The Effectiveness of Physics Learning Using Experimental and Lecture Methods on the Learning Interest of Physics Education Students at Universitas Negeri Jakarta, Class of 2022-2024

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ABSTRACT
The important role in selecting the right learning method influences in increasing student learning interest, especially students' difficulties in understanding abstract physics courses if not accompanied by practical activities. This study aims to compare the effect of the experimental method and the lecture method on the learning interest of Physics Education students at Jakarta State University, class of 2022–2024. This study used a proportionate stratified random sampling technique in sampling with a quantitative approach of 60 respondents. Data were obtained through a questionnaire using a Likert scale and the analysis used multiple linear regression. The results showed that both methods had a significant influence on learning interest, but the experimental method had a stronger influence ($\beta = 0.415$; $p < 0.001$) than the lecture method ($\beta = 0.169$; $p = 0.046$). Overall, the regression model explained 49.7% of the variation in student learning interest. This study confirms that active involvement through experiments can increase student motivation and interest in learning physics concepts.

ABSTRAK
Peran penting dalam pemilihan metode pembelajaran yang tepat berpengaruh dalam meningkatkan minat belajar mahasiswa, khususnya kesulitan siswa dalam memahami mata kuliah Fisika yang abstrak apabila tidak disertai aktivitas praktik. Penelitian ini bertujuan membandingkan pengaruh metode eksperimen dan metode ceramah terhadap minat belajar mahasiswa Pendidikan Fisika Universitas Negeri Jakarta angkatan 2022–2024. Penelitian ini menggunakan teknik proportionate stratified random sampling dalam pengambilan sampel dengan pendekatan kuantitatif sebanyak 60 responden. Data diperoleh melalui kuesioner menggunakan skala Likert dan analisisnya menggunakan regresi linear berganda. Hasil penelitian menunjukkan bahwa kedua metode memiliki pengaruh signifikan terhadap minat belajar, namun metode eksperimen memberikan pengaruh yang lebih kuat ($\beta = 0{,}415$; $p < 0{,}001$) dibandingkan metode ceramah ($\beta = 0{,}169$; $p = 0{,}046$). Secara keseluruhan, model regresi menjelaskan 49,7% variasi minat belajar mahasiswa. Penelitian ini menegaskan bahwa keterlibatan aktif melalui eksperimen mampu meningkatkan motivasi dan ketertarikan mahasiswa dalam mempelajari konsep fisika.

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INTRODUCTION

Education is crucial for national development. Law of the Republic of Indonesia Number 20 of 2023 affirms that education is a conscious and planned effort to create a learning environment that enables students to develop the potential, abilities, and competencies needed by society and the nation. Selecting appropriate learning methods is a crucial component in the educational process to achieve this goal, as the quality of student learning outcomes is largely determined by the learning process. Teachers and lecturers are required to understand and master various learning methods to adapt them to the characteristics of the material and the needs of students.

In the context of physics learning, students' ability to construct a strong conceptual understanding depends heavily on their active involvement in the scientific thinking process. However, various studies show that physics learning in higher education is still dominated by one-way lectures, which tend to make students as passive recipients of information. This condition results in low interest in learning and a decreased ability to connect theoretical concepts with empirical phenomena (Wieman, 2020). This passive learning often creates the illusion of learning, a situation where students feel they have understood the material but are unable to apply it consistently (Deslauriers et al., 2019). On the other hand, learning theory emphasizes that the learning process is not merely the delivery of information, but must involve mental processes, direct experience, and interaction with the phenomena being studied. Ahmadi, as cited in Sulistiyono (2019), emphasized that physics learning will be more meaningful if students are directly involved in observing natural phenomena. With this involvement, students can assimilate and accommodate concepts more deeply, thus forming a correct conceptual understanding. If learning does not allow for direct experience, students' motivation, interest, and intellectual engagement tend not to be optimally developed.

The experimental method is one approach that provides students with opportunities to test hypotheses, observe phenomena directly, and develop conceptual understanding through scientific activities. International research shows that experimental methods and active learning approaches are highly effective in improving student academic performance in science, technology, engineering, and mathematics (STEM) fields (Freeman et al., 2014; Freeman et al., 2020). Furthermore, experimental methods have been shown to increase student interest in learning, academic self-confidence, and motivation (Veloo et al., 2020). Similar findings were also demonstrated by national research, which showed that experimental activities can strengthen students' interest, conceptual understanding, and engagement in physics learning (Afriana et al., 2020; Widodo & Suhandi, 2021). Arini et al. (2021) showed that the experimental method significantly increased interest in learning and understanding physics concepts compared to the traditional lecture method. In fact, in project-based learning models, which share characteristics with the experimental method, students were more active in exploring concepts, thinking critically, and demonstrating a higher interest in learning than when participating in passive learning methods such as lectures (Nugraha, 2019). These findings confirm that direct involvement in the learning process is a crucial factor in developing students' understanding and interest in learning. However, most research in Indonesia still focuses on secondary school levels, while studies directly comparing the effectiveness of experimental and lecture methods on physics education students are still very limited. Furthermore, studies that highlight affective aspects such as interest in learning in higher education contexts are still scarce.

This study was conducted to analyze the comparative effect of experimental and lecture methods on the learning interests of Physics Education students at Jakarta State University. This research is expected to provide an empirical contribution to the development of more effective, relevant, and quality-oriented physics learning strategies in higher education.

METHODS

The sampling technique used in this study was proportionate stratified random sampling because the Physics Education student population consists of three cohorts (2022, 2023, and 2024) with varying numbers. The criteria included active students who had taken basic physics courses. The sample size was set at 60 respondents, representing the proportion of each cohort. This questionnaire method is a primary data collection tool using a survey method, which asks questions to respondents (Agus, 2021). Researcher developed an instrument in the form of a 1–4 Likert scale questionnaire based on learning interest, experimental methods, and lecture methods by referring to literature related to physics learning and has been validated by experts. Adjustment for confounding factors in the research data, respondents were limited to students who had completed basic laboratory work.

The research procedure was carried out in three stages. First, the preparation stage included the development and validation of the questionnaire instrument by two expert lecturers. Second, the data collection stage. Third, the data analysis stage included data cleaning, validity, reliability, normality, linearity, and regression analysis using the IBM SPSS software. This study did not involve laboratory experiments, but rather assessed students' perceptions of the two learning approaches based on their classroom experiences.

Based on the identification and formulation of the problem, it can be concluded that the aim of this study is to compare physics learning methods with lectures and experiments on the learning interests of Physics Education Students at Jakarta State University.

Data Analysis

The analysis techniques used in this study are as follows:

1. **Validity Test**

   To obtain accurate data, the questionnaire used in this study must meet good criteria. The questionnaire pilot test was intended to determine whether the questionnaire items could measure what was intended.

2. **Reliability Test**

   The valid instrument in the Learning Interest and Learning Methods questionnaire consisted of 18 items that were categorized as valid. To determine whether these questions could be reused, the researchers conducted a reliability test on the 18 questions using the Alpha formula, obtaining r14 = 0.918.

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According to Dewi & Sudaryanto (2020), if a variable shows a Cronbach's Alpha value >0.60, it can be concluded that the variable is reliable or consistent in its measurement.

3. **Normality Test**

In a normality test, data is considered normal if its distribution follows a normal distribution pattern. The criteria used are generally based on the significance value (p-value) from statistical tests such as the Kolmogorov-Smirnov or Shapiro-Wilk test. If the p-value is greater than 0.05, the data is considered normally distributed. If the p-value is less than or equal to 0.05, the data is considered abnormal.

4. **Linearity Test**

The linearity test determines whether two or more variables being tested have a significant linear relationship. This test is typically used as a requirement in correlation analysis or linear regression. The basis for making a decision in a linearity test is that if the significance value is > 0.05, the relationship between variables (X) and (Y) is linear.

5. **t Test**

This t-test is performed by comparing the t-table and the calculated t-test. Each calculated t-test is then compared with the t-table obtained using a significance level of 0.05. The t-distribution is determined by the degree of error dk = n-1. The criteria used are as follows:

a) H_0 is rejected if $\alpha < 0.05$ and t-count > t-table.
b) H_0 is accepted if $\alpha > 0.05$ and t-count < t-table.

If H_0 is accepted, it can be concluded that there is an insignificant effect. If H_0 is rejected, the effect of learning with experimental methods on increasing student learning interest is significant.

6. **Regression Test**

A regression test is a method for predicting how much the value of the dependent variable changes if the independent value is manipulated or changed, or increased or decreased (Sugiyono, 2015).

7. **Regression Significance Test**

Based on the regression significance test, if f count is greater than f table, then H_0 is rejected and H_1 is accepted, meaning it is significant. H_0 is rejected with a significance level of t = 0.05. Based on this, it can be concluded that learning with experimental methods increases student learning interest. Conversely, if the calculated F is smaller than the F table, then H_0 is accepted and H_1 is rejected, meaning it is not significant. This means there is an insignificant effect on increasing student learning interest using the experimental method.

8. **Coefficient of Determination Test**

According to Sugiyono (2019), the coefficient of determination is used to determine the extent to which an independent variable can explain the dependent variable. The R value ranges from 0 to 1. The closer the R value is to 1, the greater the ability of the independent variable (X) to explain the dependent variable (Y).

RESULTS AND DISCUSSIONS

Result

1. **Data Description**

This research was conducted by distributing questionnaires via Google Forms which were given to Physics Education students of the 2022-2024 intake in with the following data:

Table 1. Data Description

Class	Number of Respondents
2022	16
2023	29
2024	15

2. **Validity Test**

Validity testing is a test used to demonstrate the extent to which a measuring instrument measures what it purports to measure. Validity testing is used to determine whether a questionnaire is valid or not.

Table 2. Results of The Validation Test for Variable X1 (Experimental Method)

Question Items	r Count	r Table	Information
Item 1	0,738	0.254	Valid
Item 2	0,729	0.254	Valid
Item 3	0,794	0.254	Valid

Question Items	r Count	r Table	Information
Item 4	0,852	0.254	Valid
Item 5	0,723	0.254	Valid
Item 6	0,718	0.254	Valid
Item 7	0,707	0.254	Valid
Item 8	0,718	0.254	Valid
Item 9	0,664	0.254	Valid

Based on the results of the calculation of the validity of the items from the experimental method instrument, the questions that were tested showed that all items were valid because the Sig. (2-tailed) was below 0.05 and the calculated r value was greater than the r table.

Table 3. Results of The Validity Test of Variable X2 (Lecture Method)

Question Items	r Count	r Table	Information
Item 1	0,820	0.254	Valid
Item 2	0,562	0.254	Valid
Item 3	0,501	0.254	Valid
Item 4	0,869	0.254	Valid
Item 5	0,857	0.254	Valid
Item 6	0,881	0.254	Valid

Based on the results of the calculation of the validity of the items from the lecture method instrument, the questions that were tested showed that all items were valid because the Sig. (2-tailed) was below 0.05 and the calculated r value was greater than r Table.

Table 4. Results of The Validity Test of Variable Y (Learning Interest)

Question Item	r Count	r Table	Information
Item 1	0,679	0.254	Valid
Item 2	0,383	0.254	Valid
Item 3	0,684	0.254	Valid
Item 4	0,592	0.254	Valid
Item 5	0,705	0.254	Valid
Item 6	0,451	0.254	Valid
Item 7	0,388	0.254	Valid
Item 8	0,730	0.254	Valid

Based on the results of the calculation of the validity of the items from the learning interest instrument, the questions that were tested showed that all items were valid because the Sig. (2-tailed) was below 0.05 and the calculated r value was greater than r Table.

3. Reliability Test

A questionnaire is considered reliable if a person's answers to the questions are consistent or stable over time. Reliability testing is a technique for measuring the extent to which an instrument can produce consistent results at different times. The Cronbach's Alpha technique is used to measure reliability. If the Cronbach's Alpha value is greater than 0.6, then the respondents' answers to the questionnaire are considered reliable. If the Cronbach's Alpha value is less than 0.6, then the respondents' answers are considered unreliable.

Table 5. Reliability Test Results

Variables	Cronbach's Alpha Value	Information
X1 (Experimental Method)	0,893	Reliable
X2 (Lecture Method)	0,855	Reliable
Y (Learning Interest)	0.718	Reliable

4. Normality Test

The criterion used is the Asymp. Sig. (2-Tailed) value. The measurement is done by comparing the Asymp. Sig (2-Tailed) value with the specified alpha value, which is 5%. If the Asymp. Sig. (2-tailed) value is > 0.05, it is concluded that the data comes from a normally distributed population.

Table 6. Normality Test Result

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		60
Normal Parameters[a,b]	Mean	0,0000000
	Std. Deviation	2,22692407
Most Extreme Differences	Absolute	0,090
	Positive	0,042
	Negative	-0,090
Test Statistic		0,090
Asymp. Sig. (2-tailed)[c]		,200[d]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. This is a lower bound of the true significance.

Based on the results of the normality test above, the significance value of the K-S test on the Kolmogorov-Smirnov regression model is 0.200. Based on these test results, it is concluded that the regression model has met the normality requirements because the significance value of 0.200 > 0.05 with normally distributed data.

5. **Linearity Test**

A linearity test was conducted to determine whether each piece of knowledge used had a linear relationship. This study used a linearity test with a significance level of > 0.05. The results of this study are shown in the table below:

Table 7. Linearity Test Results for Variable X1 (Experimental Method)

			Sum of Squares	df	Mean Square	F	Sig.
total_y * total_x1	Between Groups	(Combined)	258,63	16	16,164	2,148	0,02
		Linearity	129,33	1	129,33	17,19	<,001
		Deviation from Linearity	129,3	15	8,62	1,146	0,35
	Within Groups		323,55	43	7,525		
	Total		582,18	59			

Based on the data, the Sig. deviation value of 0.35 > 0.05 suggests that the experimental method variable has a linear relationship with learning interest.

Table 8. Results of Linearity Test of Variable X2 (Lecture Method)

			Sum of Squares	df	Mean Square	F	Sig.
total_y * total_x2	Between Groups	(Combined)	239,312	13	18,409	2,47	0,012
		Linearity	91,92	1	91,92	12,332	0,001
		Deviation from Linearity	147,392	12	12,283	1,648	0,111
	Within Groups		342,871	46	7,454		
	Total		582,183	59			

Based on the data, the Sig. deviation value of 0.111 > 0.05 suggests that the lecture method variable has a linear relationship with learning interest.

6. **Regression analysis**

Regression analysis is a method for predicting independent and dependent variables. The following are the results of the regression tests conducted in this study.
The multiple linear regression model of this study is:

$$Y = 10{,}432 + 0{,}415X_1 + 0{,}169X_2$$

Table 9. Results of Regression Analysis

Variable	β	Beta	t	Sig	R^2 partial
X_1	0,415	0,614	6,206	< 0,001	0,461
X_2	0,169	0,202	2,043	0,046	0,158

Based on the table above, the significance value of the study is 0.000 < 0.05. Based on these values, it can be seen that:

T-test X1 6.206 > T-test 0.2542. Regression coefficient X1 = 0.415
T-test X1 2.043 > T-test 0.2542. Regression coefficient X2 = 0.169

The analysis results show:

X1 (Experimental Method): t = 6.206; p < 0.001
X2 (Lecture Method): t = 2.043; p = 0.046

Therefore, it can be concluded that the experimental method has a greater influence on the learning interest variable than the lecture method, and both methods have a comparable effect on student learning interest.

7. t Test

The partial test is used to test the partial significance of each independent variable on the dependent variable and as a decision-making tool to determine the effect of the experimental variable (X1) and variable (X2) on the learning interest variable (Y) by comparing the calculated t-value with the t-table at a significance level of 5% (0.05). Based on the following hypothesis assumptions:

H_0: There is no significant effect between the experimental method and lectures on student learning interest.

H_1: There is no significant effect between the experimental method and lectures on student learning interest.

The basis for drawing conclusions is as follows:

- H_0 is accepted if t count ≤ t table or the Sig. value > 0.05.
- H_1 is accepted if t count > t table or the Sig. value ≤ 0.05.

The results of the statistical analysis can be seen in the table below:

Table 10. Table of t Test Result Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10,432	2,023		5,157	0,000
	total_x1	0,415	0,067	0,614	6,206	0,000
	total_x2	0,169	0,083	0,202	2,043	0,046
Dependent Variable: total_y						

Based on the results of the t-test hypothesis test above, the t count of X1 was 6.206 and the t count of X2 was 2.043. Degrees of freedom (df) = n-k with n = number of samples and k = construct, so df = 60 – 3 = 57. Then the t table is 1.685. Because the t count of X1 (6.206) > t table (1.672) with a significant level in the table of 0.000 which means 0.000 < 0.05, and the t count of X2 (2.043) > t table (1.672) with a significant level in the table of 0.046 which means 0.046 < 0.05 then H_1 is accepted. This means that the variable X1 (experimental method) and the variable X2 (lecture method) have a significant influence on the dependent variable (learning interest).

8. Regression Significance Test

The F-test in a regression model is conducted to determine whether all independent variables (simultaneously/together) influence the dependent variable. In other words, to determine whether the effect is significant or not.

Table 11. ANOVA Table of Regression Significance Test Result

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	289,591	2	144,796	28,208	<,001[b]
1	Residual	292,592	57	5,133		
	Total	582,183	59			

a. Dependent Variable: total_y
b. Predictors: (Constant), total_x2, total_x1

Based on the table above, the significance value of the study can be obtained at > 0.001 and < 0.05. Based on this value, it can be seen that F count, 28.208 > T table 3.16, so it can be concluded that the experimental method and lecture method variables have an effect on the learning interest variable, and there is a comparison of the influence between the two methods on students' learning interest.

9. **Coefficient of Determination Test**

Used in hypothesis testing to determine the correlation between dependent and independent variables. The following data shows the coefficient of determination:

Table 12. Results of the Test of the Coefficient of Determination of X1 Against Y

Mode	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,679[a]	0,461	0,451	2,327

a. Predictors: (Constant), total_x1
b. Dependent Variable: total_y

Based on the results of the coefficient of determination above, the coefficient of determination (R Square) is 0.461, or equal to 46.1%. The results of this statistical calculation mean that the ability of the independent variable (Experimental Method) on the dependent variable (Learning Interest) is 46.1%.

Table 13. Results of the Test of the Coefficient of Determination of X2 Against Y

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,397[a]	0,158	0,143	2,907

a. Predictors: (Constant), total_x2
b. Dependent Variable: total_y

Based on the results of the coefficient of determination above, the coefficient of determination (R Square) is 0.158 or equal to 15.8%. The results of this statistical calculation mean that the ability of the independent variable (Lecture Method) on the dependent variable (Learning Interest) is 15.8%.

Table 14. Results of the Determination Coefficient Test for X1 and X2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,705[a]	0,497	0,480	2,266

a. Predictors: (Constant), total_x2, total_x1
b. Dependent Variable: total_y

Based on the results of the coefficient of determination above, the coefficient of determination (R Square) is 0.497 or equal to 49.7%. The results of this statistical calculation mean that the ability of the independent variables (Experimental Method and Lecture Method) on the dependent variable (Learning Interest) is 49.7%.

Research Discussion

This research is quantitative research whose data was obtained through a questionnaire distributed through Google Forms. Respondents obtained were 60 Physics Education students from the 2022—2024 intake with details of 16 students from the 2022 intake, 29 students from the 2023 intake, and 15 students from the 2024 intake. Based on the validity test, it has met the requirements and is declared valid, all items are classified as valid because sig. (2-tailed) is below 0.05 and the calculated r value is greater than r Table. Then the reliability test shows that the three variables are reliable, because if the Cronbach's Alpha value is greater than 0.6, then the answers from the respondents on the questionnaire as a measuring tool are reliable values. Based on the results of the normality test above, the significance value of the K-S Test in the Kolmogorov-Smirnov regression model is 0.200. Based on the test results, it is concluded that the regression model has met the normality requirements because the significance value is 0.200 > 0.05 with normally distributed data. Then the linearity test of Variable X1 (Experimental Method) shows that the sig. deviation value is 0.35>0.05, while Variable X2 (Lecture Method) shows a sig. deviation value of 0.111>0.05. Based on these data, it can be concluded that the variables Experimental Method and Lecture Method have a linear relationship to learning interest.

Research shows that the experimental method has a greater influence on student learning interest than the lecture method. By emphasizing knowledge formation, the experimental method also supports the principle of constructivism through direct experience. When students interact with real-world physics phenomena, learning interest tends to increase because the learning process becomes more meaningful. Conversely, the passive nature of the lecture method leaves little room for student exploration. While lectures can deliver material systematically, this approach is insufficient to increase learning interest in contexts that require an understanding of abstract concepts. This explains why the lecture method's influence score is lower than that of the experiment.

CONCLUSIONS

Based on the results of the research that has been done, it was found that the two methods have a significant comparison, variable X1 (experimental method) has a more significant effect on variable Y (learning interest). This is shown from the results of the t-test analysis t count = 6.206 > t table = 1.672, and the results obtained that variable X2 (lecture method) has less influence compared to X1 Experimental Method from the results of the t-test analysis t count = 2.043 > t table = 1.672, then H_1 is accepted. With the coefficient of determination X1 of 47.1%, the experimental method has a greater influence on Learning Interest when compared to the coefficient of determination X2 of 15.8%. Involving larger and more diverse samples, and using a mixed-method design in further research, it is recommended to explore other factors that influence learning interest, such as the quality of lecturer-student interactions, the use of digital media, or variations in the level of difficulty of physics material.

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