningkatkan Hasil Belajar Matematika Siswa Kelas XII IPA-2 SMA Negeri 1 Kampar Timur Tahun Ajaran 2017/2018. *Jurnal Pendidikan Tambusai*, *2*(6), 1551–1562. https://doi.org/10.31004/jptam.v2i3.135.

Nguyen, N. G., & Pham, H. T. (2020). Constructivist Learning and the Law of Sines in Advanced 10th Grade Geometry Textbooks in Vietnam. *International Journal of Learning, Teaching and Educational Research*, *19*(1), 38–59. https://doi.org/10.26803/ijlter.19.1.3.

Nurrita, T. (2018). Pengembangan Media Pembelajaran Untuk Meningkatkan Hasil Belajar Siswa. *Misykat*, *03*(01), 171–187. https://doi.org/10.33511/misykat.v3n1.171.

Purwaningrum, J. P., & Bintoro, H. S. (2018). Miskonsepsi Matematika Materi Bilangan Pada Mahasiswa Calon Guru Sekolah Dasar. *Prosiding Seminar Nasional MIPA 2018*, 173–180.

Riswari, L. A., & Bintoro, H. S. (2020). The Ifluence of Problem-Based Learning Model in Improving Student Engagement in Mathematics. *JPsd (Jurnal Pendidikan Sekolah Dasar)*, *6*(2), 158–173.

Soebagyo, J., Andriono, R., Razfy, M., & Arjun, M. (2021). Analisis Peran Etnomatematika Dalam Pembelajaran Matematika. *Anargya: Jurnal Ilmiah Pendidikan Matematika*, *4*(2), 184–190. https://doi.org/10.24176/anargya.v4i2.6370.

Sukestiyarno. (2020). *Metode Penelitian Pendidikan*. UNNES PRESS.

Tang, Y. M., & Yu, K. M. (2018). Development and evaluation of a mobile platform for teaching mathematics of CAD subjects. *Computer-Aided Design and Applications*, *15*(2), 164–169. https://doi.org/10.1080/16864360.2017.1375665.

Wanabuliandari, S. (2017). Pengenalan Budaya Lokal Kota Kudus Melalui Pembelajaran Etnomatematika Pada Anak Usia Dini. *Prosiding Seminar Nasional*.

Yulianti, E., & Gunawan, I. (2019). Model Pembelajaran Problem Based Learning (PBL) : Efeknya Terhadap Pemahaman Konsep Dan Berpikir Kritis. *Indonesian Journal of Science and Mathematics Education*, *02*(3), 399–408. https://doi.org/10.24042/IJSME.V2I3.4366.

Yuwana, C. A. R., Ariyanto, L., & Harun, L. (2018). Pengembangan Media Pembelajaran Pocket Book Berbasis Kearifan Lokal Untuk Meningkatkan Pemahaman Konsep Matematis Siswa SMP. *Jurnal Ilmiah Pendidikan Matematika*, *8*(1), 1–18. https://doi.org/10.26877/jipmat.v8i1.14442.

Zuliana, E., Oktavianti, I., Ratnasari, Y., & Bintoro, H. S. (2020). Design and application of marionette tangram: An educational teaching media for mathematics and social science learning process in elementary schools. *Universal Journal of Educational Research*, *8*(3), 931–935. https://doi.org/10.13189/ujer.2020.080326.