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Effectiveness of the Index Card Match (ICM) Method in Improving Science Learning Outcomes of Student at Ban Eyoh School Thailand

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Abstract: This study aims to analyze the effectiveness of applying the Index Card Match (ICM) method in improving science learning outcomes of students at Ban Eyoh School in Thailand. This study uses a quantitative experimental research design with a Quasi-Experimental Design approach. Data were collected through pretest and posttest administered before and after the implementation of the ICM method. Statistical analysis showed a significant difference between the experimental and control classes, with a sig. value of 0.001 (< 0.05). The average posttest score of the experimental (80.61) was 10.31 points higher than that of the control (70.30). This effectiveness was reinforced by the N-Gain Score of "quite effective" (56%) for ICM, while the control class was "ineffective" (39%). The effectiveness of the ICM learning model is also demonstrated by: 1) A statistically significant difference between the learning outcomes of the experimental group (ICM) and the control group (conventional), 2) A higher posttest average score for the experimental group compared to the control group, and 3) The learning effectiveness level (N-Gain Score) in the experimental class was categorized as "quite effective", while the control class was "ineffective". Therefore, ICM can be recommended as an alternative innovative learning model, especially in the context of science learning in a challenging

Keywords: Ban Eyoh School; Effectiveness; Index Card Match; Science Learning Outcomes

Introduction

Thailand is a country with a population of nearly 70 million people. It has an education system similar to that implemented in Indonesia, ranging from early childhood education to higher education, with no fundamental differences (Embassy of the Republic of Indonesia in Bangkok, 2014). Thailand also implements nine years of compulsory education, like Indonesia, but free education is provided until the end of high school. One of the interesting educational reforms in Thailand is the introduction of Information and Communication Technology (ICT) from an early age through a program called One Tablet Per Child, or OTPC for short. This ambitious project aims to strengthen pedagogy and advanced learning without the constraints of location, distance, and the economic background of students. The Thai government has so far spent 3 billion baht, equivalent to USD 96 million, to purchase 900,000 tablet computers in 2012 for distribution to first-grade elementary school students throughout Thailand.

In 2013, the Thai government distributed 1.63 million tablet computers to first-grade junior high school students throughout Thailand (Embassy of the Republic of Indonesia in Bangkok, 2014). However, despite the availability of these tablets (OTPC), students did not become more active in learning. They seemed more interested in the features available on the tablets, so their

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involvement in learning was still not very active, which affected their grades.

As a student in the Chemistry Education Study Programme, the researcher observed these learning conditions while carrying out a Community Service Programme (KKN) by teaching at Ban Eyoh School for four months. The researcher was assigned to a primary school to teach science. The obstacle faced was the difficulty in communicating between the researcher and the students due to the school's policy of requiring the use of Thai as the official language in the formal education system and prohibiting the use of Malay, so communication could only be conducted in English. Nevertheless, the reality on the ground shows that most people in Southern Thailand, especially in the provinces of Pattani, Yala, and Narathiwat, use Patani Malay in their daily conversations because the majority of the population is ethnic Malay Muslim.

These communication barriers hindered the learning process somewhat, and the students' science learning outcomes were not optimal because the author had difficulty explaining the material. Therefore, the author wanted to apply an interesting, communicative, active, and collaborative learning method (Andari et al., 2022). In the learning process, communication skills create an atmosphere conducive to active learning, enabling students to have the confidence to express their ideas, while also serving as a medium for fostering empathy and appreciation for the different perspectives they will encounter in their daily lives (Kurniawan et al., 2020), (Ariani & Setianingsih, 2018).

Science, as a branch of science, has broad applications in society, making science education crucial in shaping children's cognitive structures. The science teaching and learning process requires innovation and additional support to increase students' motivation for science learning. A fundamental understanding of science material is essential so that students do not experience difficulties in understanding more complex concepts at the next level of education (Mulyadinata et al., 2020). Science education at the primary school level plays a crucial role in deepening students' knowledge of natural phenomena and scientific methods.

The problems encountered in science education at the elementary level, especially among fourth-grade students, include a lack of active student participation and difficulties in understanding complex scientific concepts (Priyono et al., 2023). Students in science learning are usually more active in participating and have more developed critical thinking skills, especially when studying chemistry. The reason is that science is a field of study related to efforts to understand natural phenomena in a structured manner through stages of scientific discovery (Pohan & Hasibuan, 2019). One of the key factors for successful learning is the learning model applied (Rahmawati & Yulianti, 2020). Teachers' accuracy in selecting and implementing learning models that are relevant to the material will make it easier for students to accept and understand the explanations given. The application of a learning approach centred on student independence, inspired by the thoughts of Ki Hajar Dewantara, can increase learning comfort, social sensitivity, and the independence of students in exploring their interests (Jannah et al., 2023).

The Index Card Match learning method is a learning method that requires students to work together to increase their confidence and responsibility. Index card match is a problem-solving learning method used to improve students' science learning outcomes, Bona in (Putri & Tirtoni, 2022). Index Card Match is a good choice for increasing student engagement in the classroom because it includes activities that require their participation (Jumainah et al., 2023). Findings by (Hasanah et al., 2025) reinforce Piaget and Vygotsky's constructivist theory, which emphasizes the importance of interaction and direct experience in active learning, also stimulate children's cognitive and emotional development in the learning process to achieve maximum results in the learning process (Fatmawati, 2021).

The Index Card Match cooperative learning model is an interesting learning approach that can be used to reinforce students' mastery of material through recall techniques by matching pairs of question and answer cards in groups (Sirait & Apriyani, 2020). The implementation of this model makes students more active and involved in learning activities, while the role of the teacher shifts to that of a facilitator and motivator. Learning activities become more interesting and enthusiastic because students discuss to find card pairs in groups while understanding concepts or topics in a pleasant atmosphere, for example, learning packaged in the form of games in the Index Card Match (Wahyuningtyas, 2022), (Annisa & Marlina, 2019), (Hidayat et al., 2020). The application of this learning model can foster a spirit of mutual cooperation and increase a sense of responsibility, encourage active participation and collaboration in the classroom, engage students in active learning, and develop their creativity and communication skills, as they must collaborate to create question and answer cards in groups and then find the right card pairs (Nur et al., 2024), (Raihan et al., 2023), (Oktaviani & Aulia, 2024).

The application of this learning model can foster a spirit of mutual cooperation and increase students' sense of responsibility and communication skills, as they must collaborate to create question and answer cards in groups and then find the right card pairs. In this way, communication between students will be established

and a respect for other people's opinions will be formed (Ulya et al., 2020), (YATINI, 2021).

This method includes six syntactic stages, namely: conveying learning objectives and preparing students, presenting information, organising students into study groups, guiding study groups, presenting work results and evaluations, and giving rewards (Pianda, 2018). The advantages of this learning method are its ability to create an atmosphere of excitement in the learning process, make teaching materials more interesting to learners, create an active and enjoyable learning atmosphere, enhance cooperation, foster creativity in learning, and improve learning outcomes in mastering the material. This cooperative method can be applied to improve science knowledge competencies, as shown in other studies that demonstrate the significant effect of the Index Card Match cooperative learning method in improving science learning outcomes (Annisa & Marlina, 2019), (Prabowo et al., 2020).

Previous studies conducted by (Hidayat et al., 2020), (Lestari, 2023), (Parahita et al., 2024) describe Index Card Match, which can read markers that will then bring up 3D objects, commonly known as augmented reality, which will make it easier for students to visualise. Based on expert judgement, the material obtained a score of 84.4 per cent, which is considered valid. In the evaluation activity, the teacher conducted the evaluation well, showing that the Reading Card Match and Index Card Match strategies produced satisfactory science learning outcomes for students. Bridging the gap in the literature on effective learning strategies for science and how the Index Card Match cooperative learning technique affects students' science learning outcomes (Destiawati et al., 2024) mentions that the Index Card Match method works well in improving students' understanding of science ideas.

The urgency of this research is that Ban Eyoh School Thailand faces the complexity of learning with students from diverse ethnic and linguistic backgrounds, especially in the Thailand-Malaysia border area. This condition requires adaptive and engaging learning strategies and methods to ensure that all students can achieve optimal science learning outcomes. The research gap found is that there has never been any research on Index Card Match in an international context before because most research on Index Card Match has been conducted in the context of domestic learning and limited number of studies focusing on effectiveness (Hasanah et al., 2025).

Based on the experience of teaching at Ban Eyoh School and supported by several literature reviews, the researcher found the novelty of this research to be the role of KKN students as learning facilitators using the innovative Index Card Match learning method. It is hoped that the results of this study will contribute to providing alternative learning methods that are proven to be effective in improving the science learning outcomes of students at Ban Eyoh School.

Method

This research was conducted in Thailand, at Ban Eyoh School in Narathiwat Province, from June to October 2023. The research type was experimental, with a quasi-experimental design using a quantitative approach. The population in this study was all students at Ban Eyoh School, while the sample was taken using purposive sampling, namely fourth-grade students consisting of only two classes, each with 30 students, for a total sample of 60 students. The research procedures were as follows: a. Preparation stage: 1) Developing research instruments; 2) Validating instruments; 3) Selecting samples and dividing groups. b. Implementation Stage: 1) Conducting a pre-test on both groups; 2) Creating cards with guiding questions to help students formulate basic project questions; 3) Using the cards for brainstorming project ideas; 4) Applying Index Card Match to the experimental group; 5) Applying conventional learning to the control group; 6) Conducting a post-test on both groups. c. Final stage: 1) Data analysis; 2) Drawing conclusions. The research stages can be seen in the flowchart below (Figure 1).

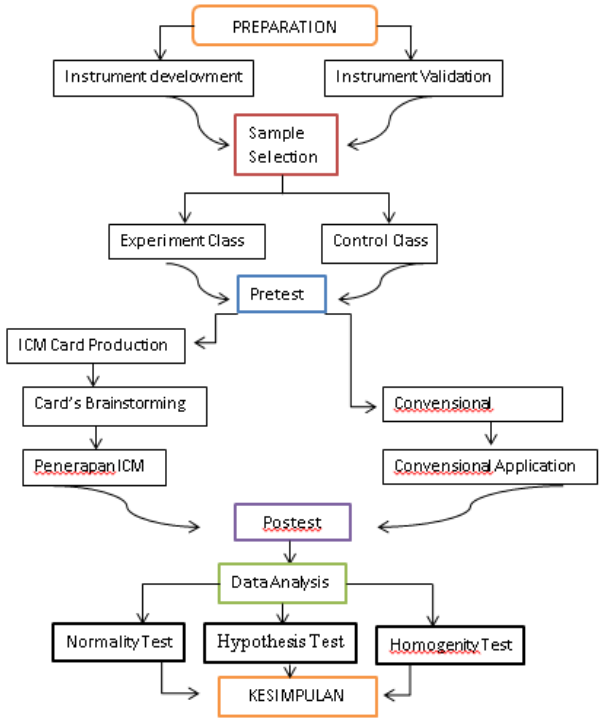

Figure 1. Flowchart Research

The data collection technique measured science learning outcomes using test sheets in the form of pre-

tests and post-tests to see the science learning outcomes of the students, independent t-tests and gain score tests. The questions designed for use in the pre-test and post-test of science learning outcomes needed to be tested for feasibility, including validity, reliability, level of difficulty, and discriminating power with the help of the SPSS25 application. The independent t-test was used to compare the test results in the experimental and control classes, and the gain score test was used to measure the increase in students' science learning outcomes using Formula 1.

$$\text{N-Gain} = \frac{post\ test - pre\ test\ score}{score\ \max - pretest\ score} \quad (1)$$

After obtaining the value using the above formula, it is then categorized using the N-Gain criteria as shown in Table 1.

Table 1. Categories of N-Gain Effectiveness Interpretation

Percentage of Learning (%)	Category
<40	Ineffective
40-55	Less Effective
56-75	Quite Effective
>76	Effective

Source : Hake, 1999 (Gunawan *et al*., 2022)

Result and Discussion

The data collected came from research on the application of the Index Card Match strategy and was collected by comparing the learning outcomes of the students. The average learning outcome score was obtained after the students were given a test consisting of 10 questions that had been validated and tested for reliability, discriminating power, and level of difficulty. The average posttest scores for experimental and control classes can be seen in Table 2.

Table 2. Posttest Scores for the Experimental and Control Class

	Eksperiment	Control
Amount	2200	1810
Average	73.33	60.33
standard deviation	20.734	23.116
Median	80	60
Highest Score	100	90
Lowest Value	30	20
Range	70	70
Variant	429.885	534.368

Based on Table 2, it can be seen that the standard deviation of the posttest results in the experimental class was 20.734, while the control class had a standard deviation of 23.116. The minimum score obtained by the experimental class was 30, while the control class achieved 20. For the maximum score, the experimental class achieved 100, while the control class achieved 90. In addition, there was a difference in the posttest mean scores of the two classes, with the experimental class obtaining a mean of 73.33, higher than the control class, which obtained a mean of 60.33.

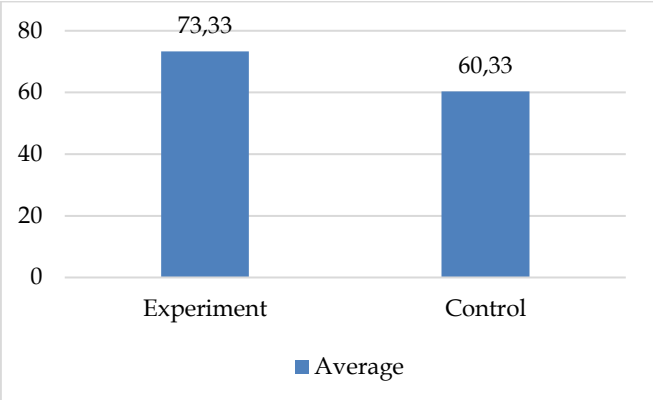

Figure 2. Graph of Average Scores for the Experimental Class and Control Class

The graph above shows that the average posttest score in the experimental class was higher than that in the control class, with the experimental class having an average of 73.33 and the control class having an average of 60.33, a difference of 13. Based on this data, it can be concluded that learning outcomes improved after the Index Card Match (ICM) method was applied to English lessons for students at Ban Eyoh School in Thailand.

Figure 3. Student Learning Activities

In response to the research questions posed in this study, the next step was to conduct an N-Gain Score test to examine the effectiveness of the Index Card Match learning model in improving student learning outcomes.

Table 3. Results of N-Gain Score (%) Calculations for the Experimental Class using SPSS Statistics 25

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_Score	33	-.50	1,00	.5617	.29531
Ngain_Persentase	33	-50.00	100.00	56.1688	29.53133
Valid N (listwise)	33				

The results of the SPSS analysis show that the mean N-Gain Score (%) in the experimental class was 56.16 or 56%, which means that learning using the Index Card Match model was quite effective in the learning process of Ban Eyoh School students in the experimental class.

Table 4. Results of N-Gain Score (%) Calculations for the Control Class using SPSS Statistics 25

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Gainscore	33	-.25	.88	.3999	.30500
gainscore_persen	33	-25.00	87.50	39.9892	30.49970
Valid N (listwise)	33				

On the other hand, the N-Gain Score (%) analysis results in the control class = 39.9 or 39%, which means that using a learning model with conventional methods is ineffective in the learning process in the control class at Ban Eyoh School. After obtaining data from each group, hypothesis testing using the t-test can be continued. However, before conducting the t-test, it is necessary to conduct a preliminary analysis of the research data, namely a normality test and a homogeneity test to determine the hypothesis test.

1. Normality Test

The normality test was conducted on the experimental class and the control class to determine whether the two sample groups were normally distributed or not. The decision criteria were that if the significant value obtained was > 0.05, the data was normally distributed, and if the significant value was < 0.05, the data was not normally distributed.

Table 5. Normality Test Results

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	Sig.
Unstandardized Residual	.933	33	.044
Unstandardized Residual	.956	33	.193
Unstandardized Residual	.931	33	.038
Unstandardized Residual	.935	33	.050

Source: Lilliefors Significance Correction

From the table above, the significant value for the learning outcomes of students (post-test scores) in the experimental class is 0.193, which has a sig.α value > = 0.05. Therefore, it can be concluded that the population of student learning outcomes is normally distributed, so H_a is accepted.

2. Homogeneity Test

The homogeneity test aims to determine whether the data obtained is homogeneous or not. The SPSS program analysis has a sig α level of 0.05, which means that if the homogeneity test data analysis value is > α, the data can be said to be homogeneous, whereas if the homogeneity test data analysis value is < α, the data is said to be non-homogeneous.

Table 6. Homogeneity Test Results

	Levene Statistic	df1	df2	Sig.
Based on Mean	1.870	1	64	.176
Based on Median	2.038	1	64	.158
Based on Median and with adjusted df	2.038	1	60.368	.159
Based on trimmed mean	2.088	1	64	.153

Based on the results of the data analysis above, the value of the Levene test for student learning outcomes is 2.088 with a sig α value of 0.176. This shows that the sig.α value is greater than 0.05, so it can be concluded that the data is homogeneous.

3. Hypothesis Testing

A hypothesis is a statement or assumption that is temporary in nature regarding a research problem whose validity is still weak (not necessarily true) and therefore must be tested empirically. This test is used to determine the difference in learning outcomes between the experimental class using the Index Card Match model and the control class using the conventional learning model. The hypothesis test used by the

researcher is the independent sample t-test and the N-Gain Score (%) test.

The results of the prerequisite test found that the data obtained met the normality and homogeneity tests, so the analysis was conducted using an independent sample t-test with equal variances assumed. The testing criteria are that if the sig.α value is greater than = 0.05, Ho is accepted, and conversely, if sig.α is less than = 0.05, Ho is rejected.

Table 7. Results of the Independent Samples Test (Levene's Test for Equality of Variances)

	F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	1.870	.176	3.552	64	.001	10.30303	2.90063	4.50835	16.09771
Equal variances not assumed			3.552	59.273	.001	10.30303	2.90063	4.49943	16.1066

From the above calculations, the calculated t-value is 3.552 and the table t-value is 2.000 at a significance level of α = 0.05. Because t-count > t-table and sig. (2-tailed) = 0.001< 0.05, the decision taken is to reject Ho and accept Ha, so it can be said that there is a significant difference between the learning outcomes of students in the control class and the experimental class. This means that the use of the Index Card Match model is effective in improving learning outcomes compared to the conventional model.

The results of the study show that with the index card match method, the average science learning outcomes of students in the experimental class were 73.33, higher than the control class, which had an average of 60.33. Based on this data, it can be concluded that science learning outcomes increased after the implementation of the Index Card Match (ICM) method, in line with the research by (Sari & Agustini, 2019). Learning using the Index Card Match model is quite effective with an N-Gain value of 39%, which means that using the conventional learning model is ineffective because with ICM, students do not feel bored, comfortable, and enjoy learning (Rijal & Wayati, 2022).

The results of the prerequisite test found that the data met the normality and homogeneity tests, so the analysis was carried out using an independent sample t-test with the assumption of equal variances. From the calculation, a t-value of 3.552 and a t-table value of 2.000 were obtained at a significance level of α = 0.05. Because t count > t table and sig. (2-tailed) = 0.001< 0.05, the decision taken is to reject H_0 and accept Ha, which means that there is a significant difference between the science learning outcomes of students in the control class and the experimental class (Fatmawati, 2021), ((Zahwa & Erwin, 2022), (Fitra, 2024), (Annisa & Marlina, 2019), (Parahita et al., 2024).

Meanwhile, in the control class that used the lecture method, learning was more teacher-centered. The researcher dominated the learning process by explaining the material verbally, while the students only listened and took notes. The increase in the average score of student learning outcomes is due to the fact that during the learning process, students participate and pay more attention during the learning process, which uses the index card match learning strategy (Wafa & Henry Januar Saputra, 2019). This method did not provide much opportunity for students to actively participate in the learning process, thus tending to make them passive. This had an effect on the students' science learning outcomes, which were relatively lower than those of the experimental class.

Conclusion

Based on the analysis of research data on the effectiveness of the Index Card Match learning model in improving student learning outcomes in grade III at Ban Eyoh School in Thailand, it can be concluded that the average learning outcome score of students using the Index Card Match model was 80.61, while the average learning outcome score of students using the conventional learning model was 70.30. These test results show that the average scores obtained by students had a difference of 10.31. The independent sample t-test results show an Asymp.Sig. (2-tailed) value of 0.001, which means that the Asymp.Sig. (2-tailed) value is smaller than the significance level of α = 0.05 (0.001 < α = 0.05). This means that Ho is rejected and Ha is accepted, and the students' N-Gain Score with the Index Card Match model of 56% is categorized as quite effective, while the results of the analysis of the effectiveness of the control class's learning outcomes produced a percentage of 39% in the ineffective category. Thus, it can be concluded that the application of the Index Card Match learning model is effective in

improving the learning outcomes of students in grade III at Ban Eyoh School Thailand.

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Author Contributions
All authors contributed to the writing and revision of the article. the tasks of individual authors. e.g., Harahap, Fatma S. contributed to data collection by conducting research; Hotrina contributed to data analysis and interpretation

Conflicts of Interest
The authors declare no conflict of interest. in the publication of this scientific article.

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