The Effectiveness of Using the EnveMath Learning Application to Improve Students' Critical Thinking Skills

Yossi Novitaningsih[1], Nafida Hetty Marhaeni[1]*

[1] Mathematics Education, Mercu Buana University Yogyakarta. Special Region of Yogyakarta, Indonesia

*Correspondence: E-mail: nafidahm@mercubuana-yogya.ac.id

Abstrak

Kemampuan berpikir kritis merupakan keterampilan esensial pada abad ke-21. Dengan adanya perkembangan TIK, kemampuan berpikir kritis dapat diintegrasikan dengan aplikasi pembelajaran. Tujuan penelitian ini adalah mengetahui efektivitas penggunaan aplikasi pembelajaran EnveMath untuk meningkatkan kemampuan berpikir kritis siswa. Jenis penelitian ini adalah penelitian eksperimen dengan desain pretest posttest control group design. Populasi yang digunakan dalam penelitian ini adalah siswa kelas VIII di SMP Negeri 11 Yogyakarta. Sampel dalam penelitian ini yakni kelas VIII C sebagai kelas eksperimen dan kelas VIII D sebagai kelas kontrol dengan masing-masing kelas berjumlah 34 siswa. Teknik pengumpulan data menggunakan wawancara, observasi, dan soal tes kemampuan berpikir kritis pada materi peluang. Hasil penelitian menunjukkan bahwa penggunaan aplikasi pembelajaran EnveMath efektif meningkatkan kemampuan berpikir kritis. Hal ini dikarenakan aplikasi pembelajaran EnveMath membimbing siswa dalam menganalisis permasalahan matematika secara logis dan sistematis melalui indikator berpikir kritis yang disajikan dalam aplikasi. Hal ini didukung dengan hasil uji statistik data dimana berdasarkan uji Wilcoxon Signed Ranks Test dari kelas eksperimen dan kelas kontrol mempunyai sig. (2-tailed) $< 0{,}05$, uji Mann-Whitney U Test mempunyai sig. (2-tailed) $< 0{,}05$ yang berarti penggunaan aplikasi pembelajaran EnveMath di kelas lebih efektif daripada kelas yang tidak menggunakan aplikasi pembelajaran EnveMath. Kemudian, uji perbedaan rata-rata menunjukkan peningkatan rata-rata kelas eksperimen lebih besar dibandingkan peningkatan rata-rata kelas kontrol (49,26 > 25,41). Dengan demikian, penggunaan aplikasi pembelajaran EnveMath saat pembelajaran matematika efektif meningkatkan kemampuan berpikir kritis siswa.

Kata Kunci: Aplikasi Pembelajaran, Berpikir Kritis, Efektivitas Media.

Abstract

Critical thinking skills are essential skills in the 21st century. With the development of ICT, critical thinking skills can be integrated with learning applications. The purpose of this study is to determine the effectiveness of using the EnveMath learning application to improve students' critical thinking skills. This type of research is an experimental research with a pretest posttest control group design. The population used in this study is grade VIII students at SMP Negeri 11 Yogyakarta. The sample in this study is class VIII C as an experimental class and class VIII D as a control class with each class totaling 34 students. The data collection technique uses interviews, observations, and critical thinking test questions on opportunity materials. The results of the study show that the use of the EnveMath learning application is effective in improving critical thinking skills. This is because the EnveMath learning application guides students in analyzing mathematical problems logically and systematically through critical thinking indicators presented in the application. This is supported by the results of the statistical data test which is based on the Wilcoxon Signed Ranks Test test from the experimental class and the control class has a sig. (2-tailed) < 0.05, the Mann-Whitney U Test has a sig. (2-tailed) < 0.05 which means that the use of the EnveMath learning application in the classroom is more effective than the class that does not use the EnveMath learning application. Then, the mean difference test shows that the average increase in the experimental class is greater than the average increase in the control class (49.26 > 25.41). Thus, the use of the EnveMath learning application during learning Mathematics is effective in improving students' critical thinking skills.

***Keyword**: Learning Applications, Critical Thinking, Media Effectiveness.*

INTRODUCTION

The development of Information and Communication Technology (ICT) has had a significant impact in various aspects of life, including in the world of education (Suradji, 2018). The use of technology in learning has become one of the main focuses to create innovative, interactive, and effective learning (Wibowo, 2023). One of the great challenges in education is improving students' critical thinking skills, which is considered one of the essential skills of the 21st century (Zubaidah, 2016). Zubaidah (2010) Putting forward critical thinking is the ability to analyze, evaluate, and synthesize information logically and

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E : mercumatika@mercubuana-yogya.ac.id

systematically. This ability is necessary so that students can face various problems, make the right decisions, and develop creative solutions (Nuryanti et al., 2018). However, students still face difficulties in critical thinking, especially in mathematics learning (Nurazizah & Nurjaman, 2018).

Mathematics is one of the subjects that requires students' critical thinking skills (Rachmantika & Wardono, 2019). Critical thinking skills in mathematics learning can help students analyze mathematical problems logically and systematically (Sulistiani & Masrukan, 2017). This is as conveyed by Azizah et al., (2018) that students with high critical thinking skills tend to be able to solve the given mathematical problems. This is reinforced by research (Gusmawan et al., 2021) which states that critical thinking skills are important to be mastered by students. However, the critical thinking skills of SMP Negeri 11 Yogyakarta students are still very low. Of the total 34 students who took the critical thinking ability test, there were 62% of students who had very low critical thinking skills, 32% of students had low critical thinking skills, and only 6% of students had moderate critical thinking skills. Therefore, the critical thinking skills of grade VIII students at SMP Negeri 11 Yogyakarta still need to be improved.

Based on the results of interviews with 8th grade students of SMP Negeri 11 Yogyakarta, the low critical thinking ability of students is caused by various factors. These factors include less varied teaching methods, low student interest in mathematics subjects, students' self-confidence in expressing opinions, and limited learning media that support the development of critical thinking skills. Therefore, learning media is needed that can improve students' critical thinking skills. One of the solutions that can be offered is the use of learning applications.

Technology-based learning applications have the ability to present learning that is more interesting, interactive, and relevant to student needs (Putra & Primary, 2023). One of the technological innovations that can be used is the EnveMath learning application. EnveMath is a technology-based learning app specifically designed to help students understand math concepts. The app is equipped with interactive features that allow students to learn independently, complete various exercises, and explore concepts through simulations and visualizations. This is supported by the results of preliminary studies that show that students want features such as explanations with pictures, explanations with videos, practice questions, and problem solving. In addition, 82% of grade VIII C students at SMP Negeri 11 Yogyakarta are interested in learning applications.

The material that will be integrated into the EnveMath application is the opportunity material. Opportunity material in mathematics is one of the topics that requires deep understanding and critical thinking skills (Herdiansyah, 2018). Understanding opportunities requires not only procedural knowledge, but also analytical abilities to determine the likelihood of events in a variety of contexts (Zainudin & Utami, 2021). Unfortunately, traditional learning approaches often only emphasize problem solving without providing space for students to develop critical thinking skills (Sartika, 2019). This causes many students to find it difficult to understand the concept of opportunity comprehensively (Surachman et al., 2024).

Based on previous research, there is empirical evidence that shows that the use of technology in learning can improve student learning outcomes, including critical thinking skills (Hafeez, 2021; Mejia & Sargent, 2023; Supriyanto et al., 2020). However, research on the effectiveness of the EnveMath application in mathematics learning, especially in opportunity materials, is still limited. Therefore, this study aims to evaluate the effectiveness of the EnveMath learning application in improving the critical thinking skills of 8th grade junior high school students on opportunity materials.

RESEARCH METHODS

The type of research conducted is experimental research using *a pretest posttest control group design*. The population used in this study is grade VIII students of SMP Negeri 11 Yogyakarta. The sample used was students of grades VIII C and VIII D. Sample selection was carried out using *a purposive sampling technique*, where the class with the lowest average Final Semester Assessment (PAS) was used as an experimental class, namely class VIII C as many as 34 students, while the class with the highest average Final Semester Assessment (PAS) was used as a control class, namely class VIII D as many as 34 students. In the experimental class, treatment is given when learning takes place using the EnveMath learning application, while in the control class, direct learning with commonly used teaching materials. The data collection techniques in this study are interviews, observations and *posttest pretest questions.* The hypothesis of this study is the use of the EnveMath learning application which can improve students' critical thinking skills, rather than learning without using the EnveMath learning application. The data analysis techniques used in this study are normality test and homogeneity test, Paired Sample T-Test, Independent Sample T-Test, and mean difference test. The data analysis technique is used if the data meets the prerequisite tests, namely the normality test and the homogeneity test. If it does not meet the prerequisites,

a non-parametric statistical test data analysis technique will be used. The data analysis techniques used were normality and homogeneity tests, Wilcoxon Signed Ranks Test, Mann-Whitney U Test, and mean difference test. Meanwhile, the level of significance used is . 0,05

RESULTS AND DISCUSSION

The results of the study presented are experimental researchers using the EnveMath learning application to improve critical thinking skills. The EnveMath learning application was developed using FRISCO critical thinking criteria (focus, reason, inference, situation, clarity) according to Ennis (1991) with indicators such as providing simple explanations, building basic skills, making conclusions, giving further explanations, and determining strategies and tactics. The EnveMath learning application developed by the researcher is only used in experimental classes. Where the research results obtained were assisted by instruments for *pretest* and *posttest* questions on critical thinking skills on opportunity material. *The pretest* was given for the control class on October 24, 2024 and for the experimental class on October 25, 2024. Meanwhile, *the posttest* was given for the control class on November 4, 2024 and for the experimental class on November 6, 2024. After the *pretest* and *posttest* questions were given to the experimental class and the control class, the researcher performed calculations using *IBM* Statistic 25 software to obtain a conclusion on the effectiveness of using the EnveMath learning application. The testing steps carried out are as follows:

1. Prerequisite Test

   The prerequisite tests used are normality test and homogeneity test. This prerequisite test is used on *pretest* and *posttest data* to determine whether the data is normal and homogeneous.

   a. Normality Test

      The normality test uses *SPSS* Statistic *25* software with the Shapiro Wilk normality test. The results of *the pretest* and *posttest* normality test of the experimental class and the control class can be seen in Table 1 as follows:

Table 1. Normality Test Results

Data	Sig Value.	Category
Experimental Class Pretest	0,252	Usual
Experimental Class Posttest	0,001	Abnormal
Control Class Pretest	0,618	Usual
Posttest Control Classes	0,023	Abnormal

      To know whether the distribution of data is normal or not, the significance value obtained must be greater than Based on Table 1, that the $0{,}05\ (> 0{,}05)$.*pretest values of* the experimental class and control are normally distributed, while the *posttest values of the* experimental class and control class are abnormally distributed.

   b. Homogeneity Test

      The homogeneity test uses *SPSS* Statistic *25* software *with* the Levene *Statistic homogeneity test*. The results of the pretest and posttest homogeneity test of the experimental class and the control class can be seen in Table 2 as follows:

Table 2. Homogeneity Test Results

Data	Sig Value.	Category
Pretest	0,212	Homogeneous
Posttest	0,959	Homogeneous

      To find out whether the data is homogeneous or not, the significance value obtained must be greater than $0{,}05\ (> 0{,}05)$. Based on Table 2, that the *pretest* and *posttest values of* critical thinking ability are homogeneous.

      The results of the prerequisite test above can be concluded that *the pretest* and *posttest* values of the experimental class and the control class have abnormal data. Therefore, the prerequisite test was not met. So, to determine the effectiveness of using the EnveMath learning application, *pretest* and *posttest* data will be analyzed by non-parametric statistical tests and mean difference tests.

2. Effectiveness Test

   a. *Wilcoxon Signed Ranks Test*

      The *Wilcoxon Signed Ranks Test* is a part of the non-parametric test that aims to find out if there is an average difference between two paired samples. In addition, the *Wilcoxon Signed Ranks Test* aims to find out whether or not there is an influence from the *treatment* that has been carried out. *The Wilcoxon Signed Ranks Test* was conducted using SPSS *Statistic* 25 software. The following are the results of *the Wilcoxon Signed Ranks Test:*

1) The Effect of Mathematics Learning Using the EnveMath Learning Application on Critical Thinking Skills
This test was carried out using *pretest* and *posttest data* on critical thinking skills of the experimental class. The test results are presented in Table 3 below:

Table 3. Experimental Class Test Results

***Pretest Posttest* Experimental Classes**	
Z	*-5,089*
Asymp. Sig. (2-tailed)	*0,000*

Based on Table 3, it shows that *Sig. (2-tailed)* $< 0{,}05$ shows that there is an improvement in critical thinking skills in the experimental class before and after the implementation of learning using the EnveMath learning application.

2) The Effect of Mathematics Learning Without Using the EnveMath Learning Application on Critical Thinking Skills
This test was carried out using *pretest* and *posttest data* for the critical thinking ability of the control class. The test results are presented in the following Table 4:

Table 4. Control Class Test Results

***Pretest Posttest* Control Class**	
Z	*-5,077*
Asymp. Sig. (2-tailed)	*0,000*

Based on Table 4, it shows that *Sig. (2-tailed)* $< 0{,}05$ means that there is an increase in critical thinking skills in the control class before and after the implementation of learning without using the EnveMath learning application.

b. Mann-Whitney U Test
The Mann-Whitney U Test is one of the parts of the non-parametric test that aims to find out which learning is more effective in improving students' critical thinking skills and learning interests. The Mann-Whitney U Test will use the posttest data of the control class and the experimental class. The Mann-Whitney U Test on critical thinking skills will use a posttest of critical thinking skills. The Mann-Whitney U Test uses SPSS Statistic 25 software. The results of the Mann-Whitney U Test on critical thinking skills are presented in Table 5 presented as follows:

Table 5. *Mann-Whitney U Test Results*

Posttest Results	
Mann-Whitney U Test	*238.500*
Wilcoxon W	*833.500*
Z	*-4.201*
Asymp. Sign. (2-tailed)	*0.000*

Based on Table 5 shows *Sign. (2-tailed)* $< 0{,}05$Therefore, it can be concluded that learning using the EnveMath learning application is more effective in improving critical thinking skills than learning without using the EnveMath learning application.

c. Average Difference Test
In addition to using the *Wilcoxon Signed Ranks Test* and *the Mann-Whitney U Test* for effectiveness tests, there will also be a comparison of the average increase in the experimental class and the control class. The average comparison test will be carried out using *pretest* and *posttest data for* critical thinking skills. The results of the calculation of the difference in the average increase in the *pretest* class and *the posttest* class for critical thinking skills can be seen in table 6 as follows:

Table 6. Statistics of *Pretest* and *Posttest Results* of Experimental Classes and Control Classes

Aspects	**Experimental Classes**	**Control Classes**
Grade Point Average	*Pretest*: 38,41 *Posttest*: 88,68	*Pretest*: 50,44 *Posttest*: 75,85
Average Increase	49,26	25,41

Table 6 shows that the control class experienced an increase in scores with an average of 25.41, while the experimental class experienced an increase in scores with an average of 49.26

Through the results obtained, it can be concluded that learning using the EnveMath learning application is more effective in improving students' critical thinking skills.

Based on the results of the effectiveness test that has been carried out, it can be concluded that the use of the EnveMath learning application can improve critical thinking skills. The difference in the average increase in *pretest* and *posttest* in the experimental class and the control class is presented in Figure 1, which is as follows:

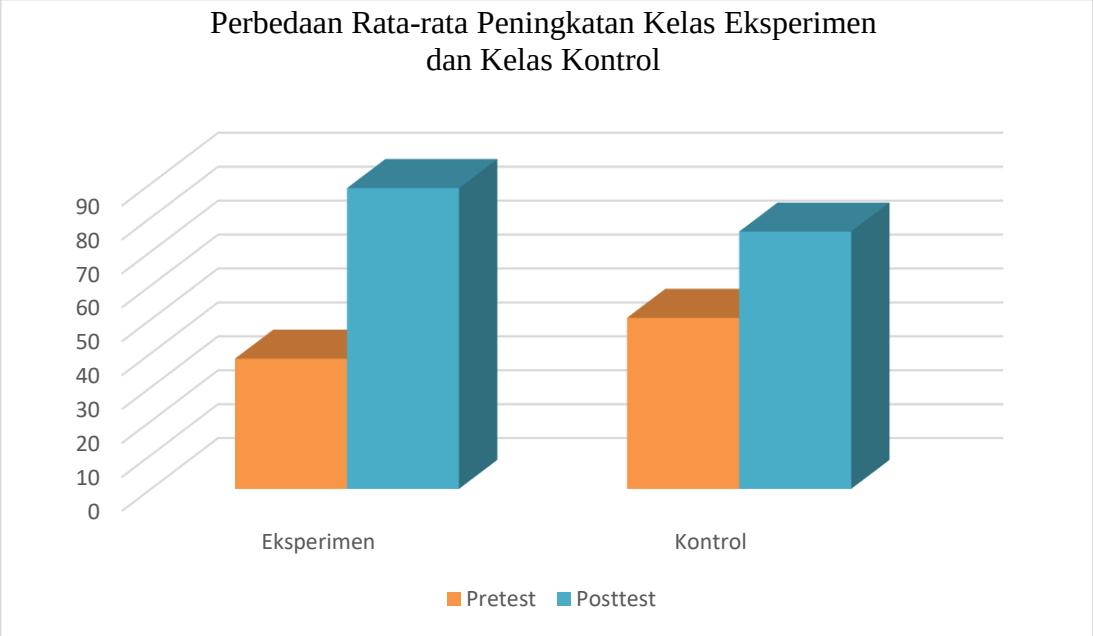

Figure 1. Difference in Average Increase

Figure 1 shows a significant improvement in the experimental class using the EnveMath learning application. This is because the learning application contains indicators of critical thinking skills, namely providing simple explanations, building basic skills, making conclusions, giving further explanations, and determining strategies and tactics. Based on these results, the use of the EnveMath learning application is effectively used to improve critical thinking skills.

CONCLUSION

This study concludes that the use of the EnveMath learning application has been proven effective in improving students' critical thinking skills. This is because the EnveMath learning application contains critical thinking indicators. The results of the statistical test, namely the *Wilcoxon Signed Ranks Test* test from the experimental class and the control class, have *a sig. (2-tailed)* $< 0{,}05$, The *Mann-Whitney U Test* has *a sig. (2-tailed)* $< 0{,}05$ which means that the use of the EnveMath learning app in the classroom is more effective than the class that does not use the EnveMath learning app. In addition, based on the mean difference test, it also showed that the average increase in the experimental class was greater than the average increase in the control class (49.26 > 25.41). Then, the average difference test in the experimental class and the control class showed an increase of 49.26 and 25.41 which means that learning mathematics using the EnveMath learning application is more effective in improving students' critical thinking skills than learning mathematics without using the EnveMath learning application.

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