

Mobile Learning Based Learning Using Ethno Edu Games to Improve Students' Critical Thinking and Cognitive Abilities on IPAS Subjects in Grade IV Elementary School

Widia Indah Rahayu^{1*}, Suroso Mukti Leksono¹, Lukman Nulhakim¹

¹ Elementary School Magister Program, Faculty of Teacher and Education, Sultan Ageng Tirtayasa University, Banten, Indonesia.

Received: April 17, 2024

Revised: July 01, 2024

Accepted: September 25, 2024

Published: September 30, 2024

Corresponding Author:

Widia Indah Rahayu

widiaindrahayu.28@gmail.com

DOI: [10.29303/jppipa.v10i9.8339](https://doi.org/10.29303/jppipa.v10i9.8339)

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Abstract: Basically, elementary school age students are still very interested in playing or games. The principle of playing while learning can create a pleasant atmosphere for students in learning. In playing, children have the freedom to channel and express what their hearts desire. An atmosphere like this will encourage students to be more enthusiastic and have more critical thinking skills. Anticipating science learning which seems difficult, so that mobile learning based learning methods using ethno edugames can be applied. The formulation of the problem to be researched is: How is mobile learning based learning using ethno edugames in class IV elementary school? How can mobile learning-based learning using ethno edu games improve students' critical thinking skills in grade IV elementary school? How can mobile learning-based learning using ethno edugames improve students' cognitive outcomes on force material in class IV elementary school? The research method used is quasi-experimental quantitative research with a pretest-posttest control group design. The total population is 96 students and the sample size is 64 students. With one class for the experimental group and one class for the control group. The conclusions from the results of this research are: there is an influence of mobile learning based learning using ethno edugames on improving students' critical thinking skills in class IV elementary school. There is an influence of mobile learning based learning using ethno edu games on improving students' cognitive abilities in class IV elementary school. There is an influence of mobile learning based learning using ethno edugames on increasing the critical thinking and cognitive abilities of students in class IV elementary school.

Keywords: Cognitive abilities; Critical thinking skills; Ethno edugames; Mobile learning

Introduction

These 21st century skills can shape student character as designed by teachers in learning. 21st century learning skills can be applied and successful if the learning process is student centered, not just teacher centered (Keiler, 2018; Kennedy et al., 2020; Kim et al., 2019; Sumardi et al., 2020). Therefore, educators must have the basic capital to be able to keep up with

developments and changes over time and be able to teach perfectly to channel their knowledge in front of students, especially when implementing the current independent curriculum (Arifah et al., 2023).

Currently technology has a very vital role in education, namely the emergence of electronic media as a learning resource other than teachers (Garlinska et al., 2023; Szyszka et al., 2022; Woltran et al., 2022), the emergence of new learning methods such as the Blended

How to Cite:

Rahayu, W. I., Leksono, S. M., & Nulhakim, L. (2024). Mobile Learning Based Learning Using Ethno Edu Games to Improve Students' Critical Thinking and Cognitive Abilities on IPAS Subjects in Grade IV Elementary School. *Jurnal Penelitian Pendidikan IPA*, 10(9), 6504–6515. <https://doi.org/10.29303/jppipa.v10i9.8339>

Learning method to facilitate the learning process, and the learning process can be carried out using the internet or online (Nikolopoulou et al., 2023; Ożadowicz, 2020; Ramalingam et al., 2022; Yangari et al., 2021). The development of this technology allows students to learn not only in the classroom, students can access learning resources from anywhere as long as there is an internet signal in their area (Haleem et al., 2022; Herliani et al., 2023; Indarta et al., 2022).

Mobile learning is a form of learning that specifically utilizes mobile communication devices and technology. The driving factors that further expand opportunities for the use or application of mobile learning are the very high level of development of mobile devices, the relatively easy level of use and the increasingly affordable price of devices compared to personal computer devices. These driving factors give rise to new tendencies in learning (Setiawati et al., 2020). Mobile learning is a learning media that is suitable for use today (Crompton et al., 2018; Hamidi et al., 2018; Meihan et al., 2020).

When conducting initial observations at the Karawaci Baru 1 State Elementary School, the results showed that the teacher only used printed books as teaching materials, as well as whiteboards and pictures as learning media, as well as a lack of innovation that had not been carried out by educators to create a positive atmosphere fun for students. Meanwhile, other facilities such as laptops, projectors and internet have not been used. Many students are noisy during learning, they don't really pay attention to what the teacher says. The students were engrossed in their own activities, even when the teacher tried to ask questions, none of the students were able to answer them. Student motivation to take lessons is low, many students are reluctant to take lessons. To overcome this problem, it is necessary to find the right solution.

One of them is by using learning media. Learning media is an important element in the learning process. Learning media is a learning resource that can help teachers enrich students' insight. With various types of learning media by teachers, it can be used as material for providing knowledge to students. The use of learning media can foster students' interest in learning new things in the learning material presented by the teacher so that they can be easily understood. Learning media that is interesting to students can be a stimulus for students in the learning process. Management of learning aids is very much needed in formal educational institutions so that they can be used as aids in teaching and learning activities (Nurrita, 2018).

During observation after learning during break time, several students were found playing traditional games. Because basically elementary school age students are still very interested in playing or games. The

traditional game is engklek. This game activity attracted the attention of researchers. Because amidst the onslaught of technology, there are still students who can play the game. By playing engklek, children's intrapersonal intelligence will be honed. Characterized by the child's ability to understand himself and act. Children will be more sensitive in understanding their strengths and limitations, will, motivation, nature, ability to discipline, and respect themselves. They can do this while playing, while moving (walking, jumping) they can also think, feel, judge and conclude. By playing engklek, children will be trained to be patient, control themselves, and practice concentration (Pebryawan, 2015).

Method

The type of research used in this research is quantitative research. This type of quantitative research is a type of research whose specifications are systematic, planned and clearly structured from the start until the creation of the research design. This type of quantitative research is a type of research that is based on the philosophy of positivism, used to research certain populations or samples, collecting data using research instruments, quantitative/statistical data analysis, with the aim of testing predetermined hypotheses (Sugiyono, 2020).

The place where this research was carried out was at the Karawaci Baru 1 State Elementary School Jalan Cempaka Raya No. 2 Perumnas I, Nusa Jaya, Karawaci District, Tangerang City, Banten, with postal code 15116. The time used by researchers for this research was carried out from the date the research permit was issued over a period of approximately 2 (two) months, 1 month for data collection and 1 month of data processing which includes presentation in the form of a thesis and ongoing guidance process.

In this research, tools are needed to facilitate the implementation of research. These tools include: (a) Smartphones are used to complete students' critical thinking ability tests. (b) Stationery is used to write a list of group names. (c) Genting fractions are used in the engklek game.

This research is a quasi-experimental research. This research involved two experimental groups. Quasi-experimental research or pretest-posttest control group design. Sugiyono (2020), explains that experimental research involves two groups. The first is the experimental group, a group that was treated using mobile learning-based learning with engklek ethno edugames. The second group is the control group, which is the group that uses learning with LKS. In this design, before the treatment is given, the sample is first given a pretest (initial test) and at the end of learning the sample

is given a posttest (final test). An overview of this experimental design can be seen as follows:

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experiment	O ₁	X ₁	O ₃
Control	O ₂	X ₂	O ₄

Information:

- O₁ : giving an initial test for the experimental class
- O₂ : giving an initial test for the control class
- X₁ : treatment of the class by implementing mobile learning-based learning with engklek ethno edugames
- X₂ : treatment of the control class by implementing learning using LKS
- O₃ : giving the final test for the experimental class
- O₄ : giving the final test to the control class

The test is given before the treatment is given and after the treatment is given. To find out whether there is an increase in students' critical thinking and cognitive abilities resulting from the treatment.

Population and Sample

Population is all objects that are in an area and meet certain requirements related to the research problem, or all units or individuals within the scope to be researched (Martono, 2015). Population is a generalized area consisting of objects or subjects that have certain qualities and characteristics determined by the researcher to be studied and then conclusions drawn. The population in this research is class IV students at Karawaci Baru State Elementary School 1 for the 2022/2023 academic year. The following is the study population.

Table 2. Research Population

School's name	Class	Number of students
SD Negeri Karawaci Baru 1	IV A	32
	IV B	32
	IV C	32
Total		96

The sample is part of the number and characteristics of the population (Sugiyono, 2020). The following is a sample in the research.

Table 3. Research Sample

School's name	Class	Number of students	Group
SD Negeri Karawaci Baru 1	IV A	32	Control
SD Negeri Karawaci Baru 1	IV B	32	Experiment
Total		64	

The sampling technique used in this research is: Cluster Sampling (Area Sampling). The sampling

technique was carried out by selecting classes that were considered to represent the research population. When selecting a sampling technique, researchers also consider the size of the population area, costs and time. The classes used as research samples were class IV A as the control class and class IV B as the experimental class. Meanwhile, class IV C is the instrument testing class.

Research Variable

Research variables are anything in any form that is determined by the researcher to be studied so that information about it is obtained, then conclusions are drawn (Sugiyono, 2020). The variables in this research are divided into 2 types, namely:

- a) Independent variables or free variables (X) or also predictor variables, are variables that can influence changes in the dependent variable and have positive and negative relationships. The independent variable in this research is mobile learning-based learning using ethno edu games.
- b) Dependent Variable or Dependent Variable or usually called a criterion variable, which is the main concern and also the main target in a research. The dependent variable in this research is the students' critical and cognitive thinking abilities.

Data Collection Techniques and Research Instruments

Research Data Collection Techniques

Data collection is a systematic and standard procedure for obtaining the required data (Sugiyono, 2020). The data collection techniques used in this research are:

- a) Test. The test instrument in this research is to determine the increase in students' critical thinking and cognitive abilities in the force material around us. The test instrument is in the form of multiple choices, each consisting of 20 questions. To fill out the test in this study using smartphone media via Google Form. By filling out the application, students are expected to be able to use information technology.
- b) Documentation, namely collecting data by viewing or recording a report that is already available. This method is carried out by looking at official documents such as existing records and regulatory books (Arikunto, 2019). In this research, the documentation method was used to obtain data about the number of students at Karawaci Baru State Elementary School 1, the number of teachers and the infrastructure used as learning media, and everything related to this research topic.

Research Data Instrument

Instruments are tools or facilities used by researchers to collect data to make their work easier and the results better, in the sense of being more careful,

complete and systematic so that they are easier to process. The method used to collect data in this research is by testing and documentation. Indicators of students' critical thinking abilities are used as a starting point for

compiling instrument items that are tests. The test type is multiple choice. The test is prepared based on indicators of students' critical thinking and cognitive abilities.

Table 4. Student Critical Thinking Ability Test Instrument Grid (Facione, 2011)

Matter	Initial Competency	Indicators of Critical Thinking Ability					Number of questions
		A	B	C	D	E	
Forces around us	The effect of gravitational force on objects	1, 2	3, 4, 5		6, 7	8	8
	The benefits of gravity in everyday life	9, 10, 11, 12	13, 14, 15	16, 17	18, 19	20	12
Number of Question Items		6	6	2	4	2	20

Information: A = Interpretation; B = Analysis; C = Evaluation; D = Inference; E = Explanation

Each question has four answer choices and one of these choices is the correct answer choice. The correct answer gets a score of one and the wrong answer gets a score of zero. The instrument used in this research is a multiple choice test with 4 alternative answers. Of the 4

alternative answers, only 1 answer is considered correct. The correct answer score is 1 and the wrong answer score is 0.

Meanwhile, the instrument grid for students' cognitive abilities is as follows.

Table 5. Student Cognitive Ability Test Instrument Grid

Variable	Indicator	Achievement Targets	Number of questions
Cognitive Ability	Knowledge	Students can identify the various force involved in daily activities.	3
		Students can find out the characteristics of force	4
	Understanding	Students can explain the properties of force.	3
		Students can name various force.	4
		Application	Students can demonstrate the use of force to help people overcome challenges in everyday life
Students can find out the benefits and applications of gravity in daily activities	3		
Total			20

The instrument for testing students' cognitive abilities is in the form of multiple choices with 4 alternative answers. Of the four alternative answers, only one answer is correct with the assessment criteria: if the answer is correct, the score is 1 and if the answer is incorrect, the score is 0.

Validity and Reliability of Research Instruments

The data collection instrument in this research is by distributing tests to determine critical and cognitive thinking abilities about the material styles around us. Before the instrument is used in collecting research data, the instrument is first tested. Instrument testing in this research includes validity and reliability tests.

Instrument Validity Test

To test the validity of the instruments in the research, corrected item total correlation was used with the help of the SPSS 23.0 for Windows computer. Validity test is a test carried out to find out how accurately an instrument measures what it wants to

measure. Decision making in this validity test uses the r table limit with a significance of 0.05. If the correlation value is above 0.30, the sample in the study is considered sufficient and suitable for further analysis.

Based on the results of the validation test that has been carried out for the student's critical thinking ability variable, it was found that the number of valid questions was 18 questions and the number of invalid questions was 2. The invalid questions were questions numbered 12 and 13. Complete results from the analysis of the validation test of the ability instrument Students' critical thinking can be found in the appendix. The validation test results for the student cognitive ability instrument with a total of 20 instruments contained 18 valid questions. There are 2 invalid questions, namely number 9 and number 15.

Instrument Reliability Test

Reliability test of question items used to measure reliability or consistency and research instruments. The criteria for reliability testing are if the alpha value is >

0.60, it means the statement is reliable, and conversely, if the alpha value is ≤ 0.60 , it means the statement is not reliable. Based on the results of reliability testing, it is stated that the instruments for students' critical thinking abilities and cognitive abilities are reliable. The results of the instrument analysis can be seen in the table below.

Table 6. Instrument Reliability Test Results

Variable	Alpha	Reliability (ri)	Decision
Critical Thinking Ability	0.614	0.60	Reliable
Cognitive abilities	0.744	0.60	Reliable

Based on the table above, it can be seen that the instruments for students' critical thinking abilities and overall cognitive abilities are declared reliable, this is shown by the value (ri) > 0.60 .

Research Data Analysis Techniques

The data obtained is still in the form of quantitative data, so the data is analyzed using two types of statistical analysis techniques, namely descriptive analysis and inferential analysis.

Descriptive Analysis

Descriptive analysis aims to determine students' critical and cognitive thinking abilities through a format by implementing a mobile learning application via the Google Form application. By using the SPSS version 23.0 program. Researchers will measure how and to what extent students' critical thinking abilities and IPAS cognitive abilities are achieved, with data interpretation criteria, namely:

- a) Scoring students' critical thinking and cognitive abilities followed by determining the final score using the formula:

$$Na = \frac{\text{total student achievement scores}}{\text{maximum score}} \times 100 \% \quad (1)$$

- b) From this data, critical and cognitive thinking ability score assessments will be grouped into the following categories.

Table 7. Categorization of Student Scores (Arikunto, 2019)

Score	Categories
$80 < Na \leq 100$	Very good
$66 < Na \leq 79$	Good
$56 < Na \leq 65$	Enough
$40 < Na \leq 55$	Less
$30 < Na \leq 39$	Very less

Inferential Analysis

In this research, the data analysis used to test the hypothesis is the Gain Score test. Gain is the difference between posttest and pretest scores. Gain shows the

increase in students' abilities after learning is carried out. To calculate the gain score, use SPSS 23.0 for Windows to avoid errors in manual calculations.

The high and low N-gain can be classified as follows:

- a) If $g > 0.7$ then the resulting N-gain is in the high category.
- b) If $0.7 > g > 0.3$ then the resulting N-gain is in the medium category.
- c) If $g < 0.3$ then the resulting N-gain is in the low category.

Furthermore, the MANOVA test was used to determine whether there was an increase in students' critical thinking abilities and cognitive abilities in the Natural and Social Sciences (IPAS) subjects. This test uses the SPSS version 23.0 for Windows application.

Research Implementation Procedures

Researchers use research stages to obtain the desired results, valid and maximum results. These stages are:

Preparation Stages

This stage begins with consultation and submission of the title to be studied in the research to the supervisor. After there is approval of the title, it is then continued with research permits, including a research permit letter from academics and a permission letter to carry out research at the place where the research is being carried out, namely Karawaci Baru State Elementary School 1. Continue with the preparation of a thesis research proposal (UP) and continue with a seminar.

Implementation Stages

This research uses test instruments to measure students' critical thinking abilities. At the research implementation stage, researchers observed learning activities carried out by class teachers using mobile learning and ethno edugames (engklek) based learning. The learning process is carried out in accordance with the teaching modules that have been prepared previously. The following is the learning process for each group.

After completing learning, students continued by filling in test questions which were distributed to students via a Google form that had been previously prepared by the researcher.

Analysis Stages

The results of filling out the questionnaire are then analyzed as research data and processed to answer the hypotheses that have been proposed in the research.

Reporting Stages

The data analysis stage is complete and the hypothesis has been answered, then continues with the stage of preparing the thesis report. Prepared for later seminars again.

Observation Parameters

Observations consist of supporting observations and main observations. The observation parameters are as follows:

Supporting Observations

Supporting observations are observations made where the data is not tested statistically to determine other possibilities outside the treatment. In this research, what is used as a supporting observation parameter is the implementation of learning using engklek ethno edugames.

Key Observations

The main observation is an observation whose data is tested statistically obtained from the results of filling in students' critical thinking ability tests via Google Form.

Result and Discussion

Implementation of learning in the control class on March 8 2024 in class IV B with a total of 32 students. Learning in the control class uses conventional methods. Before the lesson takes place, the researcher provides an explanation of the aims and objectives of conducting research. Then proceed with prayer together with the teacher. Students are greeted and carry out attendance checks together with the teacher. Followed by singing the song Garuda Pancasila. Before learning takes place, students are first given a pretest, which contains the same questions as the experimental class but the difference is that they are filled in written on paper. After completing the pretest questions, continue with learning.

The teacher begins the lesson by presenting the material or topic of the lesson by explaining it verbally and recording several important points in the book. Then give students the opportunity to ask questions that are difficult to understand regarding the learning topic. After delivering the material, the teacher gives the questions in the student's worksheet book.

The closing activity is filled with the teacher providing reflection. Then the teacher and students conclude the content of the material in today's lesson. The teacher gives students the opportunity to ask questions. Before the lesson is closed, students first work on practice questions for the posttest. The lesson closed with prayer and greetings. The learning activities are completed then the data obtained from filling in the questions by students from both the experimental class and the control class are processed for analysis.

Description of research data

The instrument in this research uses a multiple choice test. Scoring for correct items is given a value of 1 and incorrect items are scored 0. The results of the descriptive analysis of each variable are presented below.

Student Critical Thinking Ability Variables

Data on students' critical thinking abilities was obtained from the results of tests carried out by students who were treated in the experimental class and control class. The test questions given are questions about the forces around us. The instrument consists of 18 practice questions. The experimental class filled in the test questions using Google Form, while the control class filled in the test questions using paper, filled in like a normal test. Filling out the test in the experimental class was initially guided by the teacher. After students understand how to fill in, students fill out the test independently.

Data on students' critical thinking ability test results based on the N-Gain value are presented in Table 8 as follows.

Table 8. Description of Research Data on Students' Critical Thinking Ability Variables

Statistic	Experiment class			Control class		
	Pretest	Posttest	N Gain (%)	Pretest	Posttest	N Gain (%)
Mean	50.40	89.31	77.75	59.43	73.46	31.035
Std. Deviation	7.82	10.69	20.38	11.24	12.45	37.276
Minimum	33	56	25	33	44	-100
Maximum	67	100	100	78	100	100

In the table above, it can be seen that for critical thinking skills students have different average scores for each class. The average score for the pretest experimental class (50.40) was not too different from the control class (59.43). Meanwhile, the average posttest

score for the experimental class (89.31) was higher than the control class (73.46). The average N-Gain value data for the experimental class (77.75%) is higher than the control class (31.035%). Changes occurred after the class received treatment.

Contribution to increasing the average results of students' critical thinking ability tests applied with different learning models in class IV with five indicators, namely interpretation, analysis, evaluation, inference

and explanation. The average increase for each indicator along with the N-gain value obtained can be explained in the graphic image below.

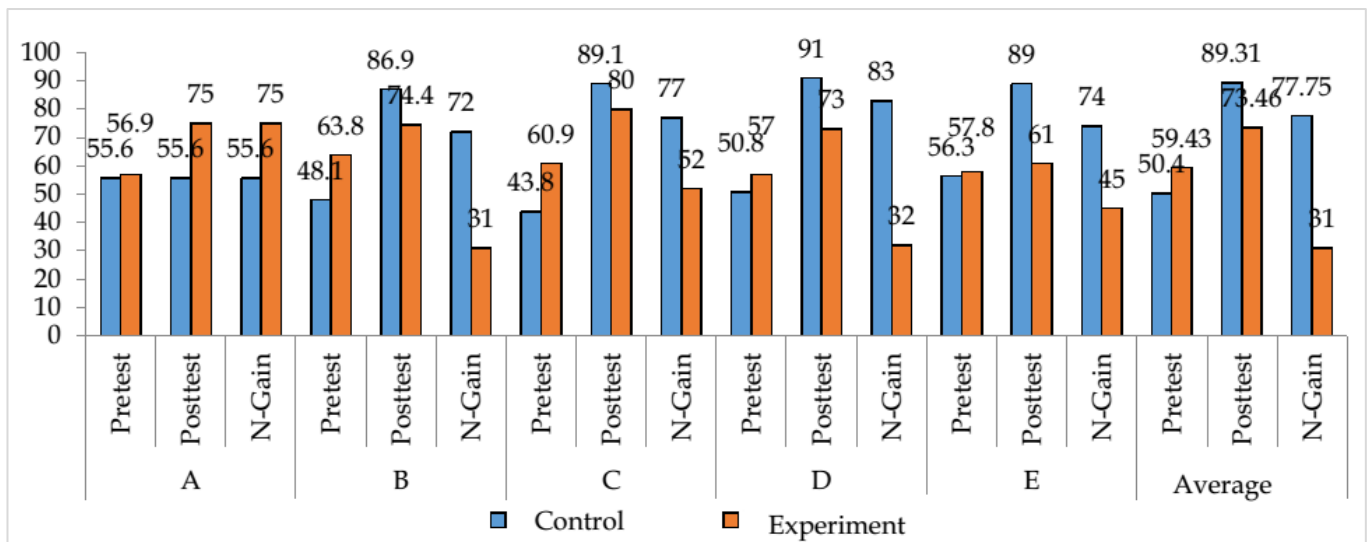


Figure 1. Increase in the average score of students' critical thinking (Information: A = Critical thinking ability interpretation indicator; B = Critical thinking ability analysis indicators; C = Critical thinking ability evaluation indicators; D = Critical thinking ability inference indicators; E = Critical thinking ability explanation indicators)

Knowing the frequency of scores for each class based on Arikunto's opinion (2019) can be described as in table 9. In the table 9 it can be seen that the score for each class shows the quality of learning that has been implemented. At the beginning, before being given treatment for the experimental class, the scores obtained by students were in the sufficient range with a frequency of 14 students. After receiving treatment with mobile

learning based learning with ethno edugames, it was in the very good score range with a total frequency of 29 students. The control class before learning was in the good score range with a total frequency of 12 students. Meanwhile, after learning was carried out using the conventional model, it remained in the good range with a frequency of 15 students.

Table 9. Categorization of Student Scores Based on Critical Thinking Ability

Score	Experiment class		Control class		Categories
	pretest	posttest	pretest	posttest	
80 < Na ≤ 100	0	29	0	10	Very good
66 < Na ≤ 79	1	1	12	15	good
56 < Na ≤ 65	14	2	11	6	Enough
40 < Na ≤ 55	13	0	8	1	Less
30 < Na ≤ 39	4	0	1	0	Very less

Student Cognitive Variables

Data on students' cognitive abilities is taken from tests given to students, as is data on students' critical

thinking abilities. Data from students' cognitive ability test results and data descriptions are presented in Table 10.

Table 10. Description of Research Data on Student Cognitive Ability Variables

Statistics	Experiment class			Control class		
	Pretest	Posttest	Ngain (%)	Pretest	Posttest	Ngain (%)
Mean	57.4063	89.81	75.90	57.68	78.00	29.19
Std. Deviation	10.1054	8.793	20.06	11.71	11.40	42.20
Minimum	39	61	22	39	78	-83.33
Maximum	78	100	100	44	94	100

The mean value of the experimental class and control class has increased. The average score for the pretest experimental class (57.40) was not too different from the control class (57.68). Meanwhile, the average posttest score for the experimental class (89.81) was higher than the control class (78.00). The average N-Gain

value data for the experimental class (75.90%) is higher than the control class (29.19%). A comparison of the average results of students' cognitive ability tests for each assessment indicator applied with different learning models in class IV can be seen in the figure 2.

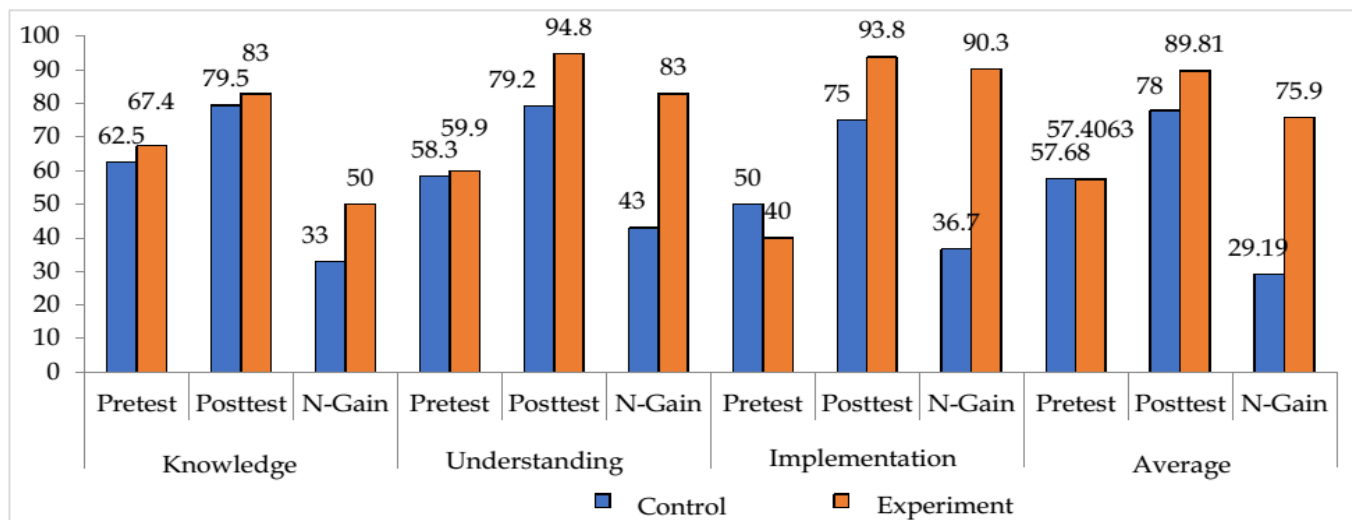


Figure 2. Increase in the average value of cognitive ability

Knowing the frequency of scores for each class based on the opinion of Arikunto (2019) can be explained in table 11. Based on the categorization in the table above for student cognitive ability variable data, the results obtained in the pretest experimental class are in the good range, while for the control class the pretest was in the sufficient range. The scores after being given treatment using mobile learning-based learning with

ethno edu games in the experimental class category of students were in the very good range with a frequency of 30 students. The control class with conventional learning was in the very good range with 17 students. Even though there was an increase in frequency in the very good category, the students with the highest frequency were in the experimental class.

Table 11. Categorization of Student Scores Based on Cognitive Ability

Score	Experiment class		Control class		Categories
	pretest	posttest	pretest	posttest	
80 < Na ≤ 100	0	30	0	17	Very good
66 < Na ≤ 79	11	1	8	12	Good
56 < Na ≤ 65	9	1	12	2	Enough
40 < Na ≤ 55	10	0	9	1	Less
30 < Na ≤ 39	2	0	3	0	Very less

Research Data Analysis

Calculations from this analysis were carried out using the SPSS 23 program. The hypotheses proposed in this research consist of three, namely as follows:

Ho : There is no effect of mobile learning-based learning using ethno edu games on improving students' critical thinking skills in grade IV elementary school.

Ha : There is an influence of mobile learning-based learning using ethno edu games on increasing students' critical thinking skills in grade IV elementary school.

Ho : There is no effect of mobile learning-based learning using ethno edu games on improving the cognitive level of students in grade IV elementary school.

Ha : There is an influence of mobile learning-based learning using ethno edu games on improving the cognitive level of students in grade IV elementary school.

Ho : There is no effect of mobile learning-based learning using ethno edu games on improving students' critical thinking and cognitive abilities in grade IV elementary school.

Ha : There is an influence of mobile learning-based learning using ethno edu games on improving students' critical thinking and cognitive abilities in grade IV elementary school.

A summary of the analysis results from each test is as follows.

The Effect of Mobile Learning Based Learning Using Ethno Edu Games on Improving Critical Thinking Abilities

The results of the analysis of critical thinking skills in both groups can be shown in table 12. The statistical analysis results table above shows that with 32 respondents in each class, the average N-gain value for the experimental class (0.7775) was higher than the control class (0.3104). Interpretation of the N gain value for the experimental class is 0.7775 in the high category and the control class is 0.3104 in the medium category. The normality test uses the Kolmogorov-Smirnov Test with the interpretation that it can be said to be normal if the sig α value is $\alpha > 0.05$. The normality test value for the experimental class (0.08) and the control class (0.200), both classes have normality test values in the normal category. The homogeneity test uses the Lavene Test, it can be said to be homogeneous if the sig value is > 0.05 . The homogeneity test result is 0.726, this result is greater than 0.05 so it can be said to be homogeneous.

Table 12. Statistical Analysis of Students' Critical Thinking Abilities in the Two Sample Groups

Statistic	Experiment	Control
N	32	32
N-Gain	0.7775 (High)	0.3104 (Medium)
Std. Deviation	0.2038	0.3727
Normality test*	0.08 (Normal)	0.200 (Normal)
Homogeneity Test**	0.726 (Homogeneous)	

Information: * = Kolmogorov-Smirnov Test (Normal, sig $\alpha > 0.05$); ** = Lavene Test (Homogeneous, sig $\alpha > 0.05$).

The average difference shows that critical thinking skills for the experimental class were higher after learning was treated with mobile learning ethno edu games. The results obtained had previously been tested for normality and homogeneity, and for both classes, both the experimental class and the control class, they were normal and homogeneous. The results of the average N-gain score prove that the difference in the average score for each class is the influence of the use of mobile learning ethno edu games on students' critical thinking abilities. So the hypothesis Ho is rejected and Ha is accepted. This means that there is an influence between mobile learning-based learning using ethno edu games on increasing students' critical thinking skills in class IV elementary school.

The Effect of Mobile Learning-Based Learning Using Ethno Edu Games on Improving Students' Cognition

The results of the analysis of students' cognitive abilities in both groups are as follows:

Table 13. Statistical Analysis of Students' Cognitive Abilities in the Two Sample Groups

Statistic	Experiment	Control
N	32	32
N-Gain	0.7591 (High)	0.2920 (Low)
Std. Deviation	0.2006	0.4220
Normality test*	0.200 (Normal)	0.200 (Normal)
Homogeneity Test**	0.120 (Homogeneous)	

Information: * = Kolmogorov-Smirnov Test (Normal, sig $\alpha > 0.05$); ** = Lavene Test (Homogeneous, sig $\alpha > 0.05$).

The normality test uses the Kolmogorov-Smirnov Test with the interpretation that it can be said to be normal if the sig α value is $\alpha > 0.05$. The normality test value in the experimental class (0.200) and the control class (0.200), both classes have normality test values in the normal category. The homogeneity test uses the Lavene Test, it can be said to be homogeneous if the sig value is > 0.05 . The homogeneity test result is 0.120, this result is greater than 0.05 so it can be said to be homogeneous. The N-gain results for students' cognitive abilities in the experimental class had an average N gain value of 0.7591 in the high category. The N gain value for students' cognitive abilities in the control class has an average value of 0.2920 in the low category. The results of the difference in average N gain values prove that the two classes have differences in increasing ability so that the methods used in learning have an influence on students' cognitive abilities. The average N gain value for the experimental class (0.7591) is higher than the control class (0.2920), so the hypothesis Ho is rejected and Ha is accepted, that there is an influence of mobile learning based learning using ethno edu games on improving students' cognitive abilities.

The Effect of Mobile Learning Based Learning Using Ethno Edu Games on Increasing Students' Critical Thinking and Cognitive Abilities

The results of the analysis using the Manova test to see the influence of the two outcome variables are shown in table 14. The influence of mobile learning-based learning using ethno edugames on improving students' critical thinking and cognitive abilities was analyzed using the Manova test. Before the test is carried out, a homogeneity of variance and covariance test is first carried out. Test homogeneity of variance using Levene's test of equality of error variances used to find out whether the variance between groups of data is the same. If sig < 0.05 then it can be concluded that the variance of the data groups is different, but conversely if

sig > 0.05 then it can be concluded that the variance of the data groups is the same. In the table above it can be seen that the significance for the critical thinking variable is 0.132, where this result is greater than 0.05 and students' cognitive abilities are 0.120 > 0.05. So it can be concluded that the variance of the data groups for the two variables is the same.

Table 14. Statistical Analysis of the Effect of Using Mobile Learning Ethno Edugames on Students' Critical Thinking and Cognitive Abilities

Statistic	Experiment	Control
N	32	32
N-gain critical thinking skills	0.7775 (High)	0.3104 (Medium)
N-gain cognitive abilities	0.7591 (High)	0.2920 (Low)
Homogeneity of covariance test*		0.08
Homogeneity test of critical thinking variants**		0.132
Homogeneity test of cognitive variance**		0.120
Hotelling's Trace Test***		0.000

Information: *= Box's M (sig $\alpha > 0.05$); **= Levene's test of equality of error variances (sig $\alpha > 0.05$); ***= Hotelling's Trace (sig $\alpha < 0.05$).

The homogeneity test of matrix variance/covariance can be seen from the results of the Box's M test, based on the table above, the sig value of the Box's M test results is 0.08. If the research significance level is 0.05, then it can be written as $0.08 > 0.05$, which indicates that the variance/covariance of the dependent variable is the same. The two prerequisites for the hypothesis above have been fulfilled, then the Manova test can be continued. The Manova test decision results were taken from Hotelling's Trace analysis. The results of the Manova test analysis with the Hotelling's Trace test obtained a significance value of 0.000, the result was < 0.05 , thus proving that H_0 was rejected and H_a was accepted. This means that mobile learning-based learning using ethno edugames has an effect on increasing the critical and cognitive thinking abilities of students in grade IV elementary school.

Conclusion

In conclusion, the difference in the average N-gain value is that there is an influence of mobile learning-based learning using ethno edu games on improving students' critical thinking skills. The results of the experimental class test using mobile learning using ethno edu games are different from the results of the control class test using conventional methods. Proving that students in the experimental class have higher critical thinking skills compared to the control class. This is because ethno edu games are one of the interesting learning media and can motivate students to actively

learn and develop creative and critical ideas and innovative learning. The difference in the average N-gain value shows that there is an influence between mobile learning-based learning using ethno edu games on improving students' cognitive abilities. Cognitive abilities will be formed if learning makes students feel comfortable and understand what is conveyed by the teacher.

Acknowledgments

Thank you to the supervisors and examiners for their guidance and input in this research. Next, I would like to thank the teachers and staff of SDN Karawaci Baru 1 who have given me the opportunity to conduct research at school, and finally to my parents and colleagues who always support and encourage me in conducting this research.

Author Contributions

Conceptualize and choose a methodology, prepare writing, carry out analysis according to the methodology, conduct research and write down the results and discuss research results.

Funding

This research received no external funding.

Conflicts of Interest

All authors declared there is no conflict of interest.

References

- Arifah, N. A., & Utami, R. D. (2023). Implementasi Keterampilan Pembelajaran Abad 21 Berorientasi Kurikulum Merdeka Melalui Proyek Penguatan Profil Pelajar Pancasila Di Sekolah Dasar. *Muallimuna: Jurnal Madrasah Ibtidaiyah*, 9(1), 27. <https://doi.org/10.31602/muallimuna.v9i1.10990>
- Arikunto, S. (2019). *Prosedur Penelitian: Suatu Pendekatan Praktik (Cetakan 5)*. Jakarta: Rineka Cipta.
- Crompton, H., & Burke, D. (2018). The use of mobile learning in higher education: A systematic review. *Computers & Education*, 123, 53–64. <https://doi.org/10.1016/j.compedu.2018.04.007>
- Facione, P. (2011). *Critical Thinking: What It Is and Why It Counts*. The California Academic Press.
- Garlinska, M., Osial, M., Proniewska, K., & Pregowska, A. (2023). The Influence of Emerging Technologies on Distance Education. *Electronics*, 12(7), 1550. <https://doi.org/10.3390/electronics12071550>
- Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, 3, 275–285. <https://doi.org/10.1016/j.susoc.2022.05.004>
- Hamidi, H., & Chavoshi, A. (2018). Analysis of the essential factors for the adoption of mobile learning in higher education: A case study of

- students of the University of Technology. *Telematics and Informatics*, 35(4), 1053–1070. <https://doi.org/10.1016/j.tele.2017.09.016>
- Herliani, Subagiyo, L., & Sukemi. (2023). The Adoption of Blended Learning in Indonesian Science Classrooms. *Jurnal Penelitian Pendidikan IPA*, 9(8), 6084–6092. <https://doi.org/10.29303/jppipa.v9i8.4735>
- Indarta, Y., Jalinus, N., Waskito, W., Samala, A. D., Riyanda, A. R., & Adi, N. H. (2022). Relevansi Kurikulum Merdeka Belajar dengan Model Pembelajaran Abad 21 dalam Perkembangan Era Society 5.0. *Edukatif: Jurnal Ilmu Pendidikan*, 4(2), 3011–3024. <https://doi.org/10.31004/edukatif.v4i2.2589>
- Keiler, L. S. (2018). Teachers' roles and identities in student-centered classrooms. *International Journal of STEM Education*, 5(1), 34. <https://doi.org/10.1186/s40594-018-0131-6>
- Kennedy, T. J., & Sundberg, C. W. (2020). *21st Century Skills*. https://doi.org/10.1007/978-3-030-43620-9_32
- Kim, S., Raza, M., & Seidman, E. (2019). Improving 21st-century teaching skills: The key to effective 21st-century learners. *Research in Comparative and International Education*, 14(1), 99–117. <https://doi.org/10.1177/1745499919829214>
- Kuswanto, E. N. T., Rahman, T., & Munadzar, A. F. (2021). Game "Roro Jonggrang" Sebagai Media Belajar Untuk Mengenalkan Cerita Rakyat. *JATI (Jurnal Mahasiswa Teknik Informatika)*, 5(1), 33–38. <https://doi.org/10.36040/jati.v5i1.3379>
- Martono, N. (2015). *Metode Penelitian Sosial: Konsep-konsep Kunci (Sampel halaman)*. Nanang Martono.
- Meihan, A., Sariyatun, & Ardianto, D. (2020). Potensi Mobile Learning Berbasis Kearifan Lokal Museum Kekhatuan Semaka Dalam Pembelajaran Sejarah. *Prosiding Seminar Nasional Rekarta*, 1(1), 1–8. Retrieved from <https://journal.rekarta.co.id/index.php/semarta/article/view/512>
- Nikolopoulou, K., & Zacharis, G. (2023). Blended Learning in a Higher Education Context: Exploring University Students' Learning Behavior. *Education Sciences*, 13(5), 514. <https://doi.org/10.3390/educsci13050514>
- Nulhakim, L., Setiawan, F. R., & Saefullah, A. (2020). Improving Students' Creative Thinking Skills Using Problem-Based Learning (PBL) Models Assisted by Interactive Multimedia. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, 6(1), 9–16. <https://doi.org/10.21009/1.06102>
- Nurrita, T. (2018). Pengembangan Media Pembelajaran Untuk Meningkatkan Hasil Belajar Siswa. *MISYKAT: Jurnal Ilmu-Ilmu Al-Quran, Hadist, Syari'ah Dan Tarbiyah*, 3(1), 171. <https://doi.org/10.33511/misykat.v3n1.171>
- Ozadowicz, A. (2020). Modified Blended Learning in Engineering Higher Education during the COVID-19 Lockdown—Building Automation Courses Case Study. *Education Sciences*, 10(10), 292. <https://doi.org/10.3390/educsci10100292>
- Pebryawan, K. (2015). Engklek Sebagai Sarana Pembelajaran Yang Asik Di Tengah Permainan Modern. *Magistra*, 92, 0215–9511. Retrieved from <https://shorturl.at/UIctz>
- Priyanto, A., Bimantara, A. R., & Yani, A. (2022). Pembelajaran Matematika Melalui Pendekatan Etnomatematika Permainan Tradisional Engklak Pada Materi Bangun Datar. *Adiba: Journal of Education*, 2(4), 492–497. Retrieved from <https://adisampublisher.org/index.php/adiba/article/view/194>
- Ramalingam, S., Yunus, M. M., & Hashim, H. (2022). Blended Learning Strategies for Sustainable English as a Second Language Education: A Systematic Review. *Sustainability*, 14(13), 8051. <https://doi.org/10.3390/su14138051>
- Setiawati, L., Purosad, A., & Darmawan, D. (2020). Implementasi Model Pembelajaran Mobile Learning Berbasis Android dalam Meningkatkan Prestasi Belajar Siswa Pada Pembelajaran Bahasa Inggris: Degrees of Comparison. *Gunahumas*, 3(2), 57–72. <https://doi.org/10.17509/ghm.v3i2.28389>
- Sugiyono, S. (2020). *Metode Penelitian dan Pengembangan (Research and Development)*. Bandung: Alfabeta.
- Sumardi, L., Rohman, A., & Wahyudiati, D. (2020). Does the teaching and learning process in primary schools correspond to the characteristics of the 21st century learning? *International Journal of Instruction*, 13(3), 357–370. <https://doi.org/10.29333/iji.2020.13325a>
- Szyszk, M., Tomczyk, Ł., & Kochanowicz, A. M. (2022). Digitalisation of Schools from the Perspective of Teachers' Opinions and Experiences: The Frequency of ICT Use in Education, Attitudes towards New Media, and Support from Management. *Sustainability*, 14(14), 8339. <https://doi.org/10.3390/su14148339>
- Tsabita Primrose, A., Faiz Nur Falah, M., Iqbal Rifqi, M., Farhana Mauliya, D., & Mukti, T. (2023). Engklek Etno-Game dengan BRUSLE Android Apps Sebagai Media Pembelajaran Matematika untuk Mereduksi Miskonsepsi Siswa. *GAUSS: Jurnal Pendidikan Matematika*, 6(1), 1–11. <https://doi.org/10.30656/gauss.v6i1.6489>
- Woltran, F., Lindner, K.-T., Dzojic, T., & Schwab, S. (2022). Will-Skill-Tool Components as Key Factors for Digital Media Implementation in Education: Austrian Teachers' Experiences with Digital Forms

of Instruction during the COVID-19 Pandemic. *Electronics*, 11(12), 1805. <https://doi.org/10.3390/electronics11121805>

Yangari, M., & Inga, E. (2021). Educational Innovation in the Evaluation Processes within the Flipped and Blended Learning Models. *Education Sciences*, 11(9), 487. <https://doi.org/10.3390/educsci11090487>