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RESEARCH ARTICLE

Exploring the impact of using Chat-GPT on student learning outcomes in technology learning: The comprehensive experiment

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Abstract: This experimental study investigates the impact of integrating Chat GPT (Generative Pre-trained Transformer) on student learning outcomes in technology education at Universitas Muhammadiyah Muara Bungo. The research involves an experimental group using Chat GPT and a control group with conventional methods. Data from 31 participants in each group were collected, assessing learning outcomes through final test scores. Analyzing the results with a t-test, the experimental group displayed significantly higher achievements than the control group, highlighting the positive effect of incorporating GPT Chat into educational technology. The study illuminates the potential of AI-powered chatbots like Chat GPT to enhance student learning outcomes. Further exploration is required to gauge its adaptability across diverse educational contexts for more enhanced learning results. T-test results, conducted at a 95% confidence level with α 0.05, and degrees of freedom dk = n1 + n2 – 2 = 60, showed t_{count} of 5.424 against t_{table} of 2.000, firmly establishing $t_{count} > t_{table}$ (5.424 > 2.000). Consequently, the null hypothesis (H_0) proposing no significant impact of Chat GPT utilization is refuted. Conversely, the alternative hypothesis (H_1), signifying a significant influence from Chat GPT usage, is upheld, affirming its substantial role in students' technological education. The implications of this study provide the potential benefits of integrating Chat GPT and similar technologies in education to improve student learning outcomes as well as the importance of further exploration in the use of AI technologies in educational contexts.

Keywords: Chat-GPT, artificial intelligence, learning outcomes, technology learning

1 Introduction

The development of information and communication technology in recent years has brought about major changes in the world of education (Viktor, Anna, and Olga 2021). Technological advancement allows learning to be more flexible and accessible online (Omar et al. 2021), (Ali et al. 2022). E-learning has become the main choice for many educational institutions to provide a more interactive and effective learning experience for students. Along with the development of technology, artificial intelligence (AI) is also growing rapidly (Kaiss, Mansouri, and Poirier 2023), (Hassan, Al-Chlaihawi, and Khekan 2021). One aspect of AI that has caught the attention of the education world is chatbots, which have been used in various contexts to provide support and assistance to users (Soboleva 2019), (Elzayady et al. 2022). A chatbot is a computer program designed to have conversations with humans through chat applications, such as text messaging or instant messaging platforms (Judd and Graves 2012).

One of the increasingly popular forms of chatbot is Chat GPT (Generative Pre-trained Transformer). Chat GPT is a natural language-based AI model that can understand and process human language very well (Kleebayoon, Mungmunpuntipanitp, and Wiwanitkit 2023). This model allows the chatbot to interact with users naturally and provide relevant and contextually appropriate responses (Sefriani et al. 2022)., (Fauzan et al. 2023). In an educational context, Chat GPT offers the potential to improve student interaction and learning outcomes in technology learning (Dayawansa, Mantziaris, and Sheehan 2023). With Chat GPT, students can communicate with the chatbot like talking to peers, get help and explanation on learning materials, and get instant feedback (Wang et al. 2023).

This study aims to investigate the effect of using Chat GPT in technology learning on student learning outcomes at Universitas Muhammadiyah Muara Bungo. This research uses an

experimental approach, where students will be divided into two groups: an experimental group that interacts with Chat GPT during the technology learning process, and a control group that uses conventional technology learning methods without interaction with the chatbot. Research data will be collected through a final test to evaluate the learning outcomes of students in both groups. The final test results will be analyzed using statistical methods to see if there is a significant difference in learning outcomes between the two group.

It is expected that the results of this study will provide a deeper understanding of the effect of using Chat GPT in technology learning. The findings can make an important contribution to the development of education in the digital era and provide practical advice for educators in utilizing the potential of AI chatbots to improve student learning outcomes. Nonetheless, this study has certain limitations, and in the future, further research could explore the application of AI chatbots in various educational contexts and subjects to comprehensively understand their impact.

The novelty of this research lies in its focus on the use of Chat GPT in technology learning, using an experimental approach to compare its impact, as well as the exploration of the role of chatbots in education. This research has a clear objective to uncover the positive effects of using Chat GPT on student learning outcomes, with potential practical implications for educational development in the digital age. In addition, this research reflects a commitment to understanding more deeply the role of chatbots in educational contexts, while openly acknowledging limitations and proposing broader research directions in the future.

2 Literature review

Technology learning has become a major option in education, especially with the development of technology in the digital era (Park, Li, and Luo 2021). One of the challenges faced in technology learning is maintaining good student learning outcomes (Sriadhi et al. 2022), (Hakiki et al. 2023). Learning outcomes are a major factor in learning to be categorized as successful, which involves active participation, motivation, and student interaction with learning materials and peers (Widodo et al. 2023). To address this challenge, researcher have explored the use of innovative technologies such as Chat GPT (Generative Pre-trained Transformer) to improve student learning outcomes in technology learning (Mahfud et al. 2020), (Ipek et al. 2023). This literature review aims to review existing research on the effect of using Chat GPT on student learning outcomes in technology learning, focusing on research conducted at Universitas Muhammadiyah Muara Bungo (Putra, Triyono, and Daryono 2022).

Chat GPT, an advanced language model that uses artificial intelligence, has emerged as a promising tool for improving student learning outcomes in technology learning (Chiesa-Estomba et al. 2023), (Athanassopoulos et al. 2023). Through natural language processing and machine learning algorithms, Chat GPT enables interactive and personalized conversations, mimicking human-like interactions (Crompton and Burke 2023). By providing real-time responses, customized feedback, and facilitating collaborative discussions, Chat GPT has the potential to create an interactive and engaging learning experience for students (Spreafico and Sutrisno 2023). Several studies have investigated the effects of using GPT Chat on education. Findings show that integrating GPT Chat in the learning environment has a positive effect on student learning outcomes (Porter, Murphy, and O'Connor 2023),(Sutrisni et al. 2022). The interactive nature of Chat GPT encourages active participation and creates a sense of connectedness and personalization. Students feel engaged in the conversational interface presented by Chat GPT, so they are more motivated to participate in discussions, ask questions, and seek clarification (Rudolph, Tan, and Tan 2023). The availability of real-time feedback and customized guidance from Chat GPT helps to create a supportive learning environment, improve student learning outcomes, and encourage a deeper understanding of the learning material (Esplugas 2023), (Karakose et al. 2023).

This research is significant due to the transformative influence of advances in information technology and artificial intelligence (AI) on the field of education. E-learning has emerged as the preferred method for educational institutions, offering students a more engaging and effective learning experience. Notably, chatbots like Chat GPT are gaining attention for their potential to support users in the educational domain. While some studies have explored the potential of Chat GPT in enhancing student learning outcomes, this research seeks to delve deeper into its impact within the specific context of Universitas Muhammadiyah Muara Bungo.

The expected results of this study hold promise for contributing substantially to the progress of education in the digital era and providing practical guidance to educators on harnessing the potential of AI chatbots, like Chat GPT, to elevate student learning outcomes. It is crucial to test the impact of Chat GPT in technology learning, considering potential limitations in previous studies, such as different contexts or populations. Moreover, as learning technologies and methods

continuously evolve, this research aims to ascertain the relevance and effectiveness of Chat GPT in the current educational landscape. By focusing on Universitas Muhammadiyah Muara Bungo, the study will provide valuable insights into the unique challenges and opportunities faced by educational institutions in adopting AI technologies like Chat GPT. Furthermore, the research outcomes will contribute significantly to the academic literature surrounding the application of AI technologies in technology learning. Overall, conducting this study is a vital step in ensuring the appropriateness and significance of Chat GPT's role in supporting technology learning and optimizing its potential to enhance student learning outcomes. The research is guided by specific objectives, including enhancing the understanding of Chat GPT's application in technology learning, strengthening empirical evidence, offering practical guidance to educators, improving the quality of technology learning, and facilitating educational development in the digital age.

3 Methodology

This study uses an experimental approach with a quasi-experimental design to thoroughly test and assess the impact of using Chat GPT (Generative Pre-trained Transformer) on student learning outcomes in technology learning. A quasi-experimental design is a research design that has some similarities to experimental designs but does not have full control over the assignment of participants into groups. In a quasi-experimental design, researcher do not have the ability to randomly assign participants into different conditions or groups. Instead, they use pre-existing groups or conditions and study the effects of the independent variable on the dependent variable (Baharom et al. 2020). Figure 1 presents the quasi-experimental research design.

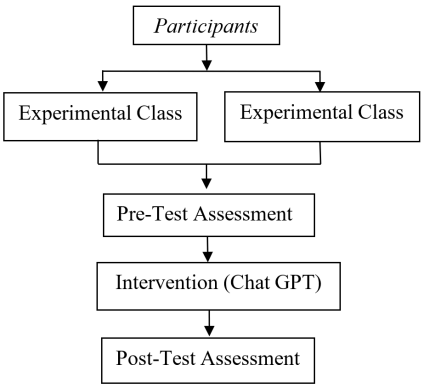

Figure 1 Quasi-experimental research design

In Figure 1, the research participants are divided into two groups: the experimental group and the control group. Pre-tests are conducted to assess the initial learning outcomes and engagement levels of both groups. The experimental group receives the intervention, which involves using Chat GPT during technology learning, while the control group follows the conventional technology learning method without Chat GPT. After a certain period of intervention, post-tests are conducted to measure the learning outcomes and engagement levels of both groups. The comparison of post-test scores between the two groups will provide insights into the impact of using Chat GPT on student learning outcomes in technology learning.

3.1 Research variables

This study aims to explore the Impact of Using GPT Chat on Student Learning Outcomes in Technology learning. In this study, there are two main variables that will be observed, the following research variable data is presented in Table 1.

Table 1 Research variables

Variable	Description
Independent Variable	The use of Chat GPT as a communication tool in technology learning. The experimental group will use Chat GPT, while the control group will use the conventional technology learning method without Chat GPT.
Dependent Variable	Student Engagement in technology learning, including active participation, motivation, collaboration, and student interaction with learning materials and peers. This variable will be measured using indicators such as level of participation in discussions, level of activity in learning tasks, and students' perception of their engagement in technology learning.

3.2 Population and sample

The study's target population consists of students enrolled in the Information Technology education study program at the University of Muhammadiyah Muara Bungo, totaling 244 students. This research aims to focus on students actively participating in technology learning within the mentioned program, specifically in educational technology courses. The selection process for the sample will be conducted randomly or through appropriate sampling techniques to ensure the sample's representativeness of the broader population. The sample size will include 31 students designated as the experimental group, who will utilize Chat GPT during technology learning, and another 31 students assigned as the control group, following the conventional technology learning method. The formula used to calculate the sample size in this study is the sample size formula for comparing two means in independent samples (A Concise Introduction to Mixed Methods Research - John W. Creswell - Google Buku n.d.). This formula is given as:

$$n = \frac{[(Z\alpha/2 + Z\beta)^2 \times (\sigma 1^2 + \sigma 2^2)]}{(\mu 1 - \mu 2)^2} \quad (1)$$

Where:

n = required sample size per group
Zα/2 = critical value for the desired level of significance ($\alpha/2$)
Zβ = critical value for the desired power (1-β)
$\sigma 1^2$ = variance of the population for the experimental group
$\sigma 2^2$ = variance of the population for the control group
$\mu 1$ = population mean for the experimental group
$\mu 2$ = population mean for the control group

To determine the sample size, researcher need to specify the desired level of significance (alpha), desired power (1-beta), estimate the population variances ($\sigma 1^2$ and $\sigma 2^2$), and have an expectation or estimate of the population means ($\mu 1$ and $\mu 2$). The critical values Zα/2 and Zβ can be obtained from standard normal distribution tables based on the chosen significance level and desired power.

3.3 Data analysis technique

3.3.1 Analysis of data description

(1) Presentation of Data

Quantitative data based on interval and ratio measurements. Data from respondents generally varies so it requires simplifying the data by grouping the data into certain classes and intervals. A frequency distribution is a grouping of data into categories that shows the amount of data in each category, and each data cannot belong to two or more categories. The purpose of a frequency distribution is to make the data informative and easy to understand.

The steps of data simplification (Frequency Distribution) are as follows: (1) Sort the data, (2) Create data categories or classes, (3) Create data intervals, (4) Create frequency tables, and (5) Perform management or tabulation to enter values into class intervals. Data presentation can be in the form of frequency tables and diagrams (graphs). For the diagram (graph) in this study, data presentation in the form of a histogram is used, which is the same as a bar chart, except that the bars are connected (not separated) because the data presented is continuous.

(2) A measure of Data Centralization

A measure of centering is a statistical measure that provides insight into the location or central tendency of a group of data. It helps us understand where the data points tend to cluster around. In data analysis, researcher often use various measures of centering, each serving a specific purpose. Some commonly used measures of centering include the mean, median, and mode.

(a) Mean: The mean is the arithmetic average of all the data points in a dataset. It is obtained by summing up all the values and dividing by the total number of data points. The mean is sensitive to extreme values, and it provides a balanced representation of the data when the distribution is approximately symmetric.

$$\overline{X} = \frac{\sum X}{n} \quad (2)$$

Description:

$\overline{X} = Mean$
$\sum \mathrm{X} = \mathrm{Sum\ of\ X1, X2, ..., Xn}$
$\mathrm{n} = \mathrm{Amountofdata}$

(b) Median: The median is the middle value in a dataset when the data is arranged in ascending or descending order. It is less influenced by extreme values and is often used when dealing with skewed or non-normally distributed data.

$$\mathrm{Med} = \mathrm{u} + \left[\frac{\frac{\mathrm{n}}{2} - \mathrm{fk_a}}{\mathrm{fi}}\right] \times \mathrm{i} \tag{3}$$

Description:
Med = Median value
u = Lower limit of median class
n = Number of data
$\mathrm{fk_a}$ = Total number of frequencies before the median class
fi = Median class frequency
i = Median class length

(c) Mode: The mode is the most frequently occurring value in a dataset. It is particularly useful for categorical data or discrete variables, where we want to identify the most common category or value.

$$\mathrm{Mod} = \mathrm{u} + \left[\frac{\mathrm{fa}}{\mathrm{fa} + \mathrm{fb}}\right] \tag{4}$$

Description:
Mod = Mode value
u = Lower limit of the mode class
fa = Difference in frequency of the mode class with the previous class
fb = Difference between the frequency of the mode class and the class after it.

Each measure of centering has its strengths and weaknesses, and researcher choose the appropriate one based on the characteristics of the data and the research objectives. By understanding the central tendency of the data, we can gain valuable insights into the distribution and characteristics of the dataset.

(3) Measure of Data Distribution

The size of the data distribution can be determined by calculating the range, variance, and standard deviation. These measures provide valuable information about the spread or dispersion of the data points in the dataset.

(a) Range: The range is a simple measure that represents the difference between the largest and smallest values in the dataset. It provides a quick glimpse of the spread of data, but it is sensitive to outliers and may not fully capture the variability of the data.

$$\mathrm{R} = \mathrm{X_{max}} - \mathrm{X_{min}} \tag{5}$$

Description:
R = Range
$\mathrm{X_{max}}$ = Highest score
$\mathrm{X_{min}}$ = Lowest score

(b) Variance: The variance measures the average squared deviation of each data point from the mean. It gives a more comprehensive understanding of the spread of data by considering the dispersion of all the values around the mean. However, the variance is expressed in squared units, making it less interpretable and harder to compare with the original data.

$$\mathrm{S^2} = \frac{\sum \mathrm{f}\left(\mathrm{X} - \overline{\mathrm{X}}\right)^2}{\mathrm{n} - 1} \tag{6}$$

(c) Standard Deviation: The standard deviation is the square root of the variance. It is the most used measure of data dispersion because it is expressed in the same units as the original data. The standard deviation provides a clear and intuitive interpretation of how much the data points deviate from the mean. It is less influenced by extreme values compared to the range and provides a more robust representation of data variability.

$$\mathrm{S} = \sqrt{\frac{\sum \mathrm{f}\left(\mathrm{X} - \overline{\mathrm{X}}\right)^2}{\mathrm{n} - 1}} \tag{7}$$

Description:
$\mathrm{S^2}$ = Variance value
S = Standard deviation value
n = The number of data

f = frequency of each value
X = Value score
$\overline{X}$ = Average

By calculating these measures, researcher can gain insights into how spread out the data points are from the center and assess the variability in the dataset. Understanding the size of the data distribution is crucial for making informed decisions, drawing meaningful conclusions, and performing statistical analyses.

3.3.2 Data analysis prerequisite test

To fulfill the analysis requirements for measuring the similarity test of two means, it is essential to ensure that the data follows a normal distribution. To assess this, both the normality test and homogeneity test were conducted. The normality test helps to determine whether the data used in the study is normally distributed or not, which is a prerequisite for using the t-test. On the other hand, the homogeneity test is employed to examine whether the two groups being compared have similar variances.

The t-test, a commonly used statistical technique, is utilized to observe, and evaluate differences in learning outcomes between the experimental and control classes. It allows for an examination of whether there are statistically significant distinctions in the mean scores of the two groups, represented by the following statistical hypotheses:

(1) Null Hypothesis (H_0): There is no effect, and the mean student learning outcomes (μ_1) with the application of Chat GPT (Generative Pre-trained Transformer) are equal to the mean learning outcomes (μ_2) using conventional learning methods.

(2) Alternative Hypothesis (H_1): There is an effect, and the mean student learning outcomes (μ_1) with the application of Chat GPT (Generative Pre-trained Transformer) are not equal to the mean learning outcomes (μ_2) using conventional learning methods.

By subjecting the data to rigorous statistical analysis and hypothesis testing, this research aims to provide meaningful insights into the impact of using Chat GPT on student learning outcomes in the context of technology learning at Universitas Muhammadiyah Muara Bungo.

(1) Normality Test

The normality test is a crucial step in assessing the distribution of data and determining its normality. It plays a significant role in determining the appropriate statistical methods to be applied in further analyses. In this study, the normality test was conducted using the Lilliefors test, which is a variant of the Kolmogorov-Smirnov test specifically designed for small sample sizes. The Lilliefors test is carried out to examine whether the data follows a normal distribution or deviates significantly from it. The steps involved in performing the Lilliefors test are as follows:

(a) Sort the sample data (x) from smallest to largest and determine the frequency of each data.

(b) Determine the Z value of each data with the formula:

$$Z = \frac{x - \overline{X}}{S^2} \tag{8}$$

(c) Determine the Zt value, based on the Z value consulted in the table list.

(d) Determine the value of F(z) with the formula:
F(z) = 0.5 - Zt if the Z value is negative
F(z) = 0.5 + Zt if the Z value is positive

(e) Determine the value of S(z) which is calculated from the cumulative frequency divided by the amount of data.

(f) Determine the calculated L value (Lo)=|F(z)-S(z)| and compare it with the Lt value.

(2) Homogeneity Test

After the normality test shows that the research data is normally distributed, the next step is to conduct a homogeneity test of the research sample. The homogeneity test aims to determine whether the two data groups have homogeneous variants or not. In this study, the homogeneity test was conducted using the F test. The following are the steps described to perform the F test:

(a) Find the variance of each data then calculate the F price with the formula:

$$\mathrm{F} = \frac{\mathrm{S}_1^2}{\mathrm{S}_2^2} \tag{9}$$

Description:
F = Comparison between the largest variant and the smallest variant
S_1^2 = The largest variant

S_2^2 = Smallest variant

(b) If the price has been obtained, it is compared with the F price found in the F distribution list with a significant level of 5% and dk numerator = n-1 and denominator n_{1-2}if only $F_{count} \leq F_{table}$ means that the two data groups have homogeneous variants.

(3) Hypothesis Test

The data in this study were found to have a normal distribution and homogeneity of variances, which met the assumptions necessary for hypothesis testing. To compare the means of two independent groups, the t-test was employed with the following hypotheses: Ho (null hypothesis): $\mu 1 = \mu 2$ and H1 (alternative hypothesis): $\mu 1 \neq \mu 2$. Since the sample sizes were not equal (n1 $\neq$ n2) and the variances were homogeneous ($\sigma 1 = \sigma 2$), the appropriate formula for conducting the t-test was the Pooled Variance method. This method considers the pooled variance of both groups to obtain a more accurate estimation of the standard error of the difference between the means. The formula for the Pooled Variance t-test is as follows:

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{(n-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \tag{10}$$

Description:

$\overline{X_1}$ = Mean score of experimental class

$\overline{X_2}$ = Mean value of control class

S1 = Standard deviation of experimental class

S2 = Standard deviation of control class

n1 = Number of experimental class students

n2 = Number of control class students

After obtaining the t-value from the Pooled Variance t-test formula, the next step is to compare the calculated t-value (t_{count}) with the critical t-value (t_{table}) at a specific significance level (α) and degrees of freedom (dk = n1 + n2 - 2). In this study, the significance level chosen is α = 0.05, which corresponds to a 95% confidence level. The degrees of freedom (dk) can be calculated as the sum of the sample sizes of both groups minus 2 (dk = n1 + n2 - 2). To compare the t_{count} value with the t_{table} value, the following test criteria are used:

(a) If $t_{count} > t_{table}$: This indicates that the calculated t-value is greater than the critical t-value. In this case, the null hypothesis (Ho) is rejected, and we can conclude that there is a statistically significant difference between the means of the two groups. It means that the effect of using Chat GPT on student learning outcomes in technology learning is significant.

(b) If $t_{count} > < t_{table}$: This suggests that the calculated t-value is smaller than the critical t-value. In such a situation, the null hypothesis (Ho) cannot be rejected, and we do not have sufficient evidence to claim a significant difference between the means of the two groups. It implies that the effect of using Chat GPT on student learning outcomes in technology learning is not statistically significant.

By comparing the t_{count} value to the t_{table} value based on the given test criteria, researcher can draw valid conclusions about the impact of using Chat GPT on student learning outcomes in the context of technology learning. It will provide valuable insights into the effectiveness of Chat GPT as an innovative technology to enhance student engagement and overall learning outcomes in the digital education landscape.

4 Results

4.1 Research result data

After conducting research and processing data for each class, namely the experimental class with a total of 31 students and the control class with a total of 31 students. In summary, the learning outcomes of experimental and control class students can be explained in Table 2.

The learning outcomes of the experimental class, consisting of 31 respondents, were analyzed based on the collected data. The maximum score obtained was 96, while the minimum score was 68, resulting in an interval of 6 and a class interval width of 5. The data analysis revealed that the mean for the experimental class was 81.81, the median was 87, and the mode was 80. Furthermore, the variance for the experimental class was calculated to be 41.58, with a standard deviation of 3.353. Similarly, for the control class, which also comprised 31 respondents, the data showed a maximum score of 88 and a minimum score of 56. The interval for this class was 6, and the class interval width was 6. The calculated mean for the control class was 70.45, the median was 80, and the mode was 60. The variance for the control class was determined to be 8.606, with a standard deviation of 9.277.

Table 2 Statistical values of experimental class and control class data

No	Statistics	Experimental class	Control Class
1	N	31	31
2	Number of Values	2536	2184
3	Mean	81.81	70.45
4	Median	87	80
5	Modus	80	60
6	Maximum Values	96	88
7	Minimum Values	68	56
8	Range	28	34
9	Interval	6	6
10	Length of Interval Class	5	6
11	Variance	41.58	8.606
12	Standard Deviations	6.353	9.277

4.1.1 Data on learning outcomes in the experimental class

By analyzing the learning outcomes of both the experimental and control classes, the numerical results provide insights into the distribution and central tendencies of the scores achieved by the students. Based on this data, the frequency distribution of the experimental class learning outcomes is compiled which is explained in Figure 2:

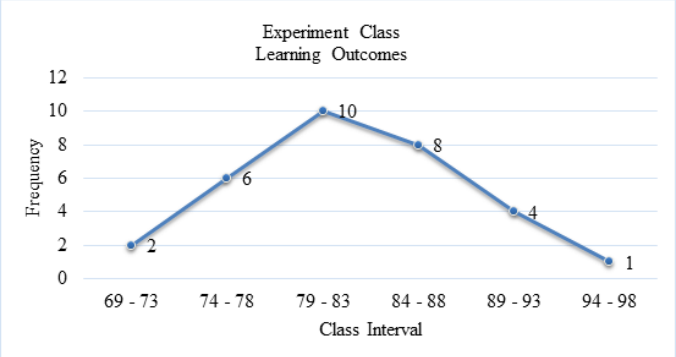

Figure 2 Frequency distribution of experimental class student learning outcomes

The analysis of Figure 2 reveals that the learning outcomes of students with the highest frequency are concentrated within the score interval of 79-83, specifically accounting for 32.26% of the total. After examining and analyzing Figure 1, it shows that the most frequently occurring answer interval falls within the class interval of 78-83. This interval shows substantial occurrence, as it was observed in 10 cases among the student participants, thus accounting for 32.26% of the total sample size.

4.1.2 Data on learning outcomes in the control class

The treatment given to the experimental and control classes was carried out differently, to determine the effect of the application of the learning model on learning outcomes. Based on the results of the research data, the frequency distribution of the learning outcomes of the control class is compiled which can be seen in Figure 3.

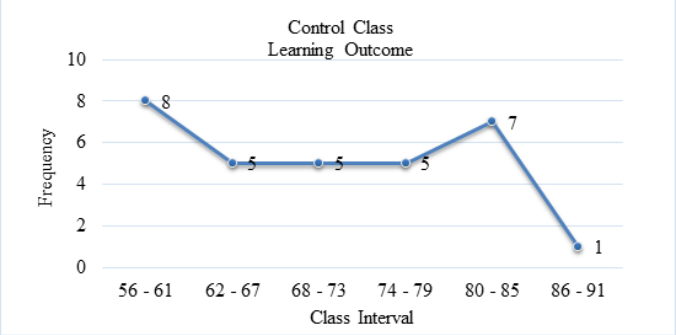

Figure 3 Frequency distribution of learning outcomes of control class students

Upon conducting an in-depth analysis of Figure 3, it becomes evident that the student learning outcomes with the highest frequency are concentrated within the score interval of 56-61, specifically representing an impressive percentage of 25.81% from the overall sample. From Figure 2, it is illustrated that the highest answer interval is in the interval class 56 - 61 with a frequency of 8 students or 25.81%.

Based on Figure 1 and 2, for learning outcomes in the experimental and control classes, the average value of the experimental class learning outcomes (81.81) and the average value of the control class learning outcomes (70.45), where the average value obtained between the experimental and control classes has a large difference. This shows that the test results of the experimental and control classes after being given the treatment are significantly different average learning outcomes. It can be concluded that the experimental class that uses learning with the use of Chat GPT can significantly increase the average student learning outcomes compared to the control class that uses conventional learning.

4.2 Analysis of research results

Before testing the hypothesis, first the normality test and homogeneity test were carried out on the data sample. Normality test is used to determine whether the data used in the analysis comes from a normal distribution or not. Meanwhile, the homogeneity test is used to check whether the data variance between the experimental group and the control group is homogeneous or not.

4.2.1 Normality test

The normality test is used to evaluate whether the data being processed comes from a normally distributed distribution or not, with the aim of ensuring that the analysis to be used, such as the t test, is reliable. The data used in this normality test are the final test scores of the control class and the experimental class. To conduct a normality test, parametric analysis is carried out using the calculation method of the average and standard deviation. In this study, the normality test was conducted using the Lilliefors test, which considers the difference between the data distribution and the expected normal distribution. The following are the results of the normality test calculations on both samples presented in Table 3:

Table 3 Calculation Results of Liliefors Test for Experimental Group and Control Group

No	Class	N	L_t	L_o	Comparison	Description	α
1	Control Class	31	0.159	0.142	$L_o < L_t$	Normal	0.05
2	Experimental Class	31	0.159	0.150	$L_o < L_t$	Normal	

Based on the Lilliefors test for the experimental and control classes, $L_o < L_t$, it can be concluded that the data is normally distributed. The L_{table} value is taken from the table of critical values L for the Lilliefors test, with a significance level of 5% and a confidence level of 95%. From the data processing of the experimental class and control class results, it is concluded that the data is normally distributed, the next step is the homogeneity test.

4.2.2 Homogeneity test

The variance homogeneity test is essential in assessing whether the research sample is derived from populations with homogeneous variances in both the experimental and control classes. The F-test formula is employed for this homogeneity test and is expressed as follows:

$$F = \frac{\text{largest variance}}{\text{smallest variance}} \tag{11}$$

In this context, the largest variance refers to the sample data of the experimental class, while the smallest variance represents the sample data of the control class. The F test helps to compare the variances of the two groups and determine whether they are significantly different or not. If the calculated F value is greater than the critical F value obtained from the F table at a given level of significance and degrees of freedom, it indicates that the variances are not homogeneous.

However, if the calculated F-value is less than the critical F-value, it suggests that the variances are homogeneous, allowing for valid statistical comparison between the means of the two groups using the t-test. A homogeneous variance assumption is crucial in ensuring the reliability of the t-test results, as it ensures that both groups have similar variability. By conducting the variance homogeneity test, researcher can establish the suitability of using the pooled variance t-test formula to analyze the data effectively and draw accurate conclusions about the impact of using Chat GPT on student learning outcomes in technology learning. In detail, the results of the variance homogeneity test can be found in Table 4.

Table 4 Homogeneity test results

No	Class	N	dk	α	F_c	F_t	Comparison	Description
1	Control Class	31	30	0.05	0.579	1.84	$F_{count} < F_{table}$	Homogeneous Variance
2	Experimental Class	31	30					

According to the results presented in Table 4, by comparing the F_{count} value with the F_{table} value at the significance level α = 0.05 and the degree of freedom (dk) = n-1 (in this case, n-1 = 30) in the experimental class and control class, the test criteria used are as follows: if the F_{count} value is greater than the F_{table} value, then the data is considered inhomogeneous, while if the F_{count} value is smaller than the F_{table} value, then the data is considered homogeneous. The calculation results show that in the treatment group, there is the smallest variation with a value of $\left(S2^2\right)$ = 40.361 and the largest variation with a value of $\left(S1^2\right)$ = 92.232. By dividing these two numbers, the homogeneity index of the variance between the two tested groups with numerator and denominator values is 30.30. The F_{count} value is 0.579 while the F_{table} value is 1.84. Thus, it can be concluded that the value of $F_{count} < F_{table}$, which indicates that the two groups tested are homogeneous.

4.2.3 Hypothesis test

Based on the initial analysis, it can be concluded that the experimental group and the control group have relatively the same starting point. Furthermore, the experimental group was given a certain treatment using Chat GPT while the control group used a conventional learning model. After the experimental class and control class have done the test, the normality and homogeneity tests are carried out, the results of which are both normally distributed and homogeneous.

After the normality test and homogeneity test are carried out, then proceed with t-tests to find out whether there is a significant influence on the values of the two groups. If $t_{count} < t_{table}$ means, there is no significant influence between the two groups. The following is the result of data processing calculations using the t-test, presented in Table 5.

Table 5 The results of data processing calculations using the t-test

No	Class	N	X	S	dk	t_c	t_t	Conclusion
1	Control Class	31	81.81	6.353	60	5.424	2.000	H_a Accepted
2	Experimental Class	31	70.45	9.604				

The test results in table 9, significance level α 0.05 (95% confidence level) and dk = n_1 + n_2 - 2 = 60 with t_{count} = 5.424 and t_{table} = 2.000 so that the obtained $t_{count} > t_{table}$ (5.424 > 2.000), then H_1 is accepted and H_0 is rejected. Based on the data above, the hypothesis testing carried out is as follows:

H_0 = There is no positive and significant effect on the use of Chat GPT (Generative Pre-trained Transformer)

H_1 = There is a positive and significant effect on the use of Chat GPT (Generative Pre-trained Transformer)

Based on the test results with a significance level α 0.05 (95% confidence level) and degrees of freedom dk = n1 + n2 - 2 = 60, with a value of t_{count} = 5.424 and t_{table} = 2.000, it can be concluded that $t_{count} > t_{table}$ (5.424 > 2.000). Therefore, the null hypothesis (H_0) which states that there is no positive and significant influence on the use of Chat GPT (Generative Pre-trained Transformer) is rejected. Meanwhile, the alternative hypothesis (H_1) which states that there is a positive and significant influence on the use of Chat GPT (Generative Pre-trained Transformer) is accepted. This shows that the use of Chat GPT has a positive and significant impact on students' technology learning.

5 Discussion

The incorporation of GPT Chat in bold learning activities at Universitas Muhammadiyah Muara Bungo is proven to significantly improve student learning outcomes. By utilizing the capabilities of Chat GPT, students can have an interactive and personalized learning experience that encourages active participation and student learning outcomes in the technology learning process. This finding is in line with previous research that shows the effectiveness of using Artificial Intelligence chatbots in educational settings to improve student learning outcomes. The findings are in line with the findings of another study that explored the use of GPT Chat in a courageous learning context in learning. The results showed that the use of GPT Chat significantly improved student learning outcomes in learning (Tlili et al. 2023). Other studies

reveal the use of GPT Chat in foreign language learning shows that interaction with GPT Chat helps increase student involvement in understanding and using foreign languages (Lund and Wang 2023), where the two studies both found that GPT Chat can increase student activity in the learning process. Another study tested the effectiveness of using GPT Chat in facilitating group discussions in technology learning. The research findings show that GPT Chat can encourage students' active participation in group discussions and increase collaboration between students (Tsai, Ong, and Chen 2023). Some of the results of these studies are in line with the results of our research so that they show consistency in research results that the use of GPT Chat in bold learning can increase the involvement of students or students in the learning process. These findings underscore the benefits of using AI technology such as Chat GPT in creating learning experiences that are more interactive, and personalized, and motivate students' active participation in the learning process. A comparison of previous research with what we did was in the context of a specific research conducted at Muara Bungo Muhammadiyah University, a case study was conducted to look in depth at how the use of GPT Chat significantly increased student involvement in courageous learning. This makes an important contribution to our understanding of how AI technologies such as GPT Chat can help create more interactive and engaging learning experiences for students. In addition, our findings provide relevant and specific insights into educational developments in these universities.

The development of science and technology opens opportunities for aligned research to further develop the body of knowledge in the future in the form of replicating the study with a larger sample size and in various other educational institutions. This could provide a broader picture of the effect of using GPT Chat on student learning outcomes in technology learning. Feature and Functionality Development for the Future, GPT Chat or similar technologies can continue to be developed with more advanced features and functionalities to further explore the potential of GPT Chat. The opportunity to conduct a comparative study between the use of GPT Chat and other learning support technologies to provide richer insights into the effectiveness of improving student learning outcomes in technology learning, so that a curriculum that has been integrated with GPT Chat can be produced that can improve the learning experience holistically.

6 Conclusion

Based on the test results with a significance level α 0.05 (95% confidence level) and degrees of freedom dk = $n_1 + n_2$ - 2 = 60, the obtained t_{count} value of 5.424 is greater than the t_{table} value of 2.000. This indicates that there is a significant positive effect of using Chat GPT on student learning outcomes in technology learning. The findings from this study show that incorporating Chat GPT into technology learning activities at Universitas Muhammadiyah Muara Bungo has a positive impact on student learning outcomes. The use of Chat GPT provides an interactive and personalized learning experience, which increases student participation and engagement in the technology learning process.

These findings are in line with previous research that highlighted to find out how the use of ChatGPT has impacted the digital education system (Castillo et al. 2023). where similar research, using descriptive statistics and linear regression analysis using randomly collected data from 216 college students' responses on the Twitter website regarding the various experiences they had with ChatGPT. According to this study, 71.30% of the participants who participated in the discussion agreed that they use ChatGPT because it is fast and provides the most accurate answers. Fifty participants representing 23.15% of the total participants stated in the discussion that they use ChatGPT because it is free and easy to use. By utilizing the capabilities of ChatGPT, educators can create an engaging and interactive technology learning environment that promotes student engagement and encourages active participation. The technology enables personalized interactions, immediate feedback, and adaptive learning experiences, which cater to the diverse needs and preferences of students.

In conclusion, the results of this study support the idea that the use of Chat GPT positively affects student learning outcomes in technology learning. It is recommended that educational institutions and educators consider integrating Chat GPT as a tool to improve student learning outcomes and enhance the overall quality of the technology learning experience. Further research could explore the long-term effects of using Chat GPT and investigate its potential applications in other educational contexts.

Conflicts of interest

The authors declare that they have no conflict of interest.

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