

The Chatbot Effect in Supporting Blended Learning on Students' Academic Achievement

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Abstract

This study is motivated by the use of technology in education that is increasingly developing, and with chatbot applications, is one of the technologies that can be utilized to improve classroom learning quality. The research method used is quantitative. The type of research is quasi-experimental with a pretest-posttest control group design. The total population and sample consist of 63 students divided into two classes, 5A and 5B. Data collection techniques using test and non-test. The data collection instruments are question sheets, observation sheets, and documentation guidelines. The analysis technique used is descriptive analysis and hypothesis testing. Based on the data analysis obtained, 1) The Control class pretest learning outcomes are 47.74. while the posttest is 71.61. 2) The experimental class pretest learning outcomes are 53.44, and the posttest is 86.88. 3) The blended learning method assisted by the NAFA chatbot application has a significant effect. 4) The blended learning method assisted by the NAFA chatbot application has an effect size test of 4.2335. So, it can be concluded that the blended learning method assisted by the NAFA chatbot application greatly influences learning outcomes. These findings imply that chatbot-assisted blended learning holds strong potential for fostering interactive and student-centered classrooms in elementary education. Future studies are recommended to expand the scope across subjects, student populations, and school settings, and to explore their long-term impact on learners' motivation, engagement, and critical thinking.

Keywords: Blended Learning, Chatbot Application, Learning Outcomes.

Abstrak

Penelitian ini dilatarbelakangi oleh penggunaan teknologi dalam pendidikan yang semakin berkembang, dan dengan aplikasi *chatbot*, merupakan salah satu teknologi yang dapat dimanfaatkan untuk meningkatkan kualitas pembelajaran di kelas. Metode penelitian yang digunakan adalah kuantitatif. Jenis penelitian ini adalah kuasi eksperimen dengan desain *pretest-posttest control group design*. Total populasi dan sampel terdiri dari 63 siswa yang dibagi menjadi dua kelas, 5A dan 5B. Teknik pengumpulan data menggunakan tes dan non-tes. Instrumen pengumpulan data adalah lembar pertanyaan, lembar observasi, dan pedoman dokumentasi. Teknik analisis yang digunakan adalah analisis deskriptif dan uji hipotesis. Berdasarkan analisis data diperoleh, 1) Hasil belajar tes awal kelas Kontrol adalah 47,74. sedangkan tes akhir adalah 71,61. 2) Hasil belajar tes awal kelas Eksperimen adalah 53,44, dan tes akhir adalah 86,88. 3) Metode pembelajaran *blended learning* berbantuan aplikasi *chatbot* NAFA memiliki pengaruh yang signifikan. 4) Metode *blended learning* yang dibantu aplikasi *chatbot* NAFA memiliki uji effect size sebesar 4,2335. Dengan demikian, dapat disimpulkan bahwa metode *blended learning*

yang dibantu aplikasi *chatbot* NAFA sangat memengaruhi hasil belajar. Temuan ini menyiratkan bahwa *blended learning* yang dibantu *chatbot* memiliki potensi yang kuat untuk mendorong kelas yang interaktif dan berpusat pada siswa di pendidikan dasar. Penelitian selanjutnya disarankan untuk memperluas cakupan di seluruh mata pelajaran, populasi siswa, dan lingkungan sekolah, serta untuk mengeksplorasi dampak jangka panjangnya terhadap motivasi, keterlibatan, dan pemikiran kritis siswa..

Kata Kunci: Aplikasi *Chatbot*, *Blended Learning*, Hasil Belajar.

INTRODUCTION

The use of digital technology has shown a positive impact on students' academic performance. It can improve language, problem-solving, and cognitive abilities (Grab, 2025; Polakova & Klimova, 2024; Su & Zou, 2022). These improvements in competency and achievement are a form of utilizing educational technology in schools, which, in practice, can be implemented through blended learning. Students who follow blended learning can access learning materials independently, while still receiving teacher instruction through face-to-face interactions or online meetings (Singh et al., 2021, 2022; Zagouras et al., 2022). In addition to technological advances, chatbots powered by Artificial Intelligence (AI) can now serve as student learning assistants (Chen et al., 2023).

A chatbot is an AI system that can communicate with users in natural language processing (NLP) like humans (Du & Daniel, 2024). It mimics human conversation through text or voice interaction to provide information in a conversational manner (Labadze et al., 2023). Through online chat, chatbots can help students complete tasks or find solutions to problems quickly and easily (Kurni et al., 2023). Based on this, chatbot applications are one of the contemporary technologies that can improve teaching quality in the classroom. By utilizing this new technology, instant feedback and personalization of materials can be provided to students by chatbot applications, which can also increase interactivity between teachers and students. For students, using chatbots in the classroom is beneficial (Jeon, 2024; Lee & Maeng, 2023; Merelo et al., 2024). Chatbots can support teaching and learning (Okonkwo & Ade-Ibijola, 2021; Straková & Válek, 2024).

Based on these insights, research on integrating chatbots in education has seen significant growth in recent years, reflecting the growing interest in this field. The existing literature can be classified into two main themes. First is learning effectiveness. That is shown by several research results, which found that the use of chatbots in the implementation of blended learning contributed significantly to improving learning outcomes, self-directed learning, critical thinking, and academic engagement of elementary school students (Fitri et al., 2025; Mehri et al., 2025). These two studies strengthen other

research results, proving that chatbot applications positively affected online learning (Afriani et al., 2024; Deveci Topal et al., 2021). Besides, chatbots were used to develop them into a chatbot prototype, Chatbot for School Violence Prevention (C-SVP), which was designed using KakaoTalk-based social media with the keyword “School Guardian Angel.” The formative evaluation results showed that the product was considered suitable for elementary school students (Kang et al., 2024).

Second is the ethical consideration. Research on this aspect is minimal; half focus on teaching new languages (Chen et al., 2023). A study has shown that students are already aware of the potential ethical issues of using chatbots, such as copyright and plagiarism, academic integrity, data privacy, and algorithmic bias (Grab, 2025; Lee & Maeng, 2023). This finding aligns with other studies that have found that, despite its advantages, the use of chatbots also has disadvantages, such as a decline in one's abilities (thinking, research), errors, and cheating. Therefore, various forms of AI and their uses should be positioned as learning aids, not as substitutes for one's abilities: teachers and students (Straková & Válek, 2024). This situation also aligns with research findings suggesting the need to pay careful attention to ethical issues when developing, implementing, and using AI-based technologies for educational purposes (Polakova & Klimova, 2024).

Previous studies have shown that two major themes stand out in research on using chatbots in education. The first focuses on learning effectiveness, where many studies show that chatbots integrated into blended learning can improve learning outcomes, self-directed learning, critical thinking, and student engagement. The second theme concerns ethical issues, where fewer studies emphasize challenges such as academic integrity, data privacy, and overreliance on technology. Although these studies have expanded our understanding of how chatbots function in educational settings, little attention is given to how chatbot-assisted blended learning explicitly affects students' academic achievement in elementary schools. Most existing studies have concentrated on higher education or general online learning contexts, while elementary learners who differ in cognitive and emotional development remain underrepresented. Furthermore, few studies have discussed ethical awareness rather than examined how chatbot use directly influences measurable academic performance.

Given this situation, the novelty of the present study lies in its focus on investigating the effects of chatbot-supported blended learning on the academic achievement of elementary school students. This study seeks to fill the existing gap by providing empirical evidence of how chatbots can enhance learning outcomes at the

foundational level of education. In doing so, it moves beyond discussions of engagement and ethics to explore the concrete impact of chatbot integration on student performance. Therefore, this study aims to examine the effects of chatbots in supporting blended learning practices on student academic achievement in elementary schools, offering new insights into how AI-based tools can be effectively and ethically used to strengthen learning in early education.

RESEARCH METHODS

The research method used in this study is quantitative research with a quasi-experimental approach and a pretest-posttest control group design. Quasi-experimental design has a control group (Andrade, 2021), but cannot fully function to control external variables that affect the implementation of the experiment (Em, 2024). Then, the pretest-posttest control group design involves randomly selecting two groups, which are examined first to see if there is a difference between the experimental and control groups (Bulus, 2021; Miller et al., 2020). This study involved 63 students who were divided into two classes, namely 5A and 5B. A total of 32 students of class 5B became the control class, and 31 students of class 5A became the experimental class.

The purpose of this study was to see how much influence the use of the blended learning method assisted by the NAFA chatbot application on the material of the human respiratory system had on the learning outcomes of class V students at SD Negeri 39 Pontianak Kota. The techniques that researchers use in this study are tests and nontests (Andrade, 2021; Em, 2024). In this study, the test used was a multiple-choice question given with a pretest-posttest. Researchers then analyzed the data obtained to find answers about whether there was an effect of using the blended learning method assisted by the NAFA chatbot application on the material of the human respiratory system on the learning outcomes of class V students at SD Negeri 39 Pontianak Kota.

RESULTS AND DISCUSSION

Result

This research was conducted at SD Negeri 39 Pontianak Kota, where this research was held in 2 classes, namely class 5A as the experimental class and class 5B as the control class. The instruments in this study were interviews, observations, and test questions, totaling 10 multiple-choice questions. This study aimed to determine the effect of the

blended learning method assisted by a chatbot application on learning outcomes at SD Negeri 39 Pontianak Kota in the academic year 2023/2024.

Table 1. Learning Outcomes of the Control & Experimental Class

Statistics	Experiment		Control	
	<i>Pretest</i>	<i>Posttest</i>	<i>Pretest</i>	<i>Posttest</i>
Total	1.710	2.780	1.480	2.220
Maximum Value	80	100	70	100
Minimum Value	30	70	20	40
Standard Deviation	11,248	11,483	15,544	16,145
Variations	122,559	127,734	236,837	252,237
Average	53,44	86,88	47,74	71,61

Based on the statistical data, both the experimental and control groups showed improvement from the pretest to the posttest, indicating a positive learning gain. The experimental group's average score increased from 53.44 in the pretest to 86.88 in the posttest, reflecting a higher improvement than the control group, which rose from 47.74 to 71.61. The experimental group also achieved a higher posttest maximum score (100) than its pretest maximum (80), while the control group's maximum increased from 70 to 100. Regarding minimum scores, the experimental group improved from 30 to 70, and the control group from 20 to 40, also showing progress in lower-performing students. The standard deviation in both groups remained relatively similar from pretest to posttest, indicating that the spread of scores did not change dramatically despite the overall improvement. However, the experimental group consistently showed lower variation values than the control group, suggesting more consistent performance among participants. The data indicate that the experimental group experienced greater improvement and more uniform achievement gains than the control group. For more details in determining the effect of using the Nafa chatbot-assisted blended learning method, the researchers conducted statistical tests, which are presented as follows:

Pretest Difference Test

In this pretest, a difference test using the Mann-Whitney U test was performed because there were different results in the normality and homogeneity tests. The Mann-Whitney U test is a statistical method for comparing two independent groups based on ranked data, not actual results. Mann-Whitney U Test Hypothesis Formula: Ho: There is no difference in the average sample between one another. Ha: There is a difference in the average sample from one another. The basis for making the Mann-Whitney U Test decision is that the Ha hypothesis is accepted if the Asymp. Sig. (2-tailed) is less than 0.05.

Table 2. Pretest Difference Test Results

Test Statistics ^a	Results
<i>Mann-Whitney U</i>	397,500
<i>Wilcoxon W</i>	893,500
<i>Z</i>	-1,390
<i>Asymp. Sig. (2-tailed)</i>	,165

Based on the Mann-Whitney U test results, the Asymp is known. Sig. (2-tailed) $0.165 > 0.05$, then the hypothesis is rejected. Thus, it can be said that there is no difference in initial ability between the control class and the experimental class.

Posttest Difference Test

In the posttest difference analysis, the Mann-Whitney U Test was applied because the homogeneity test results indicated unequal variances. This non-parametric statistical method compares two independent groups based on ranked data rather than their raw scores. The hypotheses for the Mann-Whitney U Test are as follows: H_0 states that the averages between the samples are the same, while H_a states that the averages differ. The decision-making criterion is that H_a is accepted if the Asymp. Sig. (2-tailed) value is less than 0.05.

Table 2. Posttest Difference Test Results

Test Statistics ^a	Results
<i>Mann-Whitney U</i>	227,500
<i>Wilcoxon W</i>	723,500
<i>Z</i>	-3,762
<i>Asymp. Sig. (2-tailed)</i>	,000

The results of the Mann-Whitney U test show that the Asymp. Sig. (2-tailed) The value is 0.000, which is less than the significance level of 0.05. This finding indicates that the alternative hypothesis (H_a) is accepted, meaning there is a statistically significant difference in the posttest scores between the control and experimental classes. This considerable difference suggests that implementing the blended learning method supported by a chatbot application has a positive and measurable effect on student learning outcomes. Specifically, for the topic of the human respiratory system taught to fifth-grade students at SD Negeri 39 Pontianak Kota, this approach not only enhanced overall achievement but also demonstrated its potential as a practical learning innovation that combines digital interactivity with classroom instruction to improve conceptual understanding and student engagement.

Effect Size Test

The effect size test in this study used Hedge's formula to calculate the level of influence in the effect size test. That is due to the relatively small sample size in the primary research. From the comparison of pretest and posttest scores, it is known:

$$M_1 = 86,875$$

$$M_2 = 71,6129$$

$$SD_1^2 = 11,48281$$

$$SD_2^2 = 16,14451$$

$$n_1 = 31$$

$$n_2 = 32$$

$$\begin{aligned} SD_{Pooled} &= \sqrt{\frac{(n_1 - 1)Sd_1^2 + (n_2 - 1)Sd_2^2}{n_1 + n_2 - 2}} \\ &= \frac{\sqrt{(31 - 1)11,48281 + (32 - 1)16,14451}}{31 + 32 - 2} \\ SD_{Pooled} &= \frac{\sqrt{(30)11,48281 + (31)16,14451}}{65} = \frac{\sqrt{344,4843 + 500,47981}}{65} \\ SD_{Pooled} &= \frac{\sqrt{844,96411}}{65} = \sqrt{12,999} \\ SD_{Pooled} &= 3,605 \end{aligned}$$

After knowing the results of SD_{Pooled} which is 3.605, the next step is to find out the effect size as follows:

$$\text{Hedges' } g = \frac{M_1 - M_2}{SD_{Pooled}}$$

$$\text{Hedges' } g = \frac{86,875 - 71,6129}{3,605}$$

$$\text{Hedges' } g = 4,2335$$

From the above calculations, the value of 4.2335 is greater than 1.45. It indicates a strong effect size. This result demonstrates that a chatbot's blended learning application significantly impacts students' learning outcomes. Notably, it shows that using blended learning methods assisted by a chatbot effectively enhances students' understanding of human respiratory system material. The magnitude of this impact suggests that integrating digital tools, such as chatbots, can substantially improve students' engagement and learning performance. Therefore, using chatbots to support blended learning in class V at SD Negeri 39 Pontianak Kota can be categorized as highly influencing students' learning outcomes.

Discussion

Comparison of Pretest and Posttest Learning Outcomes in the Control Class

The learning outcomes of control class students on the pretest score were 47.74. According to an interview with one of the students, the low pretest results cause students to find it challenging to understand and are confused about the questions. So, the initial knowledge about the human respiratory system, which is the field of study of this study, is still relatively low. That aligns with several studies that found the cause of low pretest scores is that students do not understand the basic concepts of the human respiratory system (Simatupang et al., 2023; Utamy & Rosdiana, 2023; Zulia & Alimah, 2023). Students only know that the human respiratory system functions to breathe, but do not understand the underlying fundamental concepts. Then, other research found that the cause of low student learning outcomes on the human respiratory system is monotonous learning and abstract concepts (Indriani et al., 2025; Rini et al., 2024). It is hoped that students will be more active, understand more, and improve their ability to think critically and solve problems.

Besides, the cause of low student pretest results is a lack of learning enthusiasm (Cahyani et al., 2024) and motivation (Akbar & Mukminan, 2019; Ningsih et al., 2019), inability to understand the material (Indriani et al., 2025; Rahayu & Wulandari, 2024), and lack of practice and learning experience (Rahayu & Wulandari, 2024; Sekarani & Abdullah, 2025). In addition, teacher and learning factors such as ineffective learning methods and inappropriate assessments also reduce students' pretest results (Kassa et al., 2024). The experts' opinions above also align with the research location where students do not understand the human respiratory system material concept. Therefore, greater efforts are needed in delivering the material and using learning methods that support students' understanding to achieve better learning outcomes at the posttest stage.

In this study, the control class used learning with a scientific approach. The learning outcomes of control class students on the posttest score were 71.61. That score shows that scientific learning effectively improves the learning quality and students' motivation. It aligns with research that provides an active and interactive approach through the predict, observe, explain (POE) learning strategy, where this learning strategy can increase the successful conceptual change of the human respiratory system in learning, and students have diverse conceptions: misconception, no understanding, partial understanding, and understanding (Kusnadi et al., 2019). In addition to providing a better understanding of concepts and actively involving students in the learning process, scientific learning can

also improve students' critical thinking and interpretation skills (Simatupang et al., 2023; Zulia & Alimah, 2023).

Other research shows that scientific learning can also improve students' scientific literacy skills (Rusmansyah et al., 2023), as teachers need to prepare students to make scientific decisions and utilize deep understanding to process new information (Hasnunidah et al., 2024). Thus, these findings indicate that the scientific learning approach has proven effective in improving students' conceptual understanding, motivation, and learning outcomes. That is due to its ability to encourage students' active participation and critical thinking skills, improve scientific literacy, and apply knowledge in real-world contexts.

Comparison of Pretest and Posttest Learning Outcomes in the Experimental Class

The learning outcomes of experimental class students on the pretest score were 53.44. According to an interview with one of the students, the low pretest results cause students to find it challenging to understand and be confused when working on questions. Several factors cause low pretest results on human respiratory system material. These include not understanding basic concepts, not wanting to learn, and not using interesting learning media. In addition, ineffective learning methods and a lack of opportunities to practice also led to poor pretest results. Students become bored, unfocused, and fail to understand the lesson because of these things. That is in accordance with several research results on causes of low initial knowledge about the respiratory system in students (Purnamasari et al., 2025), the lack of direct learning experience (Sekarani & Abdullah, 2025), difficulty understanding abstract concepts (Indriani et al., 2025; Rahayu & Wulandari, 2024), and misconceptions (Rini et al., 2024; Silva & Almeida, 2017; Utamy & Rosdiana, 2023).

In this study, the experimental class used learning with the NAFA chatbot. The learning outcomes of experimental class students on the posttest score were 86.88. There are 26 out of 32 students, or 81.25% who have reached the KKM, which is 75. Chatbots in education can potentially increase learner engagement through dynamic and responsive interactions. In addition, chatbots can assist the learning process and provide feedback to students, especially during distance learning.

Chatbots may be a better way to teach. Then, according to Kuhail et al., chatbots can present material more interactively, personalize, and engage (Kuhail et al., 2023), such as by using animations, videos, or games. Animations and videos can help students better

understand the material by providing a clearer concept picture (Deveci Topal et al., 2021). Blended learning assisted by a chatbot can increase students' motivation and engagement, enable learning personalization, increase accessibility, improve collaboration and interaction, and help students develop 21st-century skills (Baskara, 2023; Fitri et al., 2025).

The Blended Learning Effect Assisted by NAFA Chatbot on Learning Outcomes

In this study, the pretest difference test using the U Mann-Whitney test, the Asymp. Sig. (2-tailed) $0.165 > 0.05$, then the hypothesis is rejected. Thus, it can be said that there is no difference in pretest results between the control class and the experimental class. Then, the U Mann-Whitney test, the Asymp, was used in the posttest difference test. Sig. (2-tailed) $0.000 < 0.05$. Thus, it can be said that there is a difference in posttest results between the control class and the experimental class. Because there is a significant change, it can be said that using a blended learning method assisted by a chatbot application significantly influences the learning outcomes of human respiratory system material in class V at SD Negeri 39 Pontianak Kota.

With the help of chatbot applications, the blended learning method is proven to improve learner learning outcomes in science subjects (Fitri et al., 2025). Chatbots can help students acquire 21st-century skills that are important for their future. In addition, chatbots can increase students' motivation and improve their engagement in learning. Several other studies show that a chatbot can be an effective blended learning tool to help students learn better and make learning fun and independent. The results showed a significant difference between using chatbots and student learning outcomes (Afriani et al., 2024; Chen et al., 2023; Sáiz-Manzanares et al., 2023).

Meanwhile, Baskara shows that applying blended learning methods with the help of chatbot applications effectively increases students' motivation and learning activity (Baskara, 2023). There was an increase in students' learning motivation from both intrinsic and extrinsic aspects, and in students' learning activeness through active participation in learning. The chatbot helps students understand the material more easily, provides personalized feedback, and encourages independent learning.

The Magnitude of the Blended Learning Effect Assisted by the NAFA Chatbot on Learning Outcomes

The magnitude of the effect of the blended learning method assisted by the NAFA chatbot application in this study was calculated using the effect size test. The effect size

test result of $4.2335 > 1.45$ means that using the blended learning method assisted by a chatbot application on learning outcomes of human respiratory system material in class V at SD Negeri 39 Pontianak Kota has a "high influence". This finding indicates that integrating chatbot technology into the blended learning approach substantially enhances students' mastery of the human respiratory system material in fifth grade at SD Negeri 39 Pontianak Kota. The high level of influence reflects improvement in academic achievement, the potential of this learning model to foster active participation, provide instant feedback, and accommodate diverse learning styles. Such an approach combines the strengths of face-to-face instruction and digital interaction, creating a more engaging and effective learning environment that supports deeper conceptual understanding and sustained student motivation.

Wiboolyasarini et al. also show that the application of blended learning with a chatbot can significantly improve the English speaking skills of high school students (Wang, 2025; Wiboolyasarini et al., 2025). Meanwhile, several studies show that the application of chatbot-based blended learning can significantly improve the motivation and learning outcomes of school and university social students (Huang et al., 2025; Wei et al., 2025; Xia et al., 2025).

CONCLUSION

Based on the research results on the effect of applying the blended learning assisted by the NAFA chatbot application, this study shows that it significantly influences student learning outcomes. It is evidenced by the learning outcomes of control class students on the pretest, averaging 47.74. Then the learning outcomes of control class students on the posttest have an average of 71.61. Furthermore, the learning outcomes of experimental class students on the pretest had an average of 53.44. Then the learning outcomes of experimental class students on the posttest averaged 86.88. The statistical test results show that using blended learning methods assisted by chatbot applications significantly influences the learning outcomes of human respiratory system material in class V at SD Negeri 39 Pontianak Kota. The effect of the blended learning method assisted by the NAFA chatbot is calculated by effect size (4.2335), which means it has a high influence.

These results suggest that chatbot-assisted blended learning can be an effective teaching method for creating interactive and student-focused classrooms in elementary education. However, this study has some limitations. It focuses on one topic, has a relatively small sample size, and takes place in just one school, which may limit how

widely the findings apply. Future research should include a variety of subjects, larger groups of students, and different educational settings to confirm and enhance the findings. Additionally, further studies could look at the long-term effects of chatbot-assisted learning on students' motivation, engagement, and critical thinking skills. They could also examine how well these technologies can work across different grade levels and learning environments.

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