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Development of Quibot Technology-Based Learning Media to Improve Student Motivation and Learning Outcomes

Palma Juanta[1*], Indah Permata Sari Br Sembirinng[2], Liza Aulia[3]
[1,2,3] Program Studi Sistem Informasi, Universitas Prima Indonesia, Medan, Sumatera Utara, Indonesia
e-mail: palmajuanta@unprimdn.ac.id[1*], indahpermatasembiring1@gmail.com[2], liza33570@gmail.com[3]

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***Correspondence:**
Indahpermatasembiring1@gmail.com

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***Abstract*:**

This study examines the effect of Quibot, a chatbot-based learning medium, on students' learning outcomes and learning motivation in mathematics learning at the junior high school level. The study was motivated by the limited integration of interactive digital media and its impact on students' academic performance. A quantitative quasi-experimental design was employed involving 60 eighth-grade students of Yayasan Perguruan Sultan Iskandar Muda, divided into an experimental group using Quibot and a control group using conventional learning methods. Learning outcomes were measured using a validated multiple-choice mathematics achievement test, while learning motivation was assessed through a Likert-scale questionnaire. Data were analyzed using normality and homogeneity tests, followed by one-way ANOVA for learning outcomes and Welch's t-test for learning motivation. The results showed a significant difference in learning outcomes between the two groups, $F(1,58) = 4.65$, $p = 0.035$, with a moderate effect size ($\eta^2 = 0.074$). However, no significant difference was found in learning motivation ($p = 0.871$). These findings indicate that Quibot effectively improves students' academic achievement but does not significantly influence learning motivation within a short intervention period. This study highlights the role of chatbot-based learning media as an instrumental tool in supporting cognitive learning outcomes.

INTRODUCTION

The rapid development of science and technology has ushered humanity into a new era known as Society 5.0. This era, a continuation of the Industrial Revolution 4.0, emphasizes the integration of technological advancements with human-centered values. In the context of education, Society 5.0 demands that students acquire not only critical thinking, collaboration, creativity, and problem-solving skills but also essential soft skills such as leadership, adaptability, and social awareness. Basic literacy alone is no longer sufficient; instead, education must be transformed through technology-driven, student-centered approaches [1][2][3].

Society 5.0 envisions a future society built upon big data, artificial intelligence (AI), and the Internet of Things (IoT), integrating these technologies into multiple sectors, including education [4].

In response to these demands, the Indonesian education system has undergone significant reforms. The "Merdeka Curriculum," for example, emphasizes contextual, flexible, and engaging learning tailored to students' needs. Teachers are increasingly expected to act as facilitators who can leverage digital tools such as online applications, animated videos, and chatbots to create an interactive learning environment. In this context, technology-based learning media such as Quibot emerge as innovative solutions to contemporary educational challenges [5][6]. Teachers are thus encouraged to adopt innovative and adaptive pedagogical approaches in line with the rapid advancements in information technology to foster students' independent learning [4]. Several studies indicate that learning media have an indirect influence on learning motivation, because motivation is influenced by various internal and external factors such as interest, learning environment, teaching strategies, and student characteristics [11][12][17].

This often results in lower academic achievement and diminished interest in subjects such as physics and mathematics [7][8]. National survey data from the Ministry of Education's Research and Policy Center (2022) reveal that only 38% of junior high school teachers in Indonesia actively utilize technology in teaching, with the remaining 62% relying primarily on traditional, non-digital methods. Teachers interviewed confirmed that students often feel bored during class due to a lack of media variation, which leads to uncertainty in their comprehension and lower learning outcomes [10][11]. Quibot is a chatbot-based educational medium designed to assist students in understanding academic material through interactive and dialogic communication. It not only presents learning content in textual form but also responds to students' questions in real time, offers explanations, and provides interactive quizzes to stimulate engagement and motivation [12][13].

Prior studies have shown that interactive media, such as animations and simulations, can significantly enhance students' motivation and learning activities [14][15]. Firstly, most research is restricted to popular digital platforms, even though the usage of digital media has been shown to enhance learning motivation and results. Research that exclusively focuses on chatbot-based learning media is still lacking, though, and the majority of it is in the form of movies and animations [17]. Second, research on learning media frequently focuses on immediate impacts on motivation and performance, but seldom takes into account interactive elements like real-time feedback and adaptive questioning. Additionally, pupils' participation is impacted by interactive dialogue [18]. Third, although the necessity for digital learning media has been widely recognized, the majority of research is descriptive and lacks rigorous experimental methods like those used in Compared to traditional methods. The efficacy of chatbot-based learning was evaluated using an ANOVA [19]. Fourth, despite the fact that chatbots have been integrated into education in a variety of settings, their quantitative effects on learning outcomes and motivation in Indonesian classrooms are still understudied, leaving This study aims to fill a gap [20].

Learning motivation is defined as internal and external drives that motivate students to engage in learning activities consistently in order to achieve learning objectives [3]. Meanwhile, learning outcomes are the cognitive abilities acquired by students after participating in the learning process and are measured through academic tests [16]. Chatbot-based learning media does not directly affect motivation, but it can contribute indirectly through increased clarity of material, interactivity, and ease of learning [1][17]. This statistical technique allows for a

systematic comparison between students using Quibot and those taught through conventional methods [16]. The findings from this study are expected to contribute to the advancement of technology-based education and serve as a reference for developing future digital learning media.

METHOD

This study employed a quantitative research approach with a quasi-experimental design. Previous research shows that the use of interactive digital learning media can improve students' understanding of concepts and learning outcomes [21]. Chatbot technology has been proven to improve learning interactions by providing automatic feedback [22].

2.1 Population & Sample

The population comprised all eighth-grade students at Yayasan Perguruan Sultan Iskandar Muda who were enrolled in the Mathematics subject during the even semester of the 2024/2025 academic year.

The sample was selected using a purposive sampling technique based on specific criteria relevant to the research objectives:

1. Students from classes VIII-A and VIII-B who were actively enrolled in Yayasan Perguruan Sultan Iskandar Muda.
2. Students with a minimum attendance rate of 80%.
3. Students who had received the learning media designed according to the experimental grouping.

A total of 60 students participated, divided equally into two groups:

1. Experimental Group (VIII-A): Received instruction using the Quibot learning media.
2. Control Group (VIII-B): Received instruction using conventional teaching methods without Quibot.

2.2 Research Instruments

Three instruments were used in this study:

1. Learning Achievement Test

The test consists of 20 questions with four answer options, where each correct answer is given a score of 1 and each incorrect answer is given a score of 0. The test instrument was developed by the researcher together with Mathematics teachers and has undergone a validation process by expert lecturers to ensure the suitability of the material, level of difficulty, and clarity of language.

2. Learning Motivation Questionnaire

The questionnaire was adapted from a previously validated instrument based on learning motivation theory. It consisted of 25 items rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The learning motivation questionnaire in this study covers two main dimensions, namely intrinsic motivation and extrinsic motivation. Intrinsic motivation includes internal drives such as interest in learning, curiosity, and satisfaction in understanding the material. This division refers to the learning motivation theory, which states that student motivation is formed from the interaction of internal and external factors [3][12].

3. Observation Sheet for Media Implementation

This checklist ensured that the teacher consistently implemented the learning media during the lessons.

2.3 Research Stages

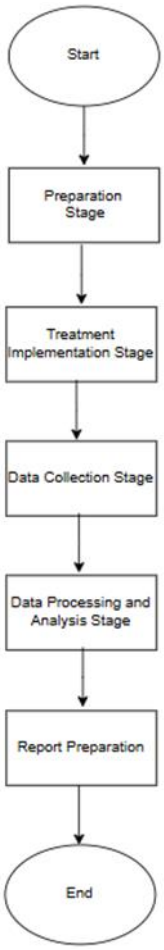

Figure 1. Flowchart Diagram
"Source: Author"

The research procedure was carried out in several sequential stages.

2.3.1 Preparation Stage

At this stage, the researcher began by compiling the research proposal and obtaining official research permits from the school authorities. After securing approval, students were assigned to experimental and control groups according to their existing class groupings.

2.3.2 Treatment Implementation Stage

During this stage, lessons were delivered according to the predetermined instructional approach for each group. The experimental group received instruction using Quibot, while the control group followed conventional teaching methods.

2.3.3 Data Collection Stage

After the treatment phase was completed, the researcher administered the learning motivation questionnaire to all participants in both groups. This was followed by the administration of the learning achievement test to measure the students' academic performance based on the targeted learning outcomes.

2.3.4 Data Processing and Analysis Stage

The main analysis employed was Analysis of Variance (ANOVA) to determine whether there were significant differences between the experimental and control groups in terms of both motivation and achievement.

2.3.5 Reporting Stage

The final stage involved compiling the research findings into a comprehensive report. Conclusions were drawn based on the statistical analysis results and the implications.

2.3.6 Data Analysis Technique

The collected data were analyzed using one-way Analysis of Variance (ANOVA) to determine whether there were significant differences in students' motivation and learning achievement between the experimental and control groups. The steps included:

1. Normality Test – The Kolmogorov–Smirnov or Shapiro–Wilk test was used to assess whether the data were normally distributed.
   a) Shapiro–Wilk

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_{(i)}\right)^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \quad (1)$$

   b) Kolmogorov–Smirnov

$$D = \sup \mid F_n(x) - F_0(x) \mid \quad (2)$$

   c) Homogeneity Test – Levene's Test was applied to verify whether variances across groups were homogeneous.

$$W = \frac{(N-k)}{(k-1)} \cdot \frac{\sum_{i=1}^{k} n_i \left(\bar{Z}_{i\cdot} - \bar{Z}_{\cdot\cdot}\right)^2}{\sum_{i=1}^{k} \sum_{j=1}^{n_i} (Z_{ij} - \bar{Z}_{i\cdot})^2} \quad (3)$$

$$Z_{ij} = \mid X_{ij} - \bar{X}_i \mid \quad (4)$$

- One-Way ANOVA – This test compared the mean scores of the two groups for learning motivation and learning achievement.

$$F = \frac{MS_{between}}{MS_{within}} \quad (5)$$

RESULTS AND DISCUSSION

3.1 Descriptive Statistics

3.1.1 Learning Outcomes

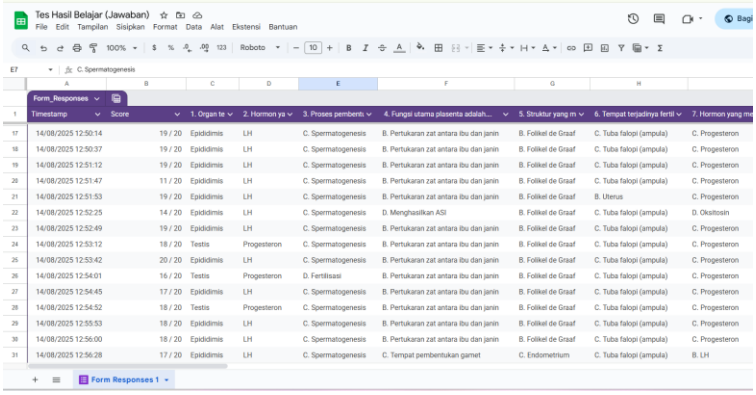

Figure 2. Learning Outcome of VIII-A (quibot) Dataset
"Source: Author"

The image shows a portion of data from the file "Learning Outcome Test (Answers) – Form Responses 1.csv", which summarizes student responses to a learning outcome test administered via Google Forms, including submission time, total scores (e.g., 20/20), and answers to multiple-choice questions on the reproductive system. Most scores range from 17

to 19 out of 20, indicating relatively high learning outcomes, and the data provide an initial overview of score distribution and response patterns that are further analyzed statistically in the research results section.

Table 1. Learning Outcomes of VIII-B (Convensional) Dataset

No.	Kelas	Skor Benar
1.	VIII-B	17/20
2.	VIII-B	16/20
3.	VIII-B	18/20
4.	VIII-B	15/20
5.	VIII-B	19/20
6.	VIII-B	14/20
7.	VIII-B	18/20
8.	VIII-B	16/20
9.	VIII-B	15/20
10.	VIII-B	17/20
11.	VIII-B	16/20
12.	VIII-B	18/20
13.	VIII-B	14/20
14.	VIII-B	19/20
15.	VIII-B	17/20
16.	VIII-B	15/20
17.	VIII-B	18/20
18.	VIII-B	16/20
19.	VIII-B	17/20
20.	VIII-B	15/20
21.	VIII-B	19/20
22.	VIII-B	14/20
23.	VIII-B	18/20
24.	VIII-B	16/20
25.	VIII-B	17/20
26.	VIII-B	15/20
27.	VIII-B	18/20
28.	VIII-B	16/20
29.	VIII-B	14/20
30.	VIII-B	19/20
Rata-rata		**16.6/20 (83%)**

The table presents the test results of eighth-grade students in class VIII-B who followed conventional learning, showing student numbers, class, and scores out of 20 questions. The scores ranged from 14 to 19, with most students scoring between 16 and 18, resulting in an average score of 16.6 (83%), which indicates that student learning outcomes in conventional learning fall into the high category.

The descriptive analysis revealed that the experimental group (Class VIII-A), which received instruction using Quibot, achieved a mean test score of 17.53 with a standard deviation (SD) of 1.94 (n = 30). This score is equivalent to 87.7% of the maximum attainable score. In contrast, the control group (Class VIII-B), which received instruction using conventional methods, achieved a mean score of 16.53 with an SD of 1.63 (n = 30), equivalent

to 82.7% of the maximum score.

3.1.2 Learning Motivation

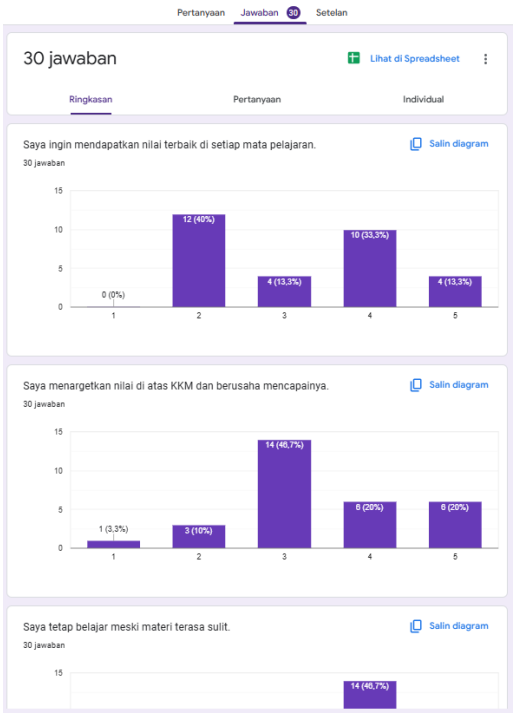

Figure 3. Learning Motivation Dataset

"Source: Author"

The image above shows that student learning motivation is measured using a learning motivation questionnaire adapted from a validated instrument based on learning motivation theory. This questionnaire consists of 25 statements, which are designed to measure several aspects of learning motivation, including:

1. Drive to achieve
2. Perseverance in learning
3. Interest and engagement in learning
4. Responsibility for tasks
5. Resilience in facing learning difficulties

Each item is assessed using a 5-point Likert scale, namely:

1. 1 = Strongly Disagree
2. 2 = Disagree
3. 3 = Neutral
4. 4 = Agree
5. 5 = Strongly Agree

The total learning motivation score is obtained by adding up all item scores, so that the score range is between 25 and 125. The mean motivation score for the experimental group was 175.73 (SD = 18.55), while the control group scored slightly higher at 176.93 (SD = 35.76). Although the averages were similar, the control group exhibited a wider range of scores, indicating greater variability in motivation levels compared to the experimental group.

```
Statistik Deskriptif Hasil Belajar:
           count       mean       std  min  max
kelompok
VIII-A        30  17.533333  1.942862   11   20
VIII-B        30  16.533333  1.634400   14   19

Statistik Deskriptif Motivasi:
           count       mean        std  min  max
kelompok
VIII-A        30  87.866667   9.276345   76  111
VIII-B        30  88.466667  17.880317   40  113
```

Figure 4. Descriptive Statistics of Learning Achievement Tests and Student Learning Motivation

"Source: Author"

Figure 4 shows that class VIII-A achieved a higher average test score (17.53 ± 1.94) than class VIII-B (16.53 ± 1.63), with score ranges of 11–20 and 14–19, respectively. For learning motivation, the average scores were relatively similar between class VIII-A (87.87 ± 9.28) and class VIII-B (88.47 ± 17.88); however, class VIII-B exhibited a wider score range (40–113) compared to class VIII-A (76–111), indicating greater variability in learning motivation among students in class VIII-B.

3.2 Assumption Testing

3.2.1 Normality Test

Shapiro–Wilk tests showed that both learning achievement and motivation data for each group did not follow a normal distribution ($p < 0.05$), and given the relatively large sample size per group ($n = 30$) and the robustness of ANOVA under the Central Limit Theorem, the analysis proceeded.

```
=== Uji Normalitas Hasil Belajar ===
VIII-A: W=0.878, p=0.00254
VIII-B: W=0.923, p=0.03285
```

Figure 5. Normality Test of Learning Outcomes

"Source: Author"

Figure 5 shows that the results of the normality test using the Shapiro–Wilk method on the learning outcome variable indicate a p-value of 0.00254 for class VIII-A and 0.03285 for class VIII-B. Since both p-values are less than 0.05, it can be concluded that the learning outcome data for both classes are not statistically normally distributed.

```
=== Uji Normalitas Motivasi ===
VIII-A: W=0.795, p=0.00005
VIII-B: W=0.861, p=0.00106
```

Figure 6. Normality Test of Learning Motivation

"Source: Author"

Figure 6 shows that the results of the normality test using the Shapiro–Wilk method on the learning motivation variable indicate a p-value of 0.00005 for class VIII-A and 0.00106 for class VIII-B. Both p-values are less than 0.05, so it can be concluded that the learning motivation data in both classes are not statistically normally distributed.

3.2.2 Homogeneity Test

Levene's Test indicated that learning achievement variances were homogeneous (p = 1.000), while motivation variances were not (p = 0.002).

```
Levene Hasil Belajar: stat=0.000, p=1.000
Levene Motivasi Belajar: stat=10.252, p=0.002
```

Figure 7. Homogeneity Test
"Source: Author"

Based on Levene's Test, the learning outcomes variable showed a p-value of 1.000 (p ≥ 0.05), indicating homogeneous variances between groups and fulfilling the assumption for ANOVA analysis. In contrast, the learning motivation variable had a p-value of 0.002 (p < 0.05), indicating that the variances between groups were not homogeneous.

3.2.3 One-Way ANOVA

1. Learning Outcomes

```
ANOVA Hasil Belajar: F=4.654, p=0.035
Eta-squared: 0.07428
```

Figure 8. Result of One-Way ANOVA of Learning Outcomes
"Source: Author"

The one-way ANOVA test showed a significant difference in learning outcomes between group VIII-A (Quibot) and VIII-B (conventional), F (1,58) = 4.65, p = 0.035. The effect size calculated using eta-squared (η2) is 0.074, which falls into the moderate category. These findings suggest that the use of Quibot technology-based learning media has the potential to provide a significant improvement in student learning outcomes compared to conventional learning methods.

2. Learning Motivation

```
Welch's t-test Motivasi: t=-0.163, p=0.871
Eta-squared: 0.00046
```

Figure 9. Result of One-Way ANOVA of Learning Motivation
"Source: Author"

Since Levene's test showed that the variances were not homogeneous (p = 0.002), the analysis of the difference in learning motivation between VIII-A (Quibot) and VIII-B (conventional) was performed using Welch's t-test. The results showed no significant difference between the two groups, t(df≈43.6) = −0.16, p = 0.871. The effect size (Hedges' g, unequal variances) ≈ is −0.04, which is very small/negligible, with a 95% CI for the mean difference [−16.03; 13.63] points. This indicates that the average learning motivation is relatively equivalent between the class using Quibot (175.73 ± 18.55) and the conventional class (176.93 ± 35.76).

Table 2. Comparison of Learning Outcomes and Learning Motivation

Variabel	Kelas VIII-A (Mean ± SD)	Kelas VIII-B (Mean ± SD)	F (df1, df2)	p-value	η^2	Keterangan
Hasil Belajar	17,53 ± 1,94	16,53 ± 1,63	4,65 (1, 58)	0,035	0,074	Signifikan (efek sedang)

Motivasi Belajar	175,73 ± 18,55	176,93 ± 35,76	0,027 (1, 58)	0,871	0,00046	Tidak signifikan

The average learning outcomes of students in class VIII-A who used Quibot (17.53 ± 1.94) were higher than those in class VIII-B who used conventional methods (16.53 ± 1.63), and the ANOVA test results showed a significant difference ($F(1,58) = 4.65$; $p = 0.035$) with a moderate effect size ($\eta^2 = 0.074$), proving that the use of Quibot contributes positively to improving student learning outcomes. However, the average learning motivation scores between class VIII-A (175.73 ± 18.55) and VIII-B (176.93 ± 35.76) did not show a significant difference ($F(1,58) = 0.027$; $p = 0.871$) with a very small effect size ($\eta^2 = 0.00046$), so it can be concluded that Quibot affects learning outcomes but does not provide a significant difference in student learning motivation.

3.3 Hypothesis Test Results

Based on a comparative analysis between group VIII-A (Quibot) and VIII-B (conventional) on two research variables—learning outcomes and learning motivation—the following summary was obtained.

1. Hypothesis 1 (H1): The use of Quibot improves learning outcomes compared to conventional learning.
2. Hypothesis 2 (H2): The use of Quibot increases learning motivation compared to conventional learning.

The ANOVA test shows a significant difference in learning outcomes, $F(1,58)=4.65$, $F(1,58)=4.65$, $p=0.035$, $p=0.035$.

The Quibot group achieved a higher average score (17.53 ± 1.94) than the conventional group (16.53 ± 1.63), with an improvement of about 1 point (≈ 5% of the maximum score) and a moderate effect size ($\eta^2 = 0.074$), indicating a practically meaningful impact of Quibot on learning outcomes and leading to the acceptance of H1. However, no significant difference was found in learning motivation between the Quibot group (175.73 ± 18.55) and the conventional group (176.93 ± 35.76) ($F(1,58) = 0.027$; $p = 0.871$), with a negligible effect size ($\eta^2 = 0.00046$), indicating that Quibot did not enhance learning motivation; therefore, H2 is rejected.

3.4 Comparison Results

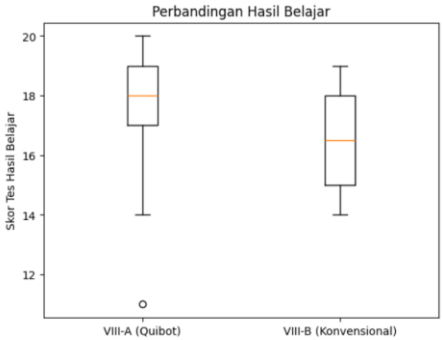

Figure 10. Learning Outcomes Comparison: VIII-A (Quibot) vs. VIII-B (Conventional)
"Source: Author"

The figure above illustrates that class VIII-A, which uses Quibot technology-based learning media, has a higher median test score than class VIII-B, indicating better learning outcomes.

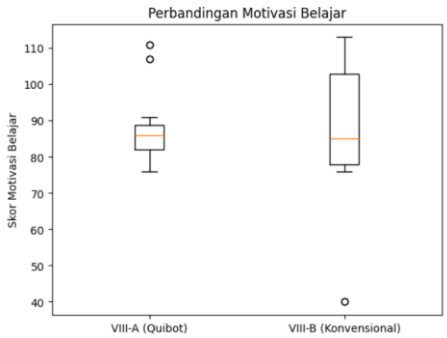

Figure 11. Learning Motivation Comparison: VIII-A (Quibot) vs. VIII-B (Conventional)
"Source: Author"

The boxplot shows that the median learning motivation scores of classes VIII-A and VIII-B are relatively similar, indicating comparable average motivation levels. However, class VIII-B has a much wider score range, reflecting greater variation in learning motivation. Outliers appear in both classes, with very high scores above 110 in class VIII-A and very low scores around 40 in class VIII-B, indicating students with extreme motivation levels. The findings confirm that Quibot positively impacted students' academic performance, aligning with previous studies demonstrating that technology-based interactive media can facilitate better understanding of learning materials [5], [15].

CONCLUSIONS AND SUGGESTIONS

The results of this study demonstrate that the use of Quibot as a technology-based learning medium had a significant effect on students' academic achievement but no significant impact on their learning motivation. The one-way ANOVA results showed a statistically significant difference in achievement scores between the experimental group (VIII-A) and the control group (VIII-B), $F(1, 58) = 4.65$, $p = 0.035$, with a moderate effect size ($\eta^2 = 0.074$). The experimental group achieved an average score of 17.53 ± 1.94, which was approximately one point higher than the control group's average of 16.53 ± 1.63, representing an improvement of about 5% of the maximum possible score. In contrast, no significant difference was found in learning motivation between the two groups. Welch's t-test yielded $p = 0.871$, with a negligible effect size ($\eta^2 \approx 0.00046$), indicating that the motivation levels of the experimental group (175.73 ± 18.55) and the control group (176.93 ± 35.76) were statistically equivalent.

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