

The Effect of Project-Based Learning Models Aided by Teaching Materials Through Internet Technology to Improve Analytical and Comprehension Mathematical Concepts Ability

Indah Fitria Rahma^{1*}, Nurlina Ariani Hrp², Syntyia Lestari Sinulingga³, Siti Amroh Harahap⁴, Tata Suhita Pramesti⁵

¹²³⁴⁵Jurusan Pendidikan Matematika, FKIP, Universitas Labuhanbatu

Jl. Sisingamangaraja No 125 – A KM 3,5, Rantauprapat, Sumatera Utara, Indonesia

*Author Correspondence. E-mail: indahfitria286@gmail.com, Telp. 082363003230

Abstract

The purpose of the study was to determine the effect of the project-based blended learning model with the help of teaching materials through the use of internet technology on increasing analytical skills and understanding concepts, especially the mathematical field of students during the Covid-19 pandemic at SMP Negeri 1 Kotapinang. The research design used a 2 x 2 factorial design with a quasi-experimental type of research. The research population was students of SMP Negeri 1 Kotapinang with a sample of two classes, namely class VIII-2 and VIII-3 with the number of each class being 30 students. The research instrument uses a test of analytical skills and understanding of mathematical concepts with reference to the combination of each achievement indicator. The results of the analysis found that from 30 students in the experimental class there were 8 students with pretest results in the poor category with a percentage of 27% and 22 students in the very poor category with a percentage of 73%. While the results of the post-test showed that 14 students got a special category with a percentage of 47% and 16 students got a very good category with a percentage of 53%. The results of the analysis of statistical testing using the t test at a significance level of $\alpha = 0.05$ obtained t count of 1.25 with a significance value of 0.000 while t table of 1.12. Because $t_{count} > t_{table}$ ($1.25 > 1.12$) and $significance < 0.05$ ($0.000 < 0.05$), then H_0 is rejected so that the expectation hypothesis is accepted. Therefore, it was concluded that there was a significant effect of the application of the project-based blended learning model on improving students' analytical skills and understanding of mathematical concepts compared to the application of the ordinary learning model.

Keyword: *Blended Learning, Project, Internet*

INTRODUCTION

The Covid-19 pandemic has resulted in a change in the model of implementing education. Especially in Indonesia, many things have been hampered and the expected achievements have been delayed. The limited learning time at school due to the COVID-19 pandemic has resulted in many changes and low learning outcomes. This is an obstacle to achieving national education goals as stated in Article 3 of Law no. 20 of 2003, namely that national education functions to develop capabilities and shape the character and civilization of a dignified nation in the context of the intellectual life of the nation. To achieve this goal, the ideas of researchers and experts are needed in overcoming the problems that occur by providing solutions to be applied. One of the problems occurred in SMP Negeri 1 Kotapinang, namely the learning achievement at the school was very low, where the school experienced a decrease in student interest in learning, which resulted in students' ability to analyze and understand concepts was also very low. Analytical skills are skills in collecting and analyzing information, solving problems, and making decisions (Saktiani, 2016). The ability to understand concepts is the mastery of a number of learning materials, where students do not just know and know, but are able to re-express concepts in a form that is easier to understand and able to apply them. Mathematics learning is said to be effective if students are able to develop representational skills to improve understanding of concepts as a problem-solving tool (Leinward, 2014). Understanding according to Bloom is how much students are able to accept, absorb, and understand the material provided



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E: mercumatika@mercubuana-yogya.ac.id



by the teacher. In addition to the material, understanding here also means understanding what students read, see, experience, and feel (Susanto, 2016). The development of technology can be utilized in the learning process in order to help achieve learning objectives properly. Information, communication and technology (ICT) capabilities can provide dynamic and proactive teaching in a learning environment (Ghavifekr, 2014). Nadya Chyntia Khairunnisa's research (2019), that the low ability to understand concepts is indicated by the number of students who are still unable to restate the solutions to the problems given. The reason for making mistakes in the first indicator is that students have not been able to restate a concept using their own language. Even though understanding the concept is very important for student development, because if students have understood the concept correctly, students can solve the problems that exist (Nadya, 2019).

The teacher also stated that the reduced learning time at school resulted in the difficulty of providing maximum material and assignments. The application of face-to-face learning restrictions due to the impact of the COVID-19 pandemic is one of the causes of the lack of interaction between teachers and students, learning is often done online, but still not optimal. Due to the inefficient condition of learning time in schools, students are less effective in receiving learning and the potential for students' ability to analyze concepts that should be obtained in the learning process is reduced. This is evidenced by researchers through data observations and direct interviews with students, teachers, and parents. The results of the interview mentioned the inconvenience of parents in seeing the learning conditions of students who left a lot of free time. The teacher also shows that students' scores in learning assignments tend to decrease, if given questions in the form of questions to test understanding of mathematical concepts the results are below the average of 50, because students are not able to understand the material just by reading and working on questions. Students' mathematics learning achievement in odd semesters averaged 60. These data indicate the low ability of students in learning mathematics. Reducing study time at school during the pandemic makes it difficult to provide maximum material and assignments to students.

To overcome this, a quality learning model is needed that can be adapted to learning during the pandemic while maintaining the quality of learning and learning between students and teachers even with a limited time. The project-based Blended Learning model is considered to be able to overcome this problem and is considered suitable to be applied in learning because the learning process during the pandemic uses internet access a lot. Project-based learning is a student-centered learning model to conduct an in-depth investigation of a topic. Students constructively carry out deepening learning with a research-based approach to serious, real, and relevant problems and questions. Blended learning is a learning model that combines face-to-face with technology-based learning which can be accessed online and offline (Dwiyogo, 2016). The blended learning model is a mixed system that combines two components or learning methods at once that combines face-to-face learning with technology-based learning that can be accessed online or offline or often referred to as e-learning (Thorne, 2013) (Dwiyogo, 2013).

Learners conduct exploration, assessment, interpretation, synthesis, and information to produce various forms of learning outcomes. The topic in the project approach must be concrete, close to the child's personal experience, interesting, emotionally and intellectually potential related to everyday life so that children can be active and creative in solving problems (Amelia, 2021). Combining blended learning with projects is a learning that can be applied to maximize learning. With the application of internet technology along with giving assignments or project-based learning methods, it gives students a lot of time to complete their workloads, find information and get instructions to solve problems, then be able to work together with the team in a timely manner. Limited face-to-face learning is maximized by online learning and project learning methods, where after getting the material then it is applied in project assignments. The project-based blended learning model maximizes learning time in project assignments with online teacher monitoring. Project assignments make students able to understand concepts from previously received material. Judging from Nunung Nurhadi's research in 2020, which states that this model can develop students' knowledge by making maximum use of online communication. The effectiveness of blended learning functions to increase insight and knowledge through online and improve skills through offline, while attitudes are obtained from

online and offline learning. The topic in the project approach must be concrete, close to the child's personal experience, interesting, emotionally and intellectually potential related to everyday life so that children can be active and creative in solving problems (Amelia, 2021). Learning that uses full online is considered inappropriate for learning that requires face-to-face because there is material that is required to be practiced to get an understanding of the concept (Nurhadi, 2020).

METHOD

The design of this study used a 2 x 2 factorial design with a quasi-experimental type of research. The research population was students of SMP Negeri 1 Kotapinang with sampling using cluster random sampling technique from 6 classes and two classes were selected as sample classes, namely class VIII-2 and VIII-3 with the number of each class was 30 students. Prior to the model application activity, a pre-test (pretest) of the question grid based on indicators was given to determine the initial ability level of students' analytical skills and understanding of mathematical concepts. The indicator of the analysis skill of this research as below (Saktiani, 2016).

Table 1. The analysis skill Indicators in this research

No	Indicator
1	Breaking down and drawing up diagrams
2	Distinguish and identify
3	Illustrate
4	Show and conclude
5	Connect, choose, separate, share

The indicator of the concept understanding skill of this research as below (Kristanti, 2019).

Table 2. The concept understanding skill Indicators in this research

No	Indicator
1	Restate the concepts that have been learned
2	Classifying objects based on mathematical concepts
3	Applying concepts algorithmically
4	Give an example or counter example of the concept being studied
5	Presenting concepts in various representations
6	Relate various mathematical concepts internally or externally

Then continued to carry out learning with a project-based blended learning model in the experimental class which was carried out directly by the researcher, while the control class was applied using a conventional model. During the activity, observations were made at each stage of the activity to determine the development of learning activities. Then give a final test, namely posttest to the two classes to determine the success of the research. The final stage is collecting and compiling research data as analysis material to

draw conclusions and determine research hypothesis decisions. The results of research observations are used as data to be analyzed qualitatively. Meanwhile, the data of students' ability to analyze and understand mathematical concepts will be analyzed quantitatively. The data analysis technique used in this research is descriptive and inferential statistical techniques. Descriptive statistical techniques were used to describe the data, while inferential statistical techniques were used to test research hypotheses using two-way analysis of variance with 2x2 factorial design at a significance level of 5% (Sudjana, 2000). Prior to the two-way ANOVA analysis, the normality test was carried out using the Liliefors test, and the homogeneity requirement was tested using the Bartlett test. If the results of the calculated F analysis have an interaction between the two independent variables on the dependent variable, then further analysis is carried out with the Scheffe test. The research instrument used 2 test questions for analytical skills and conceptual understanding abilities.

RESULTS AND DISCUSSION

The purpose of this study was to determine the increase in students' analytical skills and understanding of mathematical concepts after being given learning using a project-based blended learning learning model, then see the magnitude of the effect of the application of the model on the expected improvement. To find this out, it takes test data obtained before (pretest) and after (post-test) giving learning treatment both in the experimental class and in the control class. To obtain data on increasing mathematical representation ability, the normalized gain index formula is used.

The mathematical test was administered twice, namely the pretest and the posttest with equivalent types of questions. The test data were obtained from 60 students, consisting of 30 students in the experimental group with the application of the researcher's learning and 30 students in the control group with the application of the ordinary learning model by the teacher. The results of the analysis of pretest and posttest data obtained the lowest score (X_{min}), the highest score (X_{max}), the average score (\bar{X}) and standard deviation (s) for the experimental class and control class, which is in Table 3 below:

Table 3. Pretest and Posttest Results Data

Model Learning	Ideal Score	Pretest Score				Posttest Score			
		X_{min}	X_{maks}	\bar{X}	s	X_{min}	X_{maks}	\bar{X}	s
Project-based Blended Learning	100	35	55	45.03	5.816	70	90	80.63	8.60897
Ordinary Learning		40	55	44,20	4.139	35	70	51.13	9.999

The percentage diagram of the achievement of mathematical ability values based on research results can be seen in Figure 1 below.

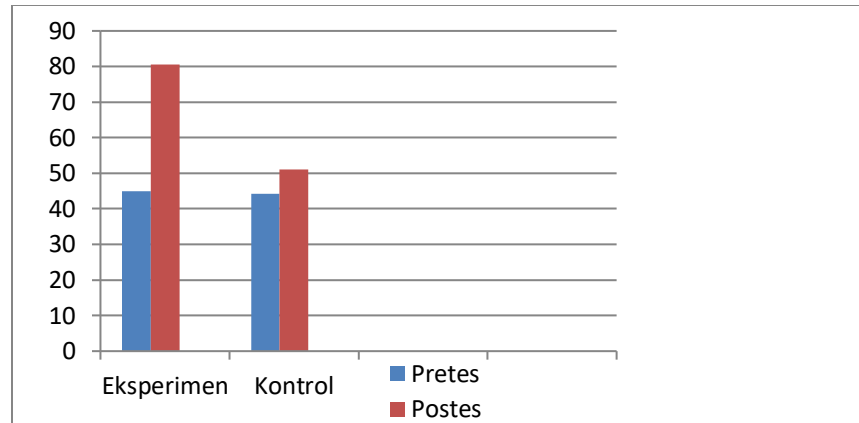


Figure 1. Diagram of the Percentage of Achievement in the Ability of Analysis and Understanding of Mathematical Concepts

The analytical ability and understanding of students' mathematical concepts are expressions of mathematics that are displayed by students in their efforts to find a solution to the problem they are facing. The data from the research results of students' mathematical tests consist of pretest and posttest obtained from test results in the form of a description with 5 items with a maximum score of 20. The test instrument given refers to the combination of indicators of analytical ability and understanding of mathematical concepts.

Other analysis results found that from 30 students in the experimental class there were 8 students with pretest results in the poor category with a percentage of 27% and 22 students in the very poor category with a percentage of 73%. While the results of the post-test showed that 14 students got a special category with a percentage of 47% and 16 students got a very good category with a percentage of 53%.

The mathematical analysis ability assessment instrument refers to 5 indicators of ability, namely (1) students are able to detail and draw up diagrams; (2) students are able to distinguish and identify; (3) students are able to illustrate; (4) students are able to show and conclude, then (5) students are able to connect, select, separate, and divide. The instrument for assessing the ability to understand concepts refers to 6 indicators of ability, namely (1) students are able to restate the concepts they have learned; (2) students are able to classify objects based on mathematical concepts; (3) students are able to apply concepts algorithmically; (5) students are able to present concepts in various representations; furthermore (6) students are able to relate various mathematical concepts internally or externally. The test which consists of 5 items includes a combination of each of these indicators which is applied into 5 steps of assessment reference on the 5 items.

The achievement indicators were developed to be owned by every student in the previously given learning cycle, namely using a project-based blended learning model with the help of teaching materials that have been prepared from the internet. Each student is given the material and understanding of the teaching materials, and students are given project assignments with the guidelines described on the task sheets previously given during face-to-face learning. Each task given has been designed by applying 5 reference indicators of analytical skills and understanding of mathematical concepts. The adapted learning materials still refer to the student handbooks that have been provided from the school. Teaching materials from the internet as teaching materials and student references to make it easier to learn and get audio-visual information without a teacher having to accompany.

The representation of the difference in the results of the pretest and posttest scores at each step of the test questions can be seen in Figure 2 below.

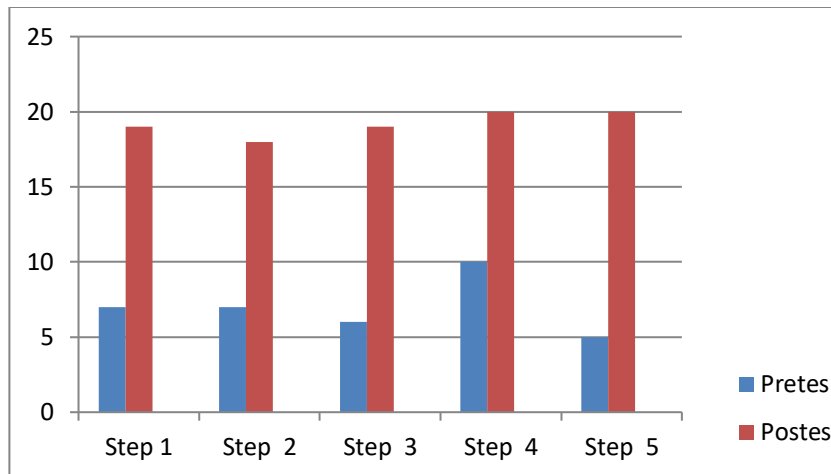


Figure 2. Diagram of Differences in Achievement of Pretest and Posttest Scores

The diagram in Figure 2 above shows that there is a significant difference in the achievement of scores on the y-axis for each student's mathematical step on the pretest and posttest questions. Seen an increase in the pretest and posttest scores at each step of problem solving. The pretest scores in steps 1,2,3, 4 and 5 are 7, 7, 6, 10 and 5 respectively while the posttest scores in steps 1,2,3,4 and 5 are 19, 18, 19, 20 and 20 with a maximum score of 20 on each test question. This shows that the achievement of 5 steps in solving problems in the test questions as research instruments given to students is very well achieved.

The test results show that the data gain group of mathematical representation ability comes from a normally distributed population with the variance of each pair of homogeneous data groups. Normalized gain or N-gain analysis aims to determine the effectiveness of the use of blended learning learning models in experimental design research.

Table 3. N-Gain Means and Classification of Mathematical Ability

Kelas	Rataan N-Gain	Klasifikasi
Eksperimen	0,803	Tinggi
Kontrol	0,420	Rendah

Based on the data in table 3 above, it can be seen that students who received blended learning had a higher average N-gain score than students who received ordinary learning. Classification of the experimental class N-gain score is in the high category, while the control class's N-gain score classification is in the low category. To find out whether the increase in analytical skills and understanding of mathematical concepts of the experimental class is better than the control class, a test of the difference in the mean N-gain score is carried out with the independent t-test. From the analysis results obtained p-value or sig. (2-tailed) that is sig. (1-tailed) = 0.00 < . This shows that the increase in mathematical problem solving ability of experimental class students is better than the control class.

The results of the analysis of statistical testing using the t test at a significance level of = 0.05 obtained t count of 1.25 with a significance value of 0.000 while t table of 1.12. Because tcount > ttable (1.25 > 1.12) and significance < 0.05 (0.000 < 0.05), then H0 is rejected so that the expectation hypothesis is accepted. Therefore, it was concluded that there was a significant effect of the application of the project-based blended learning model on improving students' analytical skills and understanding of mathematical concepts compared to the application of the ordinary learning model.

CONCLUSION

The improvement of students' analytical skills and understanding of mathematical concepts through project-based blended learning models assisted by internet technology teaching materials is better than through ordinary learning models carried out by teachers in schools. During the covid-19 pandemic, students are given learning by combining two learning models, namely face-to-face and online, which can still be carried out well. The project method applied to online learning with the help of teaching materials that have been prepared from the internet has a high impact on improving students' conceptual understanding even without face-to-face learning in class. This learning model is expected to be applied in other learning and schools as well as better developed by subsequent researchers.

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