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IMPLEMENTATION OF PROBLEM BASED LEARNING USING INTERACTIVE MEDIA CANVA AND QUIZZIZ TO IMPROVE PROBLEM SOLVING ABILITIES OF VOCATIONAL HIGH SCHOOL STUDENTS

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ABSTRACT

Problem-solving ability is an essential skill that must be possessed by students, especially in Vocational High Schools (SMK), in order to apply the concepts learned in real situations. However, many students have difficulty in identifying and solving mathematical problems because the learning method is still centered on the teacher and the minimal use of interactive learning media. This study aims to analyze the mathematical problem-solving ability of vocational high school students whose mathematics learning uses the Problem Based Learning model assisted by interactive media canva and quizizz compared to those who use regular learning. This study uses a quasi-experimental method with a Nonequivalent Control Group Design. The research sample consisted of 64 grade XI students of SMKN 1 Cariu, which were divided into an experimental class (32 students) who received learning using PBL assisted by interactive media Canva and Quizizz, and a control class (32 students) who used regular learning methods. Data collection was carried out through problem-solving ability tests (pretest and posttest), questionnaires and observations. Data analysis using inferential statistics, namely the average difference test with N-Gain as a measure of learning outcomes, and thematic analysis for qualitative data. The results of the study showed that the mathematical problem-solving ability of vocational high school students whose mathematics learning used the Problem Based Learning model assisted by interactive media canva and quizizz was better than those who used regular learning.

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INTRODUCTION

Problem-solving ability is one of the essential skills in education and everyday life. In the context of vocational education, students are expected not only to understand the theory but also to be able to apply the concepts they have learned to solve real problems related to their

field of expertise. According to Polya (1973), problem solving in mathematics consists of four main stages, namely understanding the problem, planning a solution, implementing the solution, and evaluating the results. However, various studies show that the majority of students have difficulty in identifying problems, determining the right steps to solve them, creating mathematical models, and completing and evaluating the solutions they have created (Firdaus, 2021).

Factors that cause low problem-solving skills among vocational high school students include research by Nurhayati and Bernard (2019) who found that students had difficulty understanding problems, planning solutions, and performing correct mathematical calculations, especially in the material of equations and inequalities. In addition, research by Adhimah and Ekawati (2020) showed that high math anxiety can affect students' problem-solving behavior, thus negatively impacting their ability to solve combinatorics problems. Other contributing factors are the lack of understanding of basic mathematical concepts and minimal practice in solving problem-solving questions. Research by Mahdayani (2016) revealed that students had difficulty understanding concepts in various mathematical materials, such as arithmetic, algebra, statistics, and geometry, which hindered their ability to solve problems.

To overcome this challenge, the Problem Based Learning (PBL) approach is one solution that can be applied. PBL emphasizes problem solving as the center of learning, where students are given real problems to analyze and solve independently or in groups (Setiawan, 2022; Ariyani et al, 2021; Setiani, 2016). In addition, research conducted by Husna, Veronica, & Kurniasih (2019) showed that PBL is able to improve problem-solving skills because students are more active in building their own knowledge.

However, the success of PBL depends greatly on the tools used in the learning process. The use of technology-based interactive media, such as Canva and Quizizz, can be an effective strategy to increase student engagement in problem-based learning. According to Melati et al (2023), multimedia-based learning involving text, images, and animation can increase understanding of concepts in more depth. Canva allows students to understand concepts more visually through attractive infographic, diagram, or presentation designs (Muhajir, 2024). Meanwhile, Quizizz provides a gamification-based learning experience that can increase student motivation in testing their understanding independently (Oktafrizal et al, 2025).

Several studies have shown the positive impact of using Canva and Quizizz in learning. The results of the study showed that the use of Canva-based infographic media was effective in improving students' understanding and retention of information in vocational subjects Putri and Setyawan (2023) . This is because students can see the relationship between concepts more clearly through visual representations, making it easier for them to identify and solve problems. In addition, the use of the Quizizz application in mathematics learning can improve students' problem-solving abilities (Hidayat & Sari 2022; Putra & Wijayanti, 2023; Sutrisno & Rahmawati, 2021) .

The combination of Canva and Quizizz in PBL creates a more interactive, collaborative, and fun learning environment. This combination of interactive media can facilitate problem exploration and solution visualization through Canva, as well as help students measure the effectiveness of problem-solving strategies through Quizizz.

Although previous studies have shown that Canva and Quizizz can improve learning effectiveness, there has been no study that specifically combines the two in improving problem-solving abilities of vocational high school students. Most studies still focus on the use of Canva as a visualization tool or Quizizz as a gamification-based evaluation media, but none have examined how the combination of the two can work synergistically in the PBL model. Therefore, this study has an element of novelty, namely developing and testing the effectiveness

of the integration of Canva and Quizizz in problem-based learning to improve problem-solving abilities of vocational high school students.

METHOD

This study used a quasi-experimental method with a *Nonequivalent Control Group Design* . The subjects of the study consisted of grade XI students of SMKN 1 Cariu, with an experimental class of 32 students implementing PBL assisted by Canva and Quizizz, and a control class of 32 students using conventional learning methods.

To measure the effectiveness of the learning model, this study used quantitative and qualitative instruments. Quantitative data were obtained through problem-solving ability tests, which were given before and after treatment to assess the improvement of students' skills, and questionnaires, which were used to measure the level of student engagement during learning. Meanwhile, qualitative data were collected through observation and questionnaires, which aimed to explore students' responses to the use of Canva and Quizizz in learning.

Data analysis was conducted using inferential statistics, namely the mean difference test, to identify significant differences between the experimental and control classes. Since the initial test results showed that the experimental class was better, N-gain was used as the mean difference test. In addition, qualitative data were analyzed using a thematic approach, where findings from observations and questionnaires were grouped based on emerging patterns and themes. This approach provides a deeper understanding of students' learning experiences and the effectiveness of the methods applied.

RESULTS AND DISCUSSION

Results

The initial problem-solving ability of students based on calculations using SPSS 25 software shows that the average value in the experimental class is 61.156, while in the control class it is 53.594. The standard deviation obtained is 6.90 for the experimental class and 7.75 for the control class. This shows that before being given treatment, the mathematical problem-solving ability of students in the experimental class is better than the control class.

Table 1. Pretest Normality Test (*Shapiro-Wilk*)

Class	Statistics	df	Sig.
Experiment	0.906	32	0.009
Control	0.903	32	0.007

After obtaining a statistical overview of the pretest scores from both classes, the next step is to conduct a normality test on the students' initial test scores. This normality test is carried out with the help of SPSS 25 software to determine whether the data is normally distributed or not.

Based on the results of the Shapiro-Wilk test, a significance value of 0.009 was obtained for the experimental class and 0.007 for the control class. Since both significance values are less than 0.05, it can be concluded that the data from both classes are not normally distributed. This indicates that the distribution of pretest scores does not follow a normal distribution pattern, so a non-parametric statistical test approach is needed for further analysis.

Table 2. Mean Difference Test (*Mann-Whitney*)

	Mark
Mann-Whitney U	240,000
Wilcoxon W	768,000
Z	-3,726

Asymp. Sig. (2-tailed)	.000

To overcome this, the Mann-Whitney test was conducted as a non-parametric statistical method. The results of the Mann-Whitney test showed that the Asymp. Sig. (2-tailed) value was 0.000, which is smaller than 0.05. Therefore, H_0 is rejected and H_a is accepted, which means that there is a significant difference between the initial mathematical problem-solving abilities of students in the experimental class and the control class.
In the posttest, the average value obtained increased to 86.688 for the experimental class and 75.688 for the control class. The standard deviation obtained was 5.38 for the experimental class and 5.16 for the control class. These results indicate that after being given treatment, the experimental class experienced better improvement compared to the control class.

To analyze the average difference at the end of the study, N-Gain data was used, because there was a difference in initial ability between the experimental class and the control class. The analysis was carried out using SPSS 25 software, with the results of the N-Gain normality test as follows:

Table 3. N-Gain Normality Test (*Shapiro-Wilk*)

Class	Statistics	df	Sig.
Experiment	.987	32	.955
Control	.926	32	.030

Based on the results of the normality test, a significance value of 0.955 was obtained for the experimental class and 0.030 for the control class. Because the significance value of the experimental class is greater than 0.05, the data in this class is normally distributed. On the other hand, the significance value of the control class is less than 0.05, so the data is not normally distributed. Therefore, the analysis of the average difference in N-Gain was continued using the Mann-Whitney non-parametric statistical test.

Table 4. N-Gain Mean Difference Test (*Mann-Whitney*)

	Mark
Mann-Whitney U	136,000
Wilcoxon W	664,000
Z	-5.058
Asymp. Sig. (2-tailed)	.000

The results of the Mann-Whitney Test show an Asymp. Sig. (2-tailed) value of 0.000. Because the hypothesis being tested is a one-sided hypothesis, the significance value is calculated with Sig./2, obtaining Sig. 0.000. With Sig. <0.000, it can be concluded that the average increase in mathematical problem-solving abilities of vocational school students who use the Problem-Based Learning model assisted by Canva and Quizizz interactive media is higher than students who use regular learning.

Discussions

The results of this study indicate that the implementation of Problem-Based Learning (PBL) assisted by interactive media Canva and Quizizz significantly improves the mathematical problem-solving abilities of vocational high school students compared to regular learning. This increase can be seen from the higher N-Gain results in the experimental class compared to the control class, as well as the results of the Mann-Whitney Test (Asymp. Sig. 0.000 <0.05) which shows a significant difference between the two groups. This finding is consistent with various

previous studies showing that problem-based learning models can improve students' critical thinking and problem-solving skills (Fahrunisa, 2022; Putri & Hidayat, 2022)

PBL is effective in encouraging students to be more active in identifying, analyzing, and solving problems, which ultimately improves critical thinking and problem-solving skills. This model also allows students to learn independently and collaboratively, so they can develop a deeper understanding of the mathematical concepts being studied. PBL can improve higher-order thinking skills, especially in solving complex problems that require analytical and reflective thinking (Setiawan, 2022; Rahman & Lestari, 2021; Hidayat & Susanto, 2023).

In this study, the effectiveness of PBL was further enhanced by the use of interactive media Canva and Quizizz. Canva helps students visualize mathematical concepts, making it easier for them to understand and apply concepts in problem solving. Kurniawati's (2018) research shows that multimedia-based learning can improve students' understanding through a combination of visual and textual elements, which accelerates cognitive processes and information retention. In addition, Awaliah's (2022) research found that the use of Canva in mathematics learning can improve students' activities and learning outcomes , because students can see the relationship between concepts more clearly through visual representation.

Figure 1. Canva display

On the other hand, Quizizz plays a role in increasing student motivation and engagement in the learning process. This platform allows students to test their understanding through interactive gamification-based quizzes, which are proven to increase learning motivation and positive competitiveness among students. The use of Quizizz in mathematics learning has a positive impact on students' problem-solving abilities (Astuti, 2022; Rahmawati & Effendi, 2024; Nugrahani et al, 2023).

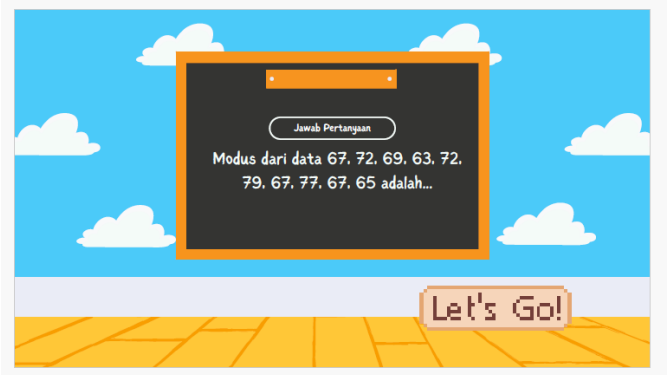

Figure 2. Quizizz display

The combination of problem-based learning methods with interactive media can create a more active and innovative learning environment, making it easier for students to understand

concepts and develop problem-solving skills. The use of Canva and Quizizz in PBL helps students explore problems and test problem-solving strategies in a more engaging and interactive way.

The results of this study indicate that the use of Canva and Quizizz simultaneously in the Problem-Based Learning (PBL) model can significantly improve students' problem-solving abilities. This is due to the advantages of each complementary media, where Canva provides a more attractive and structured concept visualization, while Quizizz allows direct interaction in the form of quizzes that can be calculated automatically.

One of Canva's major weaknesses is the lack of interactive features, especially in terms of live assessments that can provide instant feedback to students. Canva is indeed capable of presenting material in the form of infographics, presentation slides, or other visual materials, but it does not have a feature to measure student understanding in real-time. In contrast, Quizizz excels in providing interactive quizzes with an automatic scoring system, but lacks the aesthetic and attractive design elements that Canva offers.

By integrating quizzes from Quizizz into materials created in Canva, students can learn the material with an engaging visual presentation, then directly measure their understanding through interactive quizzes embedded in Canva. This combination creates a more effective learning environment, where students not only gain better conceptual understanding through visualization, but can also apply and test their understanding directly through Quizizz.

Mathematics learning can be more interesting and effective by implementing Problem-Based Learning (PBL), which emphasizes problem solving as the core of the learning process. To support the implementation of PBL, Canva and Quizizz are used as interactive media that help students understand and solve problems better.

Research by Rizalenti (2022) shows that the implementation of the PBL model supported by the Canva application can improve students' mathematical representation. The use of Canva allows students to visualize mathematical concepts more clearly, thus facilitating a deeper understanding of the material being studied.

In statistics learning in vocational high school class XI, the application of PBL can be applied in various stages. Statistics includes processing, presenting, and analyzing data that is often used in real life, such as in business, economics, and technology. This material includes data collection, data processing using central measures (mean, median, mode), and data presentation in the form of tables, bar charts, line charts, and pie charts.

At the problem orientation stage, real problems relevant to students' lives are presented using Canva in the form of infographics, animated videos, or interactive presentations. For example, students are given data on the number of visitors to a store for a month and asked to analyze sales trends. With this visual approach, students find it easier to understand the information provided, so that indicators of understanding the problem can be achieved, especially in identifying information that is known and that must be sought in the problem.

The next step is to organize students to learn, which is facilitated by Canva to organize information in the form of diagrams or mind maps. In statistics learning, students can use Canva to create data distribution diagrams, which make it easier to understand data patterns and variations. Presenting information in a visual format helps students in developing a solution plan, such as choosing the right data analysis method.

In the individual and group investigation stages, Quizizz is used as an interactive practice medium that tests students' understanding of statistical concepts. The use of Quizizz in the PBL model can improve students' mathematics learning outcomes, because this application provides

direct feedback that helps students identify and correct their mistakes effectively. Students can work on problems about data processing and get direct feedback to improve their understanding.

Once a solution is found, the stage of developing and presenting the results is carried out by utilizing Canva to create interactive presentations, visual reports, or infographics. For example, after analyzing survey data on student learning habits at school, they compile a report in the form of an attractive and easy-to-understand infographic. This presentation allows students to communicate the solutions they have compiled systematically and logically, support indicators for implementing the resolution plan and re-check the results obtained.

As a final stage, Quizizz is used as a reflection tool in analyzing and evaluating the problem-solving process. Through the evaluation quiz, students review the process that has been carried out and identify errors or concepts that still need to be fixed. In this way, the indicator of re-examining the results obtained can be achieved, ensuring that the solution found is correct and in accordance with the context of the problem.

The integration of Canva and Quizizz in the PBL model increases student engagement and understanding in mathematics, especially in statistics material. Canva supports the orientation, organization, and presentation stages of results, while Quizizz is effective in investigation and final evaluation. The combination of these two media creates a more interactive, collaborative, and meaningful learning experience, so that students can develop problem-solving skills more systematically and confidently.

This application proves that learning mathematics does not have to be rigid and boring. With the right approach and interesting media, students can enjoy the learning process while developing critical thinking and problem-solving skills that are very important for the future.

Overall, the results of this study strengthen previous findings that PBL supported by interactive media can significantly improve students' mathematical problem-solving skills. This improvement is not only seen from the test results, but also from students' responses that show higher engagement in learning. Thus, the implementation of Problem-Based Learning assisted by Canva and Quizizz can be an effective alternative in improving the quality of mathematics learning in vocational schools, especially in equipping students with critical thinking and problem-solving skills needed in the world of work.

CONCLUSION

The mathematical problem-solving ability of vocational high school students whose mathematics learning used the Problem Based Learning model assisted by interactive media canva and quizizz was better than those who used regular learning.

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