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The Influence of the Introduction, Connect, Apply, Reflect, and Extend (ICARE) Learning Model on Cognitive Learning Outcomes in Science and Social Studies (IPAS) in Elementary Schools

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Abstract: This study addresses the issue of low student learning outcomes attributed to the frequent use of conventional teaching methods by educators in elementary schools. The Introduction, Connect, Apply, Reflect, and Extend (ICARE) learning model is proposed as a potential solution to enhance these outcomes. The purpose of this research is to examine the impact of implementing the ICARE learning model on students' cognitive learning outcomes in science and social studies (IPAS) in elementary schools. Additionally, the study compares the improvement of cognitive outcomes between students taught using the ICARE model and those taught using traditional methods. This quasi-experimental research employs a non-equivalent pretest-posttest control group design. The findings reveal that the application of the ICARE learning model significantly influences cognitive learning outcomes in IPAS subjects, with an effect size of 46.2%. Furthermore, students instructed through the ICARE model demonstrate greater improvement in cognitive learning outcomes compared to those who receive conventional instruction.

Keywords: ICARE Learning Model, Cognitive Learning Outcomes, IPAS, Elementary Education, Teaching Methods

INTRODUCTION

Education is one of the most crucial aspects of human life. It has the power to transform and shape the future of both individuals and nations. The quality of education in a nation is a key determinant of its human resources' quality; thus, a nation with a robust education system will likely produce highly skilled and knowledgeable citizens. Education is closely linked to the process of learning. Learning, as described by Suardi (2018), is the assistance provided by educators to students, facilitating the acquisition of knowledge, skills, and attitudes, and shaping beliefs and behaviors.

In reality, education in Indonesia faces significant challenges, particularly in the context of science education. According to data from the Programme for International Student Assessment (PISA) in December 2023, Indonesia ranked among the bottom 15 in science out of 81 participating countries, with student performance falling below the average PISA scores (Rizky et al., 2024). The low achievement in science learning is evident even at the elementary school level, where several studies have indicated that students' science learning outcomes are often below the minimum competency standards (KKM). The factors contributing to these poor outcomes include a lack of understanding of fundamental concepts, which begins during the early stages of learning a subject, educators' skills in delivering material, and the appropriateness of instructional design and implementation (Nabillah & Abadi, 2019).

One effective way to improve student learning outcomes is by employing appropriate teaching models that can help achieve learning objectives more efficiently and effectively. The teaching model plays a vital role in the learning process, directly influencing students' activities as they engage with the material, which in turn affects their learning outcomes. Rahmawati (2022) notes that using the right teaching model can make it easier for students to master the material, leading to better and improved learning outcomes.

Given these challenges, it is necessary to implement a teaching model that can enhance student learning outcomes, such as the ICARE (Introduction, Connect, Apply, Reflect, and Extend) model. The ICARE model encourages students to build their own knowledge, develop higher-order thinking skills, stay motivated and engaged, and foster curiosity (Mufidah et al., 2020). This model allows students to apply or practice what they have learned, providing a balanced approach between theory and practice. As a result, students are expected to easily understand complex topics such as energy transformation, as presented by the teacher. Additionally, the ICARE model offers schools the opportunity to align the curriculum structure with the needs and characteristics of students and their environmental conditions. Based on these considerations, the researcher is interested in conducting a study titled "The Influence of the Introduction, Connect, Apply, Reflect, and Extend (ICARE) Learning Model on Cognitive Learning Outcomes in Science and Social Studies (IPAS) in Elementary Schools."

METHOD

This study employs a quasi-experimental research design, specifically using "The Nonequivalent Pretest-Posttest Control Group Design," to compare learning outcomes between an experimental group and a control group. In this design, the experimental group is administered a pretest at the beginning of the study, followed by the intervention, and a posttest at the end of the study. The quasi-experimental approach involves two groups: one serving as the experimental group, which receives instruction using the ICARE learning model, and the other as the control group, which continues with conventional teaching methods. The study was conducted at SDN 2 Cilandak, with a sample consisting of 31 students from Grade IV A and 31 students from Grade IV B.

The instruments used in this research include tests and documentation. According to Munadi (2018), a test is a set of questions or tasks that must be answered or performed by the participants to measure a specific aspect of their knowledge or skills. The tests used in this study are pretests and posttests designed to assess students' cognitive learning outcomes, comprising 7 multiple-choice questions and 5 essay questions. Documentation involves collecting data from various documents relevant to the study.

Prerequisite Analysis Tests

Normality Test

The normality test is conducted to determine whether the collected data follows a normal distribution. The Kolmogorov-Smirnov test, performed using SPSS, is used for this purpose. The testing criteria are as follows:

- Accept H_0 and reject H_1 if the significance value (Sig.) is ≥ 0.05.
- Reject H_0 and accept H_1 if the significance value (Sig.) is < 0.05.

Hypotheses:

- H_0: The data follows a normal distribution.
- H_1: The data does not follow a normal distribution.

The results of the normality test for the pretest data in the experimental and control groups are as follows:

Table 1. Normality Test Results for Pretest Data in Experimental and Control Groups

Learning Outcome	Group	Kolmogorov-Smirnov Statistic	Df	Sig.
Pretest	Experimental	0.122	31	0.200
Pretest	Control	0.160	31	0.042

Source: Data processed using SPSS 26.0

The normality test results in Table 1 show differing significance values for the experimental and control groups. The experimental group has a significance value of 0.200, which is greater than 0.05, indicating that H_0 is accepted, and the data follows a normal distribution. In contrast, the control group has a significance value of 0.042, which is less than 0.05, indicating that H_1 is accepted, and the data does not follow a normal distribution.

The normality test results for the posttest data in the experimental and control groups are as follows:

Table 2. Normality Test Results for Posttest Data in Experimental and Control Groups

Learning Outcome	Group	Kolmogorov-Smirnov Statistic	Df	Sig.
Posttest	Experimental	0.146	31	0.089
Posttest	Control	0.162	31	0.037

Source: Data processed using SPSS 26.0

Based on Table 2, the normality test results show that the experimental group has a significance value of 0.089, which is greater than 0.05, indicating that H_0 is accepted and the data follows a normal distribution. However, the control group has a significance value of 0.037, which is less than 0.05, indicating that H_1 is accepted and the data does not follow a normal distribution. Since the data from one of the groups does not follow a normal distribution, the Mann-Whitney U test will be used for further analysis to compare the mean differences.

Hypothesis Testing

The Mann-Whitney U test is used when the data does not follow a normal distribution. This test was conducted using SPSS 26.0 software. The hypotheses for the Mann-Whitney U test are as follows:

- H_0: $\mu_1 = \mu_2$ - There is no difference in pretest scores of cognitive learning outcomes between students taught using the Introduction, Connect, Apply, and Extend (ICARE) learning model and those taught using conventional teaching methods.
- H_1: $\mu_1 \neq \mu_2$ - There is a difference in pretest scores of cognitive learning outcomes between students taught using the Introduction, Connect, Apply, and Extend (ICARE) learning model and those taught using conventional teaching methods.

Testing Criteria:

- Accept H_0 and reject H_1 if the p-value (sig. 2-tailed) > 0.05.
- Accept H_1 and reject H_0 if the p-value (sig. 2-tailed) < 0.05.

The results of the Mann-Whitney U test for the pretest scores in the experimental and control groups are presented below:

Table 3. Mann-Whitney U Test Results for Pretest Scores in Experimental and Control Groups

Test Type	Group	Mann-Whitney U	Z	Sig. 2-tailed
Pretest	Experimental	463.500	-0.240	0.810
Control				

Source: Data processed using SPSS 26.0

The results of the Mann-Whitney U test in Table 3 indicate that the sig. 2-tailed value for the pretest data in the experimental and control groups is 0.810, which is greater than 0.05. Based on the testing criteria, H_0 is accepted, indicating that there is no significant difference in pretest scores between students taught using the ICARE learning model and those taught using conventional methods.

The results of the Mann-Whitney U test for the posttest scores in the experimental and control groups are presented below:

Table 4. Mann-Whitney U Test Results for Posttest Scores in Experimental and Control Groups

Test Type	Group	Mann-Whitney U	Z	Sig. 2-tailed
Posttest	Experimental	323.500	-2.221	0.026
Control				

Source: Data processed using SPSS 26.0

Based on the data in Table 4, the sig. 2-tailed value for the posttest data in the experimental and control groups is 0.026, which is less than 0.05. According to the testing criteria, H_1 is accepted, indicating that the mean posttest scores of students taught using the ICARE learning model are significantly higher than those of students taught using conventional methods.

Simple Linear Regression Test

A simple linear regression test is conducted to determine the influence of one variable on another. The regression analysis in this study was performed using SPSS 26.0 software. The results of the simple linear regression test are shown in Table 5 below.

Table 5. Simple Linear Regression Test Results

Model		Unstandardized Coefficient		Standardized Coefficient	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	41.690	3.964		10.517	.000
	Pretest (ICARE)	.557	.112	.680	4.990	.000

Based on the results of the simple linear regression test, the significance value is 0.000. According to the testing criteria for regression analysis, a sig. value of 0.000 is less than 0.05, which indicates that the ICARE learning model significantly influences students' cognitive learning outcomes.

Next, the coefficient of determination (R^2) is calculated to determine the extent to which the ICARE learning model affects students' cognitive learning outcomes. Before determining the coefficient of determination, the R^2 value is found using SPSS 26.0 software. Table 6 shows the R^2 value:

Table 6. R^2 Value

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.680	0.462	0.443	10.613

Source: Data processed using SPSS 26.0

The coefficient of determination (D) is calculated using the formula:

$$D = R^2 \times 100\% = 0.462 \times 100\% = 46.2\%$$

Based on this calculation, the coefficient of determination (D) is 46.2%, indicating that the ICARE learning model accounts for 46.2% of the variance in students' cognitive learning outcomes in elementary school.

N-Gain Test

The N-Gain test is conducted to determine whether there is an improvement in cognitive learning outcomes among students taught using the ICARE learning model compared to those taught using conventional methods, based on the mean N-Gain values. The results of the N-Gain test for the experimental and control groups are presented in Table 7.

Based on Table 7, the mean N-Gain value in the experimental group is 0.39, while the mean value in the control group is 0.22. The mean increase in cognitive learning outcomes in the control group is lower than in the experimental group, with the experimental group falling into the "moderate" category and the control group falling into the "low" category.

Table 7. N-Gain Test Results for Experimental and Control Groups

Test Type	Group	Minimum Score	Maximum Score	Std. Deviation	Mean	Criteria
N-Gain	Experimental	0.00	0.67	0.16118	0.39	Moderate
	Control	0.00	0.55	0.15640	0.22	Low

Source: Data processed using SPSS 26.0

N-Gain Normality Test

The normality test on N-Gain data is conducted to determine whether the data follows a normal distribution. The results of the normality test for the N-Gain data in the experimental and control groups are presented below:

Table 8. Normality Test Results for N-Gain Data in Experimental and Control Groups

N-Gain	Group	Kolmogorov- Smirnov		
		Statistic	Df	Sig.
	Experimental	0.085	31	0.200
	Control	0.156	31	0.053

Source: Data processed using SPSS 26.0

Based on Table 8, the normality test results indicate that the experimental group has a significance value of 0.200, which is greater than 0.05, and the control group has a significance value of 0.053, which is also greater than 0.05. According to the normality test criteria, since both groups have significance values greater than 0.05, H_0 is accepted and H_1 is rejected, indicating that the N-Gain data is normally distributed.

N-Gain Homogeneity Test

The homogeneity test is performed to determine whether the sample groups or data are homogeneous. The homogeneity test criteria are as follows:

- Accept H_0 and reject H_1 if the significance value (Sig.) > α or 0.05.
- Accept H_1 and reject H_0 if the significance value (Sig.) < α or 0.05.

Hypotheses:

- H_0: The variances of the two populations are homogeneous.
- H_1: The variances of the two populations are not homogeneous.

The results of the homogeneity test for the N-Gain data in the experimental and control groups are shown below:

Table 9. Homogeneity Test Results for N-Gain Data

N-Gain		Levene Statistic	df1	df2	Sig.
	Based on Mean	0,082	1	60	0,776

Source: Data processed using SPSS 26.0

Based on the data in Table 9, the homogeneity test results show a significance value of 0.776, which is greater than 0.05. According to the homogeneity test criteria, since the significance value is greater than 0.05, H_0 is accepted and H_1 is rejected, indicating that the N-Gain data is homogeneous.

Parametric Test (T-Test) for N-Gain Data

After confirming that the data is both normally distributed and homogeneous, a t-test is performed. The t-test criteria are as follows:

- Accept H_0 and reject H_1 if the Sig. (2-tailed) > α or 0.05.
- Accept H_1 and reject H_0 if the Sig. (2-tailed) < α or 0.05.

Hypotheses:

- H_0: There is no significant difference in the improvement of cognitive learning outcomes between students taught using the ICARE learning model and those taught using conventional teaching methods.
- H_1: There is a significant difference in the improvement of cognitive learning outcomes between students taught using the ICARE learning model and those taught using conventional teaching methods.

The results of the t-test for the N-Gain data in the experimental and control groups are presented below:

Table 10. T-Test Results for N-Gain Data in Experimental and Control Groups

N-Gain		F	Sig.	t	df	Sig. (2-tailed)
	Equal Variances assumed	0,082	0,776	4,195	60	0,000

Source: Data processed using SPSS 26.0

Based on the data in Table 10, the t-test results for the N-Gain data show a Sig. (2-tailed) value of 0.000, which is less than 0.05. According to the t-test criteria, since the Sig. (2-tailed) value is less than α or 0.05, H_1 is accepted and H_0 is rejected. This indicates that there is a significant difference in the improvement of cognitive learning outcomes between students taught using the ICARE learning model and those taught using conventional teaching methods.

RESULTS & DISCUSSION

The Influence of the ICARE Learning Model on Cognitive Learning Outcomes in Science and Social Studies (IPAS) in Elementary Schools

During the pretest, the students scored a maximum of 85 and a minimum of 5, with an average pretest score of 31.15. As Sudjana (in Nurrita, 2018) states, learning outcomes are the competencies achieved by students after participating in a learning activity designed and implemented by the teacher. After the experimental class received treatment using the ICARE learning model, there was a significant improvement in student learning outcomes. This is evident from the posttest results, where students scored a maximum of 85 and a minimum of 30, with an average posttest score of 59.03. Therefore, it can be concluded that the implementation of the Introduction, Connect, Apply, Reflect, and Extend (ICARE) learning model led to an improvement in students' cognitive learning outcomes.

To assess the impact of this study, the researchers compared two classes: an experimental class using the ICARE learning model and a control class using conventional teaching methods. The control class, consisting of 31 students from Grade IV A, had a pretest maximum score of 65, a minimum score of 0, and an average pretest score of 32.58. After conventional instruction, the posttest scores in the control class showed a maximum score of 80, a minimum score of 10, and an average posttest score of 47.74. The improvement in learning outcomes in the experimental class was greater than that in the control class.

The IPAS lessons on energy transformation around us were conducted over two sessions in both the experimental and control classes. Based on the data analysis, it was found that the cognitive learning outcomes of students using the ICARE learning model were superior. The ICARE model aids students in better understanding the subject matter by applying what they have learned, reflecting on it, and extending their knowledge. This aligns with Triani's (2018) assertion that the ICARE model aims to enhance learning outcomes through five stages, allowing students to express their ideas and learning experiences. Learning processes improve when students are encouraged to rearticulate information, connect it, provide examples, and use various methods (Eliyati in Triani, 2018).

The students' learning outcomes, as analyzed through the R-value (correlation coefficient) of 0.680 and an R square (coefficient of determination) of 0.462, indicate that the ICARE learning model has a 46.2% influence on students' cognitive learning outcomes. In terms of classroom participation, students treated with the ICARE model were more active than those in the conventional teaching model. These students were more engaged in asking and answering questions. The steps of the ICARE model implemented in classroom learning activities include:

a. Introduction Stage

At this stage, the teacher provides an overview of the lesson objectives, the activities planned for the lesson, and the prerequisite materials (Yumiati & Wahyuningrum, 2015). The teacher also poses leading questions to students about the lesson topic, encouraging them to share their experiences, open up discussions, and think critically. These questions help develop students' critical thinking skills, making it easier for them to remember and reason when answering questions (Pandu et al., 2023). According to Bahr in Eliana (2020), critical thinking is categorized as higher-order thinking skills, including analysis (C4), evaluation (C5), and creation (C6). During this stage, the teacher presents the material and asks questions, engaging students in cognitive activities at the remembering (C1) and understanding (C2) levels.

b. Connect Stage

In the connect stage, the cognitive level targeted is C3, where the teacher and students relate the lesson material to real-life activities. By emphasizing the connection between the material and daily life, students can apply the competencies they have learned in their roles as family and community members (Primayana et al., 2019). Students are divided into groups to collaboratively work on learning worksheets (LKPD). Group discussions promote cooperation among students and the exchange of information, enabling active learning and collaborative problem-solving.

c. Apply Stage

In this stage, students engage in activities that allow them to apply the knowledge gained in previous stages. They work on LKPD sheets in groups and participate in practical activities. Learning supported by practical work enhances problem-solving abilities, the quality of learning, and student outcomes (Triani et al., 2018). Problem-solving skills in this activity correspond to the C4 cognitive level.

d. Reflect Stage

At this stage, students reflect on what they have learned by presenting the results of their practical work and LKPD completion in front of the class. Reflection activities allow students to think and freely express their ideas, helping less proficient students learn from their peers and reinforcing the material (Listiyani, 2018). According to Drost in Pranyoto (2016), reflection activities encourage students to collect and consider materials based on their experiences, helping them become aware of various facts, data, values, and understandings related to the subject.

e. Extend Stage

In this final stage, students are given homework assignments. The extend stage helps solidify students' knowledge, ensuring it remains in their memory. Homework reinforces learning through practice, application, transfer, and enrichment, leading to the integration of various skills (Wangid, 2017).

Improvement in Cognitive Learning Outcomes of Students in the Experimental Class Using the ICARE Learning Model

Based on the analysis conducted in this study, it is evident that cognitive learning outcomes are higher when using the ICARE learning model compared to conventional methods. Learning outcomes serve as a measure for teachers to assess students' understanding of a subject. According to Nabillah & Abadi (2019), learning outcomes provide teachers with information about students' progress toward achieving learning objectives through the teaching and learning process. In the experimental class, students using the ICARE learning model had an average pretest score of 31.15 and an average posttest score of 59.03. In contrast, the control class, using conventional methods, had an average pretest score of 32.58 and an average posttest score of 47.74.

When categorized using the N-Gain metric, the cognitive learning outcomes for the IPAS experimental class with the ICARE model had an average N-Gain of 0.39, which corresponds to a 39% improvement in the medium category. The control class with conventional methods had an average N-Gain of 0.22, corresponding to a 22% improvement in the low category. Based on this data, it is clear that the cognitive learning outcomes of IPAS students taught using the ICARE model are superior to those of students taught using conventional methods. This finding is consistent with research conducted by Noge (2017), which states that the average learning outcomes in the experimental class using the ICARE model are better than those in the control class using conventional methods.

The improvement in each indicator on the research instrument can be observed in the diagram in Figure 1.

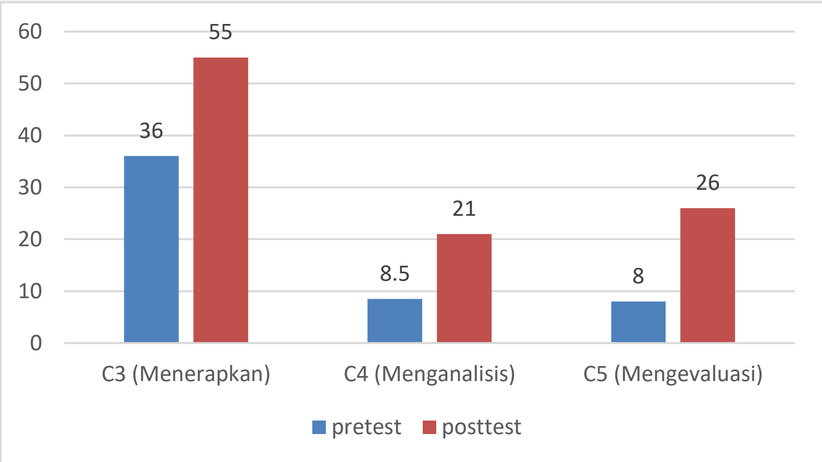

Figure 1. Diagram of Average Cognitive Learning Outcome Indicators for Students in the Experimental Class.

Based on the diagram in Figure 1, it can be seen that each indicator of student learning outcomes in the experimental class showed significant improvement. The C3 indicator in the research instrument is found in multiple-choice questions number 2 and 5, in the essay question is found in number 5. In the pretest, the C3 indicator got an average of 36 and the posttest got an average of 55 with an increase of 53%. The C4 indicator is found in multiple-choice questions numbers 3, 4, and 6 with an average pretest score of 8.5 and an average pottest of 21 so that it has increased by up to 100%. The C5 indicator is found in multiple-choice questions number 1 and 7 with a pretest score of 8 and pottest 26 and there is an increase of up to 100%. Based on this data, it can be seen that the lowest increase is in the C3 question, in this indicator students who are able to answer the questions correctly in the pretest are more than other indicators.

The improved cognitive learning outcomes in students using the ICARE model can be attributed to the model's ability to expose students to real-life phenomena, motivating them to be more active and curious. The Apply stage of the ICARE model, where students apply the material, they have learned through practical activities, along with the Reflect and Extend stages, which reinforce the material in students' memory, contribute to better retention. Reflection activities are designed to help students recall the knowledge and skills they have learned as a foundation for further learning (Wowor et al., 2022). The use of the ICARE model also enhances problem-solving skills and overall student learning outcomes (Triani et al., 2018). The implementation of the ICARE model in this study was designed to achieve the goal of improving students' cognitive learning outcomes.

CONCLUSION

Based on the above discussion, it can be concluded that the ICARE learning model significantly improves students' cognitive learning outcomes compared to conventional teaching methods. This improvement occurs because the ICARE model provides opportunities for students to connect with real-life phenomena, thereby increasing their motivation to be more active and enhancing their curiosity. The conclusions drawn from this research are as follows:

1. The use of the ICARE learning model positively influences the cognitive learning outcomes of students in IPAS, with an average posttest score of 59.03.
2. Students who were taught using the ICARE learning model demonstrated better learning outcomes compared to those taught using conventional teaching methods.

RECOMMENDATIONS

Based on the research findings and data analysis, the following recommendations are proposed:

1. For Teachers: The ICARE learning model can be used as an alternative to conventional teaching methods to make the learning process more engaging. By using this model, students become more active and can better understand the material, leading to improved learning outcomes.
2. For Schools: Providing moral and material support for the implementation of the ICARE learning model can enhance teachers' effectiveness in the classroom, ultimately optimizing the learning process.
3. For Future Researchers: This study found that the ICARE learning model accounted for 46.2% of the variance in students' cognitive learning outcomes, indicating that 53.8% of the outcomes were influenced by other factors. Future researchers are encouraged to explore these additional factors and conduct further studies on the ICARE learning model.

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