Students' Mathematical Critical Thinking Ability: Influenced by Edpuzzle Assisted Problem Based Learning (PBL) Model

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Abstrak

Permasalahan yang terjadi saat ini keterampilan berpikir kritis siswa relatif rendah, kemampuan yang rendah ini karena siswa masih menghafal materi dan rumus daripada memahami konsep. Selain itu, kemampuan berpikir kritis matematis siswa dalam menganalisis suatu masalah terbilang rendah. Tujuan penelitian ini yaitu menganalisis pengaruh penggunaan model PBL berbantuan Edpuzzleon terhadap kemampuan berpikir kritis matematis siswa. Penelitian ini menggunakan metode kuantitatif. Desain penelitian yang digunakan adalah post-test only control. Teknik pengambilan sampel menggunakan simple random dengan jumlah subjek sebanyak 69 siswa. Metode pengumpulan data menggunakan tes. Instrumen pengumpulan data menggunakan instrumen tes. Dalam pengumpulan data dilakukan uji validitas dan reliabilitas dengan menggunakan WinSteps 3.73 yang mana semua indikator instrumen dinyatakan valid dan reliabel. Uji analisis data pada SPSS 26. Hasil penelitian menunjukan hasil uji effect size sebesar 1,06 dengan kriteria tinggi. Penggunaan model PBL dengan edpuzzle berpengaruh terhadap kemampuan berpikir kritis matematis. Disimpulkan bahwa model PBL dengan edpuzzle dapat meningkatkan kemampuan berpikir kritis matematis. Implikasi dari penelitian ini adalah dapat memberikan wawasan bagi guru dalam memberikan perlakuan terhadap kemampuan berpikir kritis siswa.

Kata Kunci: Problem Based Learning; Edpuzzle; Kemampuan Berpikir Kritis Matematis

Abstract

The current problem is that students' critical thinking skills are relatively low. This low ability is because students memorize materials and formulas rather than understand concepts. In addition, students' mathematical critical thinking skills in analyzing a problem are relatively low. This study aimed to analyze the effect of using the PBL model assisted by Edpuzzleon on students' mathematical critical thinking skills. This study uses a quantitative method. The research design used is a post-test-only control. The sampling technique used was simple random sampling with 69 students. The data collection method uses a test. The data collection instrument uses a test instrument. Validity and reliability tests were carried out in data collection using WinSteps 3.73, and all instrument indicators were declared valid and reliable. Data analysis test on SPSS 26. The study showed that the effect size test was 1.06 with high criteria. The use of the PBL model with edpuzzle affects mathematical critical thinking skills. It is concluded that the PBL model with edpuzzle can improve mathematical critical thinking skills. This research implies that it can provide insight for teachers in treating students' critical thinking skills.

Keywords: Problem Based Learning; Edpuzzle; Mathematical Critical Thinking Ability

1. INTRODUCTION

Critical thinking is able to apply high-level and rational skills to students by means of analysis, synthesis, identification, problems, problem solving, reasoning, and evaluation and this ability can be defined by two approaches, namely the cognitive psychology approach and the educational approach (Oztel, 2020; Petrie. et al., 2020). The importance of critical thinking skills comes from the fact that critical thinking skills are thinking skills in general with one of the most important indicators of the quality of student learning and can encourage creativity through self-reflection and justify our way of life and opinions, speaking skills such as presentations can be improved by critical thinking by knowing how to think clearly and systematically (Alsaleh, 2020; Shamboul, 2022). In fact, students' critical thinking skills are relatively low, this low ability is because students are still memorizing material and formulas

rather than understanding concepts (Arif et al., 2019; Tamur et al., 2023). In addition, students' mathematical critical thinking skills in analyzing a problem are fairly low with a percentage of 46% from research (Basri et al., 2019).

One learning approaches that can enhancing critical thinking skills is Problem Based Learning (PBL). The models can enhancing students' critical thinking skills because the characteristics of PBL models can encourage open, reflective, critical, and active thinking (Mareti & Hadiyanti, 2021; Miterianifa et al., 2021). The problem found is that teachers rarely provide practice problems related to real problems so that students get poor grades (Maghfiroh & Mulyani, 2019). The PBL models is a learning models that can be did collaboration and investigation in solving real-life problems (Fidan & Tuncel, 2019; Hayama & Desai, 2022). The advantages of the PBL models are (1) students can solve problems in real situations, (2) increase learning activities students that can form their knowledge independently, (3) students can understand the nature of learning not just memorizing, and (4) students can do interaction between groups (Rerung et al., 2017; Yulianti & Gunawan, 2019). The disadvantage of the PBL model is that students need quite a long time to solve problems (Yulianti & Gunawan, 2019; Zainal, 2022).

Appropriate learning methods to enhancing students' critical thinking skills is PBL because this model involves students in solving real problems and one of the media that can integrate with the model is Edpuzzle because teachers can introduce digital environments to students using Edpuzzle media (Mayang et al., 2021). Edpuzzle is an online learning platform that uses video to enhance learning, allowing teachers to search and access educational content from various trusted sources such as YouTube, Khan Academy, TED Talks, National Geographic, and Vimeo. In addition, being able to upload your own videos through Edpuzzle helps teachers deliver material through easily accessible videos and allows teachers to add sound, notes, and quizzes to them (Emiliya Hidayat & Dzulfiqar Praseno, 2021; Mayang et al., 2021; Mischel, 2019). Edpuzzle has several advantages of its features. The advantages are that videos can be set "prevent skipping" students cannot skip videos, videos can vary because they can be taken from other learning video channels, teachers can insert questions such as multiple choice or essays, teachers can find out statistics on how long students watch videos, teachers can provide feedback on student answers automatically or manually and scoring can be done automatically by the system for multiple choice questions (Mischel, 2019; Qadriani et al., 2021).

Previous research related to the PBL model with geogebra media obtained results In Test I, 81.67% and in Test II, 87.22% were placed in the "good" category. The learning tools in Test II achieved the results of students' classical learning completeness in Test II, or 87.5%, achievement of the learning objectives was achieved (Harahap et al., 2021). Moreover, the previous reseacrh of PBL models with other applications such as Augmented Reality (AR) (Mulianti et al., 2023) and Google Classroom (Ramadhani et al., 2019). From all these studies obtained significant results, namely an increase and a positive effect of using the PBL model with AR and Google Classroom.

Futher, research on critical thinking skills is being applied in the fields of Science, Technology, Engineering, and Mathematics (STEM) Inquiry with the results of non-parametric statistical hypothesis testing significance level of 0.004 (sig <0.05) (Pahrudin et al., 2021). In addition, the previous reseacrh about critical thinking skills mathematics with other models, namely Peer Assisted Reflection (PAR) (Calkins et al., 2020) and Discovery Learning Models (Komariyah & Karimah, 2019). From all of these studies obtained significant results, i.e., the improvement of critical thinking skills and scores results using different models of mathematical critical thinking skills. Meanwile, previous research used technology in PBL model to develop mathematical thinking skills. Apart from that, other research also used others learning model to know the effet stundents' mathematical critical

thinking abilities without using Edpuzzle. This research shows the novelty of the effect of PBL model assited by Edpuzzleon students, mathtematics critical thinking ablities.Therefore, the purpose of this study is to find out the effect of using Edpuzzle-assisted PBL model on students' mathematical critical thinking ability.

2. METHODS

This research used a quantitative method. Quantitative method includes teaching and learning activities using PBL model with Edpuzzle and examines whether this type of teaching and learning activity influence on students' mathematical skills critical thinking. This study uses a quantitative method of conducting experiments by controlling the conditions of the experimental group and control group (Akbar et al., 2023).

In this research 69 students were used as research subjects taken from a senior high school, where the class is divided into X-B as the experimental class and X-C as the control class in east Jakarta. Learning process in the experimental class used the PBL model by using Edpuzzle to facilitate learning. In contrast, the control class used PBL models without Edpuzzle. The post-test only control design is an experimental research design with a post-test control group and randomised subjects, with random selection of subjects and involving two groups of subjects consisting of experimental and control groups without using pretest use of this design only conducts post-test for experimental and control classes (Krishnan, 2019; Rukminingsih et al., 2020). Critical thinking skills can be measured using several indicators, namely: Understanding, Comparing and developing solutions, Reaching the correct solution and proving, Proposing a new solution, and reflecting (Dolapcioglu & Doğanay, 2020). There is a rubric of assessment of critical ability in Table 1.

Table 1. Critical Thinking Skills Rubric

Performance Indicators	Level 4 4 Point	Level 3 3 Point	Level 2 2 Point	Level 1 1 Point
Understanding	Convey the main idea logically and consistently using our own language.	He managed to convey the core idea and problem correctly by asking more questions.	He has a lot of ideas and key issues, but not many details.	Having difficulty identifying the central idea and defining the main problem.
Comparison and evaluation of solutions	Comparing provided solutions through both induction and deduction to accurately identify pertinent information.	Use of argumentation when assessing solutions is appropriate, but there is a lack of clarity in the way the pertinent information is presented.	Makes various errors in selecting information or evidence regarding solutions.	Unable to disclose details about the solutions.
Reaching the right solution and proving it	Resolved issue thoroughly and followed the proper process procedures. It precisely	Resolves the problem by carrying out the necessary process steps. explains specific data	He solves part of the problem, However, he is unable to achieve the	Unable to provide a rationale and solve the issue.

Performance Indicators	Level 4 4 Point	Level 3 3 Point	Level 2 2 Point	Level 1 1 Point
	described the solution he had in defense and provided basic information thoroughly.	components that support the solution.	outcomes. Gives explanations that are not pertinent.	
Suggesting a new solution	Find various information with ideas accurately and in different ways to achieve the desired result.	Acquire different information and ideas. However, cannot come up with new conclusions.	Various information and ideas are presented in a variety of different formats and cannot achieve the correct result.	Unable to show new methods or information.
Reflection	Own the knowledge learned independently and provide meaningful interpretations.	Acknowledges the information it has acquired, but only gives a superficial presentation.	Has received feedback, but is unable to offer accurate information.	Have no idea for individual thoughts.

This research was conducted for 8 months with the procedure starting from the researcher compiling a mathematical critical thinking ability test instrument, collecting data, conducting experiments, and processing or analyzing data. Simple random sampling was used to select participants for this research. The process of choosing a sample from a group in which every member has an equal opportunity of being selected is simple random sampling (Arieska, 2018).

Data collection in research is seen from the results of validity and reliability. In research using construct validity, construct validity is the ability to distinguish between participants who have and who do not have the behavior or quality to be measured in other words, this refers to how well the instrument accurately measures the concept, behavior, idea, or quality it is designed to assess (Surucu & Maslakci, 2020). This study used a critical thinking test instrument, where the instrument was validated by two validators, namely one lecturer and one teacher. The instrument was deemed appropriate for usage with revisions by both validators. One of the items that have been made has a revision, namely in the section where the cartesian graph numbers are not very clear and replaced with a clearer carterius graph.

After the instrument is suitable for use in construct validation by lecturers and teachers. Furthermore, in the content validation process, the critical thinking skills test instrument was validated in two schools consisting of 6 classes in total with a total of 191 students. Content validity was analyzed with the Rasch Model using the WinSteps 3.73 application. Rasch Model is suitable in instrument validation because it will produce more holistic information about the instrument and fulfill the definition of measurement (Muntazhimah et al., 2020). Courtesy of the results of the Rasch WinStep Model, student validation data are presented in Table 2.

Table 2. Misfit Item

	Item				
	1	**2**	**3**	**4**	**5**
Measure	-0.16	0.76	0.43	-0.45	-0.67
Outfit MNSQ (0.5 - 1.5)	1.41	1.29	1.21	1.20	0.95
Outfit ZSTD (-2.0 - +2.0)	3.8	2.7	2.1	1.9	-0.4
PTMEA-CORR (0.4 – 0.85)	0.63	0.67	0.65	0.28	0.44

In Table 2 all items are considered appropriate as they fulfill the two recommended criteria (Saidi & Siew, 2019). In testing the reliability of the instrument using WinSteps and the Rasch Model while to decide the quality using Cronbach's alpha value. The KR-20 value of 0.79 is obtained, which means it meets the high standard (Faradillah & Septiana, 2022). The person reliability value is 0.75 which is considered adequate, while the highest item reliability value is 0.99 which is rated as very high (Faradillah & Septiana, 2022). If the degree of separation is high, the quality of the instrument will increase. The tool is more effective in identifying both groups of items and individuals due to its higher quality. The instrument was considered trustworthy according to the data collected from the KR-20 value exceeded 0.7 in accordance with the findings in the study (Fatahillah & Faradillah, 2023). This research employs the Kolmogorov-Smirnov test for assessing normality and the Levene test for assessing homogeneity, consistent with previous research in the field (Fatahillah & Faradillah, 2023). This research uses an independent sample test. This test is used to find out whether there is an average effect from two independent samples (Izazayyah, 2023).

3. RESULTS AND DISCUSSION

Result

The data obtained were tested for normality and homogeneity. The Kolmogorov-Smirnov test was used to test for normality, the test can be used to compare the distribution of data from two samples that come from the same population to see differences and patterns in data at another times (Porwik & Dadzie, 2022). The Kolmogorov-Smirnov test criteria are if Sig. > 0.05 then the data is considered normally distributed and if the Sig.< 0.05 value then the data is considered not normally distributed (Permatasari, 2021). The Kolmogorov-Smirnov test is obtained in Table 3.

Table 3. One-Sample Kolmogorov-Smirnov Test

	Class	**Statistic**	**df**	**Sig**
Math results of students Using Model PBL and Edpuzzle on critical thinking skills	Post-test Experimental Class	0.142	35	0.073
	Post-test Control Class	0.111	34	0.200

Table 3 shows the results of testing PBL model data on mathematical critical thinking skills using Edpuzzle. From the analysis of the experimental class, the post-test Significance value is 0.073 while the control class has a Sig. posttest value of 0.200 by cause of the second Sig. value > 0.05 data is considered normal. If data retrieved from a normal distribution is tested, then a homogeneity test will be carried out. After data is declared normal, the next step is to test the homogeneity of the data. Testing the homogeneity of the data using the Levene test by analyzing a set of data to see its variance (Yan et al., 2020). The levene test criteria are if the levene test value or Sig > 0.05 then the variance data is homogeneous, while

if the levene test value or Sig. < 0.05 then the variance data is not homogeneous (Asrial et al., 2022). Table 4 displays the homogeneity results based on the post-test scores.

Table 4. Test of Homogeneity of Variance Post-Test

	Mean	Median	Median and with Adjusted df	Trimmed Mean
Levene Statistic	0.69	0.012	0.012	0.029
df1	1	1	1	1
df2	67	67	65.950	67
Sig.	0.793	0.913	0.913	0.865

Table 4 shows that the Sig. value is 0.793 because the value of Sig. > 0.05, then determination is to accept H_0. This means that the variation of data in the post-test groups of the experimental and control classes is the same and homogeneous. Furthermore, data collected were analyzed for variations in the average of separate samples through an Independent Samples t-test. Before proceeding, two requirements must be fulfilled-specifically the normality test and the data homogeneity test (Izazayyah, 2023). This This test is used to determine whether there is an average effect of two free samples. The criteria are if the Sig value. > 0.05, then the null hypothesis (H_0) is accepted and the alternative hypothesis (H_1) is rejected, which means that the independent variable has no effect on the dependent variable. However, if the Sig. < 0.05 value, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted, indicating that the independent variable has an influence on the dependent variable (Magdalena & Angela Krisanti, 2019). From the previous test, the data is declared in the normal and homogeneous category, so the data can be carried out Independent Sample T Test in Table 5.

Table 5. Independent Sample Test Post-test

		F	Sig.	t	df	Sig. (2-tailed)
Results Students Mathematical	Equal Variances Assumed	0.069	0.793	4.436	67	0.000
	Equal Variances Not Assumed			4.437	66.990	0.000

Based on Table 5. Obtained a Sig, (2-tailed) value of 0.000 < 0.05, Therefore, there is an influence on student learning outcomes when using the PBL model with Edpuzzle compared to the PBL model without Edpuzzle. After that, to see the difference in effect between the control and experimental classes with effect size, showed in Table 6.

Table 6. Mean and Standard Deviantion Data

	Mean	N	Standard Deviation
Experiment Group	16.69	35	3.01
Control Group	13.50	34	2.96

Table 6, the mean value for the experimental group is 16.69 whereas the mean value for the control group is 13.50. The experimental group has a standard deviation of 3.01, while the control group has a standard deviation of 2.96. Using the formula and criteria for effect size, the size of the cohen effect size is 1.06 with criteria d ≥ 0,8 that is high.

Discussions

First, syntax of orienting students to the problem, namely by giving students a problem so that students can be actively involved in solving problems (Abdiyani et al., 2019; Khikmiyah, 2021; Kurniawan et al., 2017). The teacher provides problems related to linear program material that has been presented in the Edpuzzle video, the teacher and students solve these problems together. Second, organizing students to learn, students can define and organize learning tasks related to the problems given (Laa et al., 2017; Naibaho, 2023). Previously, students to solve problems made a group so that students could discuss with each other. Third, guiding individuals or groups, namely students gathering information (Dewi et al., 2018; Kurniawan et al., 2017).

Information obtained by students from videos that are already available in Edpuzzle is then processed by students to get problem solving. The teacher is also in charge of guiding and helping when students experience difficulties, for example, such as students who are still confused in making SPtLDV graphs. Fourth, developing and presenting work, students with their group plan and prepare works such as reports (Effendi et al., 2021; Hayu et al., 2023). The final report that students have obtained is presented in front of the class to determine the group that performs first by lottery system and then witnessed by the teacher and other group friends. Fifth, analyzing and evaluating the problem solving process, students reflect on or evaluate the investigations and processes used by students (Hastuti et al., 2020; Pribadi et al., 2021). After being presented, the teacher and other group friends analyze whether the work is correct or not and the steps that have been used.

In the PBL model, researchers use a tool, namely Edpuzzle. Video teaching materials that have been uploaded can be accessed by students. By viewing the teaching material video, students are expected to be able to solve the problems given. In addition, researchers can see statistics on students who have seen the learning video. According to the findings, researchers hope that teachers can utilize current technology such as Edpuzzle as an effective teaching tool (Amaliah, 2020; Cesare et al., 2021; Hamid, 2022).

There are limitations in this study, namely teaching materials that are made less attractive so that they make students feel bored, so the solution for further research in making teaching materials in the form of videos uploaded to Edpuzzle is given a storyline in the form of animation. In addition, the use of Edpuzzle can be developed to focus more on abilities that focus more on visualization or concept aspects because learning materials that are complex or require deep understanding are also suitable for integration with Edpuzzle. The implication of this research is that it helps teachers that the PBL model supported by Edpuzzle can affect students' ability to think critically in mathematics.

4. CONCLUSION

The experimental class using Edpuzzle-assisted learning has an influence with a high category seen by using the cohen effect size compared to learning without the help of Edpuzzle in the control class. It can be seen from the independent sample t-test that students in the experimental class have higher posttest scores compared to students in the control class, this shows that the use of the PBL model assisted by Edpuzzle has an influence when compared to the PBL model without Edpuzzle.

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