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THE EFFECT OF ICARE LEARNING MODEL ON JUNIOR HIGH SCHOOL STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITY

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ABSTRACT

The mathematical problem-solving ability of junior high school students is still considered low, as evidenced by the low learning outcomes among seventh-grade students at SMP Negeri 1 Suwawa. To enhance this ability, an innovative learning model is required. One such model is ICARE, which is believed to encourage active student engagement and foster a deeper understanding of mathematical concepts. This study aims to determine the differences between the ICARE learning model and the conventional learning model on the mathematical problem-solving abilities of seventh-grade students at SMP Negeri 1 Suwawa. The research was conducted from May to June during the even semester of the 2024/2025 academic year. The research method employed in this study was an experimental method involving two classes, namely the experimental class and the control class. Simple random sampling was used to select the samples. The research design utilized was a Post-test Only Control Group Design. The data were collected through a written post-test. The results of the study, based on hypothesis testing using a t-test, showed that the obtained $t_{count} = 3.050$, while the critical $t_{table} = 2.007$ at a significance level of 0.05. Since $t_{count} > t_{table}$ the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted. Therefore, it can be concluded that the mathematical problem-solving ability of students taught using the ICARE learning model is higher than that of students taught using the conventional learning model.

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INTRODUCTION

Education is a conscious and planned effort to create an environment and learning process that enables students to actively participate in developing their abilities. The purpose of education is for students to possess spiritual strength, self-control, good character, intelligence, noble morals, and the skills necessary for themselves as well as for life in society, the nation, and the state, in accordance with the provisions of Law Number 20 of 2003 concerning the National Education System. Mathematics is a subject that is well known within the national education system, as it has been taught from primary and middle school up to tertiary education.

According to Hudoyo, mathematics is a field that studies and analyzes forms, structures, and the relationships among them (Safari & Rahmaniatul Milah, 2024). Mathematics ranks among the compulsory courses that students are required to take at all levels of education. Mathematical skills are crucial not only within the scope of classroom learning but also in everyday life. Based on the Minister of Education and Culture Regulation (Permendikbud) No. 58 of 2014, mathematics is a universal science that offers significant benefits for human life. It also forms the foundation for modern technological progress, plays a vital role across various scientific fields, and enhances human cognitive abilities. According to Utami and Wutsqa in (Suryani et al., 2020), problem-solving ability is one of the learning objectives in mathematics that must be achieved by students, as stated in the Regulation of the Minister of National Education Number 22 of 2006.

According to Pamungkas and Siswanto in (Tharob et al., 2024), mathematical problem-solving ability is the capacity to identify known elements, the elements being asked, and the sufficiency of the required information; to construct mathematical models; to develop problem-solving strategies; and to explain and verify the correctness of the obtained answers. Meanwhile, according to Davita and Pujiastuti (2020) in (Annisa Riyanto, 2024), mathematical problem-solving ability refers to students' efforts to apply their existing skills and knowledge to find solutions to problems. The steps of problem-solving according to Polya, as cited in (Zakiah et al., 2019), consist of: (1) Understanding the problem – students identify the information provided and what is being asked in the problem; (2) Devising a plan – students connect their prior knowledge with the information presented in the problem; (3) Carrying out the plan – students perform calculations or computations; and (4) Looking back – students review and verify the solution they have obtained. The ability to solve problems is among the essential competencies that students are required to possess. By mastering this ability, students can be regarded as having acquired skills that are closely related to the characteristics of the learning process (Idrus et al., 2023).

The ability to solve problems is one of the competencies that students are anticipated to cultivate through education. Although problem-solving is an important skill, in reality, many students continue to face challenges in solving mathematical problems. The weakness in students' problem-solving skills may be observed from the results of the Programme for International Student Assessment (PISA) conducted in 2022. Based on the 2022 PISA data, Indonesian students' mathematical problem-solving ability remains relatively weak. Indonesian students achieved an average mathematics score of 366 points, which is lower than the scores obtained in the 2015–2018 PISA assessments. This score is also below the average of OECD member countries, which ranges between 465 and 475 points.

The insufficient problem-solving skills of students is a contributing factor to low learning outcomes, particularly in middle school. This situation arises because teachers tend to assign questions and tasks in monotonous formats; as a result, when students encounter different types of problems, they find it difficult to solve them (Unonongo et al., 2021). s

The previous study conducted by (Dian Ditasari & Noriza Munahefi, 2024), entitled *"Analysis of the Mathematical Problem-Solving Ability of Seventh Grade Students at MTs Abadiyah Gabus on the Topic of Plane Figures,"* also stated that students' mathematical problem-solving ability was categorized as very low. Furthermore, based on the researcher's observations during the PPL II (Teaching Practice Program), students' mathematical problem-solving skills were still lacking. Students encountered difficulties when faced with problems that did not follow familiar patterns or examples they had learned, and they struggled to solve problems according to the steps of the problem-solving process. Based on the explanation, it can be concluded that students still experience difficulties in developing their mathematical problem-solving abilities. They are less capable of understanding and formulating problems effectively.

Based on an interview with the mathematics teacher at SMP Negeri 1 Suwawa, the learning process is still largely dominated by the use of conventional models, in which teachers frequently employ the lecture method as the primary means of delivering material. A contextual approach has begun to be implemented to relate the subject matter to real-life situations, and presentation media such as PowerPoint are used to clarify concepts. However, this approach sometimes fails to accommodate the diversity of students' learning styles. The one-way nature of instruction can reduce active participation, and many students tend to lose focus during lessons, causing them to feel bored when learning mathematics and to struggle in developing their mathematical problem-solving abilities. This condition is reflected in the students' learning outcomes, where the average final exam scores were 70.27 for Class VII A, 39.04 for Class VII B, and 74.6 for Class VII C.

The learning practices implemented by teachers in schools have not yet been effective in fostering students' problem-solving abilities. This is evident from students' low level of understanding of the problems presented in the given tasks, as well as their limited ability to plan and identify appropriate solutions to resolve those problems (Pauweni, 2020). Teachers should serve as facilitators and mediators in the learning process rather than merely transferring knowledge to students. This means that teachers need to provide both opportunities and guidance for students to build and construct their own understanding (Habibie et al., 2018). Problem-solving ability is a process of facing and responding to challenges. Through problem-based learning, students are trained to make decisions and to find solutions to various problems. In this regard, educators need to design a variety of relevant and meaningful problems for students to work on, either individually or collaboratively (Isa et al., 2023).

Changes in the learning process are essential to address existing problems, encompassing the understanding of theories, concepts, and their applications in daily life. Learning materials need to be systematically organized, accompanied by the development of students' attitudes, knowledge, and skills. Therefore, it is necessary to implement an innovative, interactive, and student-centered learning model to create a conducive and engaging learning environment. One of the learning models that can be applied to enhance students' mathematical problem-solving abilities is the ICARE learning model.

According to Carni et al. in (Yasa et al., 2019), the ICARE learning model provides students with opportunities to construct their own knowledge and apply the concepts they have acquired through the process of solving mathematical problems. The ICARE learning model consists of five stages: *Introduction*, *Connection*, *Application*, *Reflection*, and *Extension*. By implementing the ICARE learning model, students are encouraged to actively construct and connect their knowledge, enabling them to derive meaning from the given problems and to better understand the concepts related to those problems.

The effectiveness of implementing the ICARE learning model in mathematics can be demonstrated through several studies. For instance, a study conducted by Anggita (2021) found that the use of the ICARE learning model had a significant effect on students' problem-solving abilities and learning outcomes. In addition, research by (Yasa et al., 2019) showed that the ICARE learning model supported by open-ended mathematical problems was more effective in improving students' mathematical problem-solving abilities than the conventional learning model.

METHOD

The research method employed in this study was an experimental method involving two classes. One class implemented the ICARE learning model, while the other class used a conventional learning model. The research design applied was the Post-test Only Control Group Design. The population of this study comprised all seventh-grade students at SMP Negeri 1 Suwawa, consisting of three classes. The sampling technique used was simple random sampling. According to Sugiyono (2017), simple random sampling is a method of selecting a sample from a population randomly without considering levels or strata within the population. In this study, class VII-A was designated as the control group, while class VII-C served as the experimental group.

The data in this study were collected using tests and document review. A test is an instrument used to assess or obtain information about students' competencies, which can be administered in written or oral form, either individually or in groups. Thus, a test is considered a tool to reveal various aspects possessed by students (Dr. Laili Etika Rahmawati & Dr. Miftakhul Huda, n.d.).

Validity is a testing process aimed at determining the extent to which a measuring instrument is capable of assessing the specific aspect it is intended to measure (Ir. Syofian Siregar, 2023).

Before conducting the validity test, the researcher prepared 11 test items. After the validity test was carried out, 8 items were found to be valid, while 3 items were invalid. Therefore, the researcher used the 8 valid items for the study. An item is considered valid if rcount > rtable. Furthermore, a reliability analysis was performed using Cronbach's Alpha with a significance level of $\alpha = 0.05$. The post-test, consisting of 8 valid items, yielded a reliability coefficient of 0.881, demonstrating that the instrument has a high level of reliability.

An instrument or data collection tool is a means used to obtain data in a research activity (Amalia & Arthur, 2023). The instrument in this study was developed to assess students' mathematical problem-solving skills and was presented in the form of an essay test. The data were analyzed using both descriptive and inferential statistical techniques.

RESULTS AND DISCUSSION

Results

Description of Research Results

This study included two classes. The experimental class, VII-C, received instruction through the ICARE learning model, whereas the control class, VII-A, was taught using the conventional learning model. Overall, the following provides a summary of the data on students' mathematical problem-solving abilities in both classes.

Table 1. Description of Post-Test Data

Class	N	Maximum Score	Minimum Score	Mean	Median	Mode	Standard Deviation
Experimental Class	26	21	78	49,73	47,17	45,50	13,01
Control Class	27	20	70	39,33	39,75	40,93	10,24

According to Siagian as cited in (Hayati & Jannah, n.d.), mathematics is a branch of knowledge that plays a role in the development of other sciences, technological advancement, and the progression of mathematics itself.

In this study, each problem was designed to encompass the four indicators of mathematical problem-solving ability. According to Polya's theory, as cited in (Purba et al., 2021), the steps of problem-solving consist of: (1) understanding the problem, (2) devising a plan for the solution, (3) carrying out the plan, and (4) looking back or reviewing the solution.The score for each problem represented a combination of assessments from these four indicators, so the students' final scores reflected their integrated achievement in problem-solving ability. Based on the test results, it was found that some students were able to understand the problems and plan appropriate solution strategies well. This was evident from the predominance of scores falling within the fair to good categories. However, several students still experienced difficulties at the stage of reviewing their solutions, as indicated by the presence of low scores on certain items. These findings suggest that although students were able to solve problems correctly, their skills in reflection and verification of answers still need improvement.

Description of Post-Test Data for the Experimental Class

In the final assessment of mathematical problem-solving ability among the 26 students in the experimental class, the lowest score obtained was 21, while the highest score was 78. The mean score (M) was 49.73, the median (Me) was 47.17, and the mode (Mo) was 45.50. The standard deviation (SD) was 13.01, with a variance of 169.38. The distribution of the experimental class post-test data is presented in the following table.

Table 2. Distribution of Post-Test Results for the Experimental Class

Score Interval	f_i	f_{kum}(%)
21 – 30	1	3,85%
31– 40	4	15,38%
41 – 50	12	46,15%
51 – 60	4	15,38%
61 – 70	2	7,69%
71 – 80	3	11,54%
Total	**26**	**100%**

Table 2 shows that 17 students (65.39%) obtained scores below the mean, 4 students (15.38%) fell within the score interval that includes the mean, and 5 students (19.23%) achieved scores above the mean. The following histogram presents the distribution of post-test scores for the 26 students in the experimental class.

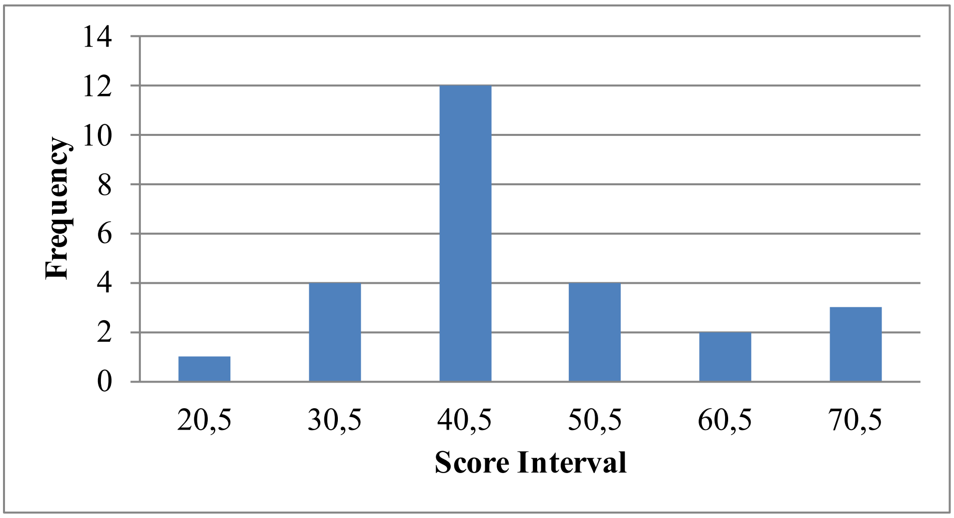

Figure 1. Histogram of Post-Test Scores in the Experimental Class

In the final assessment of mathematical problem-solving ability among the 27 students in the control class, the lowest score obtained was 20, while the highest score was 70. The mean score (M) was 39.33, the median (Me) was 39.75, and the mode (Mo) was 40.93. The standard deviation (SD) was 10.24, with a variance of 104.77. The distribution of post-test data for the control class is presented in the following table.

Table 3. Distribution of Post-Test Results for the Control Class

Score Interval	f_i	f_{kum}(%)
20 – 28	4	14,81
29 – 37	6	22,22
38 – 46	14	51,85
47 – 55	1	3,70
56 – 64	1	3,70
65 – 73	1	3,70
Total	**27**	**100%**

Table 3 shows that 24 students (88.88%) obtained scores below the mean, 1 student (3.70%) fell within the score interval that includes the mean, and 2 students (7.40%) achieved scores above the mean. The following histogram presents the distribution of post-test scores for the 27 students in the control class.

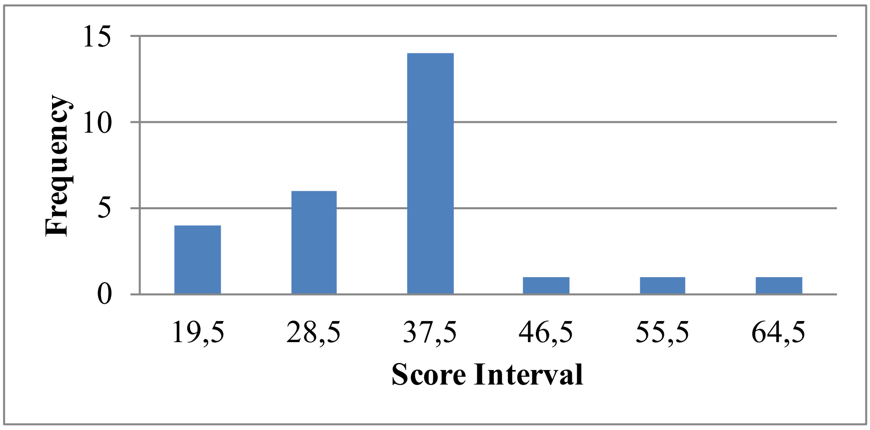

Figure 2. Histogram of Post-Test Scores in the Control Class

Test of Data Normality

The normality test aims to determine whether the data follow a normal distribution. In this study, the Liliefors test was used to assess normality. The criteria for decision-making are: H0 is accepted if Lcount ≤ Ltable, indicating that the data are normally distributed; H0 is rejected if Lcount > Ltable, indicating that the data are not normally distributed. The test was carried out at a significance level of α = 0.05.

Table 4. Results of the Data Normality Test

Group	N	Lcount	Ltable	Conclusion
Experimental Class	26	0,1619	0,1699	Normal
Control Class	27	0,1079	0,1665	Normal

Based on the results of the data analysis, it was found that Lcount < Ltable for each group. Therefore, it can be concluded that the data in this study are normally distributed.

Homogeneity Test

Following the normality test, the next step is to conduct a homogeneity test. In this study, the homogeneity test was performed using the F-test to determine whether the two groups have equal variances at a significance level of α = 0.05. Homogeneity testing is conducted to determine whether the variances of two or more distributions are equal (Dr. Yuliana, 2024).

The testing criterion is that if Fcount < Ftable, the data are considered to have equal or homogeneous variances.

Table 5. Results of Homogenity Test

Group	N	Fcount	Ftable	Conclusion
Experimental Control	26 27	1,76	1,94	Homogeneous

Based on the table above, the results of the homogeneity test show that Fcount = 1.76 and Ftable = 1.94. Since Fcount < Ftable falls within the acceptance region of H0 is accepted. Therefore, it can be concluded that the data in this study come from a homogeneous population.

Hypothesis Testing

In testing the hypothesis, the researcher used an independent samples t-test to examine the effect of the difference between the ICARE learning model and the conventional learning model on the mathematical problem-solving abilities of seventh-grade students at SMP Negeri 1 Suwawa. The results of the t-test indicate whether the research hypothesis is accepted or rejected. The findings are considered significant if tcount > ttable at a significance level of α = 0.05.

Table 6. Results of the Post-Test t-Test

Class	N	Mean	SD	Varians	tcount	ttable
Experimental Control	26 27	49,27 39,56	13,31 10,04	177,08 100,87	3,058	2,007

Based on Table 6, the experimental class achieved an average score of 49.27, while the control class had an average score of 39.56. This indicates that the mathematical problem-solving ability of students in the experimental class was higher than that of the control class. With a degree of freedom (df) of 51 and a significance level of α = 0.05, the critical values were tcount = 3.058 and ttable = 2.007. Since tcount > ttable, H0 is rejected and H1 is accepted. Therefore, it can be concluded that students taught using the ICARE learning model have significantly higher mathematical problem-solving abilities compared to those taught using the conventional learning model.

Discussions

The study was carried out at SMP Negeri 1 Suwawa with the purpose of examining the difference between the ICARE learning model and the conventional learning model on the mathematical problem-solving abilities of seventh-grade students at the school.

The description of the post-test data illustrating the mathematical problem-solving scores of the experimental and control classes is presented in Table 1. Furthermore, the normality test of the data distribution in this study was conducted using the Liliefors test at a significance level of α = 0.05. The results of the normality analysis for the experimental group, which consisted of 26 students, showed that the Lcount value was 0.1619 and the Ltable value was 0.1699. Meanwhile, for the control group with 27 students, the Lcount value was 0.1079 and the Ltable value was 0.1665. It can be observed that for both the experimental and control groups, Lcount < Ltable. This indicates that the students' mathematical problem-solving ability data are derived from a normally distributed population. The data analysis was then continued with a homogeneity of variance test. In this study, the homogeneity test was conducted using the F-test, which resulted in Fcount = 1.76. Based on the F distribution table at a significance level of $\alpha = 0.05$, with numerator degrees of freedom = 25 and denominator degrees of freedom = 26, the critical value was Ftable = 1.94. Since Fcount < Ftable, it can be concluded that the data on students' mathematical problem-solving abilities have homogeneous variances.

Based on the results of the normality and homogeneity tests, it was determined that the data on students' mathematical problem-solving abilities in both the experimental and control groups were normally distributed and exhibited homogeneous variances. Subsequently, hypothesis testing was performed using a t-test at a significance level of $\alpha = 0.05$. As shown in Table 6, the results were tcount = 3.050 and ttable = 2.007. Since tcount > ttable, it can be concluded that students taught using the ICARE learning model have significantly higher mathematical problem-solving abilities compared to those taught using the conventional learning model.

The ICARE learning model serves as an alternative approach that can enhance students' active participation while simultaneously developing their thinking skills. This model emphasizes active, collaborative, and experience-based learning, allowing students to engage directly in the learning process. This aligns with the statement by Carni et al. in (Yasa et al., 2019), who explain that the ICARE learning model provides students with opportunities to construct their own knowledge and apply the concepts they have acquired through the process of mathematical problem-solving.

The ICARE learning model has an influence on students' mathematical problem-solving abilities. This is supported by a study conducted by (Yasa et al., 2019) entitled *"The Effect of the ICARE Learning Model Assisted by Open-Ended Mathematical Problems on the Mathematical Problem-Solving Ability of Eighth-Grade Students at the Undiksha Singaraja Laboratory Junior High School."* The results of the study indicate that students who were taught using the ICARE learning model assisted by open-ended mathematical problems demonstrated better mathematical problem-solving abilities than those taught using conventional learning models. Furthermore, the ICARE learning model assisted by open-ended mathematical problems was found to have a significant effect on students' mathematical problem-solving skills. Similarly, a study by Anggita (2021) stated that the use of the ICARE learning model had a significant impact on students' problem-solving abilities and learning outcomes in statistics material at MTs Al-Ghozali Tulungagung.

This study shares several similarities with previous research, particularly in terms of employing the ICARE learning model as the independent variable and mathematical problem-solving ability as the dependent variable. However, there are notable differences. In the study conducted by (Yasa et al., 2019), the ICARE model was combined with open-ended mathematical problems, whereas the present study applies the ICARE model independently without incorporating any additional approaches. Meanwhile, the research by Anggita (2021) not only examined problem-solving ability but also assessed students' learning outcomes, thereby encompassing a broader scope compared to the present study, which focuses solely on mathematical problem-solving ability.

Another difference lies in the context and learning material. The study conducted by Anggita (2021) focused on statistical material, whereas the present study employs content related to data presentation and interpretation. This distinction demonstrates that the ICARE model can be applied across various mathematical topics, and the present study contributes additional empirical evidence regarding its effectiveness in improving students' mathematical problem-solving abilities on a different subject matter. Thus, this study not only reinforces existing findings but also provides a new contribution by implementing the ICARE model in its pure form without combining it with other instructional strategies, as well as by applying it to different mathematical content. These findings affirm that the ICARE model remains relevant and effective in mathematics instruction for developing students' problem-solving skills.

Based on the results and discussion, it has been confirmed that there is a significant difference in the mathematical problem-solving abilities of students taught using the ICARE learning model compared to those taught using the conventional learning model on the topic of data presentation and interpretation. Students instructed with the ICARE learning model demonstrated higher mathematical problem-solving abilities than those taught with the conventional approach. This finding indicates that implementing the ICARE learning model positively influences students' mathematical problem-solving skills.

CONCLUSION

The study examining the ICARE learning model and its effect on seventh-grade students' mathematical problem-solving abilities in the topic of data presentation and interpretation at SMP Negeri 1 Suwawa showed that students taught using the ICARE learning model achieved higher mathematical problem-solving skills than those taught using the conventional learning model. This conclusion is supported by the average post-test scores of students in both the experimental and control classes. Based on hypothesis testing using the t-test, the results showed tcount = 3.050 and ttable = 2.007 at a significance level of $\alpha = 0.05$. Since tcount > ttable, H0 is rejected and H1 is accepted, indicating that the ICARE learning model has a significant effect on students' mathematical problem-solving abilities.

Future research may be conducted at different educational levels, on broader learning materials, and with a larger sample size in order to obtain more generalizable results. In addition, subsequent studies may examine other aspects, such as students' motivation and learning independence, as well as integrate the ICARE learning model with instructional media or educational technology. Furthermore, it is recommended that future studies perform analyses based on each indicator of problem-solving ability to determine whether all students achieve satisfactory results on every indicator or whether certain indicators still require improvement.

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