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Research Article

The Effect of Zep Quiz-Assisted Physics Learning on Students' Learning Motivation and Learning Outcomes in the Topic of Energy Sources in Grade X of Madrasah Aliyah

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ABSTRACT

Students' learning motivation and cognitive learning outcomes in physics, particularly on the topic of energy sources, remain suboptimal. One contributing factor is the tendency for assessment activities to be monotonous and to provide no immediate feedback to students. This study aimed to determine the effect of Zep Quiz-assisted physics instruction on the learning motivation and cognitive learning outcomes of Grade X students studying energy sources. A quasi-experimental method with a nonequivalent pretest-posttest control group design was employed. The sample comprised one experimental class receiving Zep Quiz-assisted instruction and one control class receiving conventional instruction. Data were collected using a cognitive learning-outcomes test and a learning-motivation questionnaire and were analyzed through Multivariate Analysis of Covariance (MANCOVA), with pretest scores as covariates, after all analytical assumptions had been satisfied. The results showed that Zep Quiz-assisted instruction had a significant simultaneous effect on students' learning motivation and learning outcomes, with Wilks' Lambda = 0.157 and $p < 0.001$. The experimental group achieved a mean learning-outcomes posttest score of 86.88, exceeding the control group's score of 66.25. The experimental group also recorded a higher mean learning-motivation score (29.16) than the control group (22.54). Optimizing the gamification features in Zep Quiz stimulated students' emotional engagement, creating a dynamic and enjoyable classroom atmosphere and encouraging active participation throughout instruction. Therefore, Zep Quiz can serve as a gamified digital assessment tool to support improvements in motivation and physics learning outcomes on the topic of energy sources.

Keywords: Gamification; Cognitive learning outcomes; MANCOVA; Learning motivation; Energy sources; Zep Quiz

1. INTRODUCTION

Education plays an essential role in developing high-quality human resources capable of responding to advances in science and technology (Wibowo, 2024).Physics is one of the subjects that contributes to achieving this goal. As a branch of the natural sciences, physics helps students understand natural phenomena in their surroundings and explain their connections with technology (Busyairi et al., 2021; Riska et al., 2025). Therefore, physics instruction should not focus merely on memorizing theories or mathematical formulas; it should also develop students' scientific reasoning skills for solving real-world problems encountered in everyday life (Hidayatulloh, 2020; Nisa et al., 2024; Zahara et al., 2025). In practice, however, physics is often perceived as difficult because its content is abstract and involves complex mathematical problem-solving (Darwata et al., 2025). This perception directly contributes to declining student motivation in the classroom. Difficulty understanding the material tends to make students less enthusiastic and more passive during instruction, more likely to give up when faced with complex exercises, and less confident about actively expressing their views (Tombuku & Melati, 2025).

This decline in motivation is particularly evident in the topic of Energy Sources, one of the important topics in the Grade X Madrasah Aliyah physics curriculum. The topic requires a progressive understanding of energy-source diversification, energy-conversion mechanisms, and their practical applications in supporting daily human life. Interviews with a physics teacher at MAN Kota Lhokseumawe during the second semester of the 2025/2026 academic year indicated that students continued to experience considerable difficulty understanding Energy Sources. Documented cognitive learning outcomes at levels C1-C4 from eight Grade X classes reinforced this finding. Although the Learning Objective Achievement Criteria (Kriteria Ketercapaian Tujuan Pembelajaran [KKTP]) were set at 75, the mean score in each class ranged only from 44.5 to 56.1. Furthermore, only 23% of students achieved mastery, whereas the remaining 77% did not meet the minimum KKTP threshold, underscoring the low percentage of students who attained mastery.

These low cognitive learning outcomes are closely associated with students' suboptimal learning motivation at school. Theoretically, learning motivation functions as an internal force that drives students to engage fully and persistently in achieving the desired understanding (Rahmaniar & Latip, 2021). The relationship between motivation and learning outcomes is inseparable: when students have low motivation, they tend to participate less in the learning process, practice less independently, and fail to promptly correct misunderstandings. Consequently, their mastery of physics concepts remains weak and their learning outcomes are suboptimal (Anugrah, 2023; Utami et al., 2024; Vidy et al., 2025). In addition to the abstract nature of the subject matter, a major cause of this problem is the form of assessment that has been used. Learning assessment remains dominated by conventional, repeatedly administered written tests. This monotonous assessment model prevents immediate feedback on students' conceptual errors, provides a less engaging learning experience, and contributes to boredom (Rustiyana, 2025). Interviews with Grade X students confirmed that repeated written tests were perceived as uninteresting and tended to reduce their enthusiasm when answering questions. Questionnaire data further showed that 53.7% of students reported always feeling bored when physics lessons concluded with written-test assessments. By contrast, 74.1% of students reported greater interest in digital assessment than in conventional written tests.

As an alternative for creating a more interactive assessment process, integrating gamification-based digital media offers a logical solution. One relevant innovative tool is Zep Quiz, an online quiz platform that provides multiple-choice questions, automated scoring, and engaging visual displays (Widyaningrum et al., 2025). The questionnaire results also showed that most students had never used Zep Quiz, with 79.6% reporting no prior experience with the platform. This finding indicates the need for more varied and interactive learning and assessment activities to promote student engagement and learning motivation. Zep Quiz has been reported to positively influence assessment activities because its instant-feedback feature enables students to identify conceptual errors immediately and correct them promptly. In addition, score accumulation and leaderboard features psychologically encourage students to engage in healthy competition; interactive challenges can increase active involvement; and the game-based interface can reduce tension or anxiety during assessment (Ariani, 2020; Kuron et al., 2025; Mursalin et al., 2025)Previous studies have also confirmed that using Zep Quiz can improve students' enthusiasm, participation, and cognitive achievement (Kulsum et al., 2024; Arnudia & Wita, 2025). Nevertheless, research examining the simultaneous effects of Zep Quiz on learning motivation and physics learning outcomes in the topic of Energy Sources remains limited. Accordingly, this study analyzed the effect of Zep Quiz-assisted physics instruction on the motivation and learning outcomes of Grade X Madrasah Aliyah students studying Energy Sources at MAN Kota Lhokseumawe.

2. RESEARCH METHOD

This study employed a quasi-experimental method. This method was selected because it enables analysis of the effect of a treatment on dependent variables without imposing strict controls on factors outside the treatment (Saputri & Mardiati, 2025). The study used a nonequivalent pretest-posttest control group design, in which participants were assigned to an experimental class and a control class. The structure of the assessment and treatment design is presented in detail in **Table 1**.

Table 1. Nonequivalent pretest-posttest control group design

Group	Pretest	Treatment	Posttest
Experimental	O_1	X	O_2
Control	O_1	-	O_2

Source: (Sugiyono, 2023)

The study was conducted at MAN Kota Lhokseumawe during the second semester of the 2025/2026 academic year. Purposive sampling was used on the basis that the selected classes had relatively equivalent academic ability. One class was selected as the experimental group and used Zep Quiz-assisted learning media for assessment, whereas another class served as the control group and used written tests for assessment. The data collected in this study covered indicators of learning motivation and learning outcomes in the topic of energy sources. Students' learning motivation was measured using a questionnaire addressing persistence, personal interest, effort, and self-confidence when participating in classroom activities (Sudibyo et al., 2017). Learning outcomes were measured using a cognitive test specifically designed to assess students' abilities in remembering, understanding, applying theory, and analyzing, based on the cognitive levels of the revised Bloom's taxonomy (Nafiati, 2021). Data collection was conducted simultaneously in both groups through a pretest administered at the beginning and a posttest administered at the end. The resulting data were processed using descriptive statistics to describe the data and inferential statistics to test the hypotheses.

Before the hypotheses were tested using MANCOVA, the data were required to satisfy the statistical assumptions of multivariate normality, equality of variances (homogeneity), linearity, and homogeneity of covariance matrices (Kadhim & Naji, 2022). Multivariate normality was assessed using Mahalanobis distance (d^2), with the criterion that approximately 50% or more of the values being less than or equal to the theoretical chi-square value indicated a multivariate normal

distribution (Rahmadina et al., 2022). Homogeneity of variance was tested using Levene's test, with the data considered homogeneous when the significance value exceeded 0.05 (Hayati et al., 2022). The relationship between variables was examined through a linearity test using the Deviation from Linearity output, with linearity indicated by a significance value greater than 0.05 (Nasar et al., 2024).The equality of covariance matrices was subsequently tested using Box's M test; the homoscedasticity assumption was considered satisfied when the significance value exceeded 0.05 (Sutrisno, & Wulandari, 2018). After all assumptions had been satisfied, the hypotheses were tested using Multivariate Analysis of Covariance (MANCOVA) in IBM SPSS Statistics version 27 at a significance level of 0.05 to determine the effect of Zep Quiz-assisted physics instruction on students' motivation and learning outcomes (Agustian et al., 2021).

3. RESULTS AND DISCUSSION

3.1 Description of the Research Data

The data in this study comprised students' cognitive learning outcomes and learning motivation in both the experimental and control classes. Learning outcomes were assessed using cognitive tests administered during the pretest and posttest sessions. Motivation data were obtained through a questionnaire administered after the entire treatment sequence had been completed. A summary of the descriptive statistics for both variables is presented in **Table 2.**

Table 2. Descriptive statistics of students' learning outcomes and learning motivation

Variable	Group	Pretest mean	Posttest mean
Learning outcomes	Experimental	44.84	86.88
Learning outcomes	Control	41.67	66.25
Learning motivation	Experimental	20.09	29.16
Learning motivation	Control	20.08	22.54

The data presented in **Table 2** show an increase in the learning outcomes of the experimental group, from an initial pretest mean of 44.84 to a posttest mean of 86.88. The control group also showed an increase in its mean score, from 41.67 to 66.25. The higher posttest score in the experimental group indicates that using Zep Quiz in physics instruction produced more optimal results in facilitating students' understanding of energy sources than conventional instruction. In addition to the cognitive variable, the mean learning-motivation score in the experimental group increased from 20.09 to 29.16. In the control group, the mean learning-motivation score increased from 20.08 to 22.54. These empirical findings indicate that Zep Quiz had a simultaneous positive effect by improving cognitive learning outcomes and fostering students' motivation and enthusiasm throughout the learning process.

3.2 Assumption Testing

3.2.1 Multivariate Normality Test

Multivariate normality was examined to ensure that the research data satisfied the assumption of a multivariate normal distribution as a prerequisite for MANCOVA. The results of the multivariate normality test are presented in **Table 3.**

Table 3. Results of the multivariate normality test

Variables tested	Correlation coefficient	Significance (Sig.)	Interpretation
Learning-outcomes posttest and learning-motivation posttest	0.985	<0.001	Multivariate normal Distribution

Based on the results presented in **Table 3**, the correlation coefficient was 0.985, with $p < 0.001$. A correlation coefficient approaching 1 indicates a very strong linear relationship between Mahalanobis distance (D^2) and the theoretical chi-square values (χ^2). These results indicate that the research data satisfied the assumption of multivariate normality and could therefore be analyzed further using MANCOVA.

3.2.2 Homogeneity of Variance Test

The homogeneity of the data variances was analyzed using Levene's test before proceeding to MANCOVA. The output of the homogeneity-of-variance test is summarized in **Table 4.**

Table 4. Results of the homogeneity of variance test

Variable	Significance (Sig.)	Interpretation
Learning outcomes	0.514	Homogeneous
Learning motivation	0.495	Homogeneous

As shown in **Table 4,** the significance values were 0.514 for learning outcomes and 0.495 for learning motivation. Because both values exceeded 0.05 ($p > 0.05$), the variances of the two classes were considered homogeneous. This confirms that the relevant MANCOVA assumption was satisfied.

3.2.3 Linearity Test

The linearity test was conducted to verify a linear relationship between the learning-outcomes posttest and learning-motivation posttest variables before proceeding to MANCOVA modeling. The results are summarized in Table 5.

Table 5. Results of the linearity test

Relationship between variables	Significance (Sig.)	Interpretation
Learning outcomes posttest x motivation posttest	0.541	Linear

The statistical results in **Table 5** show that the significance value in the Deviation from Linearity row was 0.541. This value was greater than the standard criterion of 0.05 ($0.541 > 0.05$), demonstrating a linear relationship between students' learning outcomes and motivation after instruction. Thus, the linearity assumption was satisfied and the data were suitable for MANCOVA modeling.

3.2.4 Homogeneity of Covariance Matrices Test

The homogeneity of the variance-covariance matrices across the sample classes was analyzed using Box's M test. The results are presented in Table 6.

Table 6. Results of the homogeneity of covariance matrices test

Test aspects	Value
F	0.577
Sig.	0.630
Interpretation	Homogeneous

As shown in Table 6, the significance value was 0.630. This value exceeded the specified significance criterion ($0.630 > 0.05$), indicating that the variance-covariance matrices across the sample classes were homogeneous. Therefore, all parametric assumptions required for MANCOVA were satisfied.

3.3 Hypothesis Test

The hypotheses were tested using Multivariate Analysis of Covariance (MANCOVA). This analysis examined the simultaneous effect of implementing Zep Quiz on students' learning outcomes and learning motivation while controlling for their initial ability (pretest). The multivariate analysis results are presented in **Table 7**.

Tabel 7. The multivariate analysis

Statistical component	Value
Indicator	Wilks' Lambda
Value	0.157
F	136.461
Sig.	<0.001

The statistical summary in **Table 7** yielded Wilks' Lambda = 0.157, F = 136.461, and a significance level below 0.001. Because the significance value was far below the alpha level of 0.05 ($p < 0.001$), the findings empirically confirm that Zep Quiz-assisted physics instruction had a highly significant positive simultaneous effect on students' learning outcomes and learning motivation. On this basis, the research hypothesis was convincingly accepted.

3.3 Discussion

This study demonstrates that integrating Zep Quiz into physics instruction on Energy Sources makes a significant positive contribution to students' learning motivation and cognitive learning outcomes. MANCOVA yielded Wilks' Lambda = 0.157, with $p < 0.001$. These results confirm that Zep Quiz simultaneously promoted students' learning motivation and academic achievement even after the effect of their initial ability (pretest) had been statistically controlled.

When learning motivation was examined separately, the experimental group achieved a mean final score of 29.16, higher than the control group's mean of 22.54. This increase in motivation resulted from the interactive and dynamic classroom atmosphere. Gamification elements in Zep Quiz, including an automated leaderboard, interactive scoring, engaging avatars, and time-limited challenges, successfully fostered healthy competition. Students in the experimental group responded actively to each question, enthusiastically competed for the highest leaderboard positions, and maintained their attention throughout the lesson. This finding is consistent with Kulsum et al., (2024), who reported that Zep Quiz effectively optimizes students' participation, attention, and active engagement. In contrast, the lower motivation in the control group was associated with conventional paper-based assessment. Completing written tests independently through a one-way process tended to be monotonous and did not sufficiently stimulate students' emotional engagement, making the assessment activities seem rigid and tedious. Interactive instruments of this kind have been recognized theoretically and empirically as capable of capturing students' emotional attention while increasing active classroom participation (Ananda et al., 2023; Masruroh et al., 2025; Muslimin, 2025).This is also consistent with earlier researchers' view that digital game-based assessment media can gradually strengthen students' motivation to an optimal level (Adinda et al., 2025; Widyaningrum et al., 2025). The finding further aligns with Mursalin et al., (2025), who showed that applying gamification elements in assessment can enhance students' motivation and active engagement.

The psychological improvement represented by increased learning motivation became a key factor that directly strengthened students' cognitive learning outcomes. Supporting literature indicates that highly motivated students tend to demonstrate greater persistence, focus, and responsiveness when facing academic challenges (Indriansyah & Amin, 2025). Because students in the experimental group were actively engaged from the beginning of the quiz, they were better able to absorb and construct conceptual understanding of the analytically demanding Energy Sources material. In addition, the real-time feedback provided by Zep Quiz immediately presented brief explanations when students made mistakes. This immediate-feedback mechanism effectively helped students promptly recognize and correct misconceptions without waiting for delayed feedback (Nainggolan et al., 2025). The causal relationship is clearly reflected in the mean cognitive achievement scores: the experimental group attained a posttest score of 86.88, whereas the control group scored 66.25. This substantial score gap demonstrates that Zep Quiz-assisted assessment was considerably more effective than conventional paper-based testing in facilitating students' conceptual understanding. The lower cognitive achievement of the control group resulted from the limitations of written tests, which did not provide immediate answer confirmation. Consequently, misconceptions about Energy Sources that arose while students completed the written test could not be corrected at that time and persisted through the final assessment. This finding is consistent with previous reports indicating that classes implementing the interactive Zep Quiz assessment system achieved significantly greater academic gains than conventional classes (Arnudia & Wita, 2025; Mulyawan et al., 2025). Overall, integrating gamification-based platforms such as Zep Quiz not only makes the assessment atmosphere more interactive but also offers strong potential as an adaptive alternative assessment instrument for sustainably supporting the attainment of physics competencies.

4. CONCLUSION

Based on the data analysis and discussion, integrating Zep Quiz into physics instruction on Energy Sources made a positive and significant simultaneous contribution to the learning motivation and cognitive learning outcomes of Grade X students at MAN Kota Lhokseumawe. The MANCOVA results yielded Wilks' Lambda = 0.157 ($F = 136.461$; $p < 0.001$). This statistic strongly confirms that Zep Quiz significantly and simultaneously improved both dependent variables even after the effect of students' initial ability (pretest) had been statistically controlled. The advantage of the treatment is clearly reflected in the descriptive achievements of the two groups. The experimental group recorded mean scores of 86.88 for cognitive learning outcomes and 29.16 for learning motivation, substantially exceeding the control group's corresponding scores of 66.25 and 22.54. This achievement gap demonstrates that using Zep Quiz as a gamification-based assessment instrument successfully fostered a competitive and interactive learning climate through its leaderboard and real-time-feedback features. In contrast, conventional paper-based assessment in the control group was less effective because it tended to be rigid and monotonous and provided delayed correction of students' misconceptions.

This study makes an important contribution to the scientific community, particularly in digital pedagogy and physics education, by providing empirical evidence that gamification-based assessment can transform passive assessment into an adaptive medium for reinforcing concepts. The implementation of Zep Quiz also has concrete economic implications, including greater efficiency in school operating budgets through reduced paper consumption via paperless assessment, as well as time and cost efficiency in automatically scoring and analyzing learning-outcome data. These implications

underscore the strong potential of Zep Quiz as an adaptive interactive assessment alternative for physics educators seeking to address students' boredom with conventional written-test systems. Nevertheless, this study was limited to one physics topic and one level of schooling. Future researchers are therefore advised to expand the implementation of Zep Quiz to other analytically demanding physics topics and examine its effects on Higher Order Thinking Skills (HOTS), including critical-thinking and problem-solving skills.

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