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The Relationship between Learning Motivation and Biology Learning Outcomes of Grade XI Science Students at SMA Hidayatun Najah Proppo, Pamekasan

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Abstract: This study aimed to analyze the relationship between learning motivation and biology learning outcomes among Grade XI science students at SMA Hidayatun Najah Proppo, Pamekasan, within the implementation of a guided inquiry learning approach. The study employed a quantitative correlational design and involved 19 students from Class XI IPA 1 as the sample. Learning motivation was measured using an ARCS model (Attention, Relevance, Confidence, Satisfaction) questionnaire, while learning outcomes were assessed using an essay test on the coordination system topic. Data were analyzed using simple linear regression assisted by Jamovi software. The results showed that learning motivation was not significantly associated with biology learning outcomes ($R = 0.0373$; $R^2 = 0.00139$; $F(1,17) = 0.0237$; $p = 0.880$), explaining only 0.139% of the variance. These findings indicate that, in the context of a pesantren-based school with limited face-to-face instructional time and students' dense activity schedules, learning outcomes are likely influenced more strongly by factors other than the motivation measured in this study. Accordingly, improving biology learning outcomes requires interventions that not only strengthen motivation but also optimize the learning environment, coordinate school–pesantren schedules, and enhance the quality of guided inquiry implementation so that students' motivation can be effectively converted into optimal academic achievement.

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Introduction

Education in Indonesia is positioned as a strategic instrument to enhance the quality of human resources and national competitiveness. Law of the Republic of Indonesia Number 20 of 2003 emphasizes the function of national education to develop learners' capacities, shape character, and build a dignified civilization, to produce individuals who are faithful, possess noble character, are knowledgeable, competent, creative, independent, and responsible. In line with this mandate, upper secondary education is expected not only to foster cognitive achievement but also to cultivate character and 21st-century skills that support students' life-readiness (Mantiri, 2019). However, various studies indicate that students' learning outcomes in science subjects, including biology, remain suboptimal (Emda, 2017; Utami et al., 2022). At SMA Hidayatun Najah Proppo, Pamekasan, preliminary observations conducted on 18 December 2021 in a Grade XI science class suggested low student engagement in biology learning: students paid limited attention to teachers' explanations, were passive during discussions and questioning, rarely used learning resources, and tended to study only shortly before tests. This phenomenon suggests weaknesses in internal factors—particularly learning motivation—although external factors such as the school environment and facilities may also contribute (Damopolii et al., 2018). Within learning theory, learning motivation is regarded as a

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key determinant that mediates the influence of various internal and external factors on learning outcomes (Hamdu & Agustina, 2011), and is often emphasized as an essential prerequisite for optimizing students' broader learning achievement (Fernando et al., 2024).

Learning motivation is defined as a set of processes that energize, direct, and sustain learners' study behavior toward the attainment of specific goals (Schunk et al., 2014). Self-determination theory highlights that when the needs for autonomy, competence, and social relatedness are met, the quality of intrinsic and extrinsic motivation improves and positively affects academic performance (Uno, 2023). Empirical studies in Indonesia have also consistently reported positive relationships between learning motivation and learning outcomes or academic achievement across subjects and educational levels: in science/biology (Palittin et al., 2019; Sappe et al., 2018), on specific science topics such as thermal expansion (Aulia, 2021), in mathematics (Waritsman, 2020), in chemistry (Budiariawan, 2019; Simatupang, 2021), in geography among Generation Z students (Indah, 2025), in physical education (Fernanda et al., 2023), as well as in social studies and primary education (Esterina et al., 2022; Prasetya et al., 2023). These cross-disciplinary findings strengthen the argument that variations in learning outcomes cannot be explained solely by intellectual ability, but also by the quality of learning motivation as a "driver" of engagement, persistence, and learning strategies (Schunk et al., 2014; Uno, 2023). Nevertheless, most of these studies are generally correlational and/or focus on other subjects; they have not examined the dynamics of motivation and biology learning outcomes within a specific school context, have not specifically targeted Grade XI science students, and generally do not situate the classroom learning model as a pedagogical context that may strengthen or hinder the function of learning motivation. This constitutes the first conceptual gap: while the motivation–achievement relationship has been widely studied, it remains weakly grounded in concrete pedagogical contexts for senior high school biology.

On the other hand, scientific literature indicates that guided inquiry is highly relevant for biology learning because it provides students with opportunities to observe, formulate hypotheses, conduct simple experiments, and actively reconstruct concepts through systematic investigative activities. Several studies report that guided inquiry improves science process skills, scientific character, and learning outcomes in science/biology across educational levels (Dwijono, 2017; Hulu & Sinaga, 2022; Megawati, 2018; Pendrice et al., 2018; Widani et al., 2019). Other research shows that organizing biology learning within a guided inquiry framework, including the use of digital media such as Google Classroom, can enhance students' science process skills and strengthen student-centered learning experiences (Hulu & Sinaga, 2022). However, most of these studies emphasize the effect of guided inquiry on learning outcomes, process skills, or scientific attitudes, and have not explicitly analyzed how learning motivation relates to biology learning outcomes in classrooms implementing (or oriented toward) guided inquiry—particularly at SMA Hidayatun Najah Proppo, Pamekasan. Therefore, this study aims to analyze the relationship between learning motivation and biology learning outcomes among Grade XI science students at SMA Hidayatun Najah Proppo, Pamekasan. Theoretically, the findings are expected to enrich the literature on the motivation–achievement relationship in biology within inquiry-oriented learning; practically, the results are expected to provide a basis for biology teachers to design more effective instructional interventions to strengthen students' learning motivation.

Research Method

Research Design

This study employed a quantitative, non-experimental correlational design (Arikunto, 2013; Sugiyono, 2017) to test the linear relationship between learning motivation, the predictor variable, and biology learning outcomes, the criterion variable, among Grade XI science students at SMA Hidayatun Najah Proppo. More specifically, the study used a cross-sectional

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design (Creswell & Creswell, 2018) because measurements of learning motivation and learning outcomes were obtained at a single time point after the biology learning process, using a guided inquiry approach (Creswell, 2011; Rangkuti & Albina, 2025).

Participants and Research Context

The research was conducted in the second semester of the 2021/2022 academic year at SMA Hidayatun Najah, located in Samiran Village, Proppo District, Pamekasan Regency. The study population comprised all Grade XI science students. The sample included all 19 students in Class XI IPA 1; thus, the sampling technique used was saturated sampling because all accessible population members were included as participants (Arikunto, 2013; Sugiyono, 2017). The selection of Class XI IPA 1 was also based on the relevance of the coordination system topic in biology, which demands higher-order thinking and science process skills, making it suitable for examining variations in learning motivation and learning outcomes.

Research Instruments and Data Collection Procedures

Students' learning motivation was measured using a learning motivation questionnaire based on Keller's (2009) ARCS model (Attention, Relevance, Confidence, Satisfaction), adapted to the context of senior high school biology learning (Table 1) and scored using a five-point Likert scale (Table 2) for both positive and negative statements (Azwar, 2012). The ARCS model was selected because it provides a comprehensive conceptual framework to measure attention, material relevance, academic confidence, and learning satisfaction, which are theoretically closely related to the sustainability of students' learning effort. A Likert scale was employed because it is among the most widely used techniques for measuring attitudes and motivation; responses to a set of statements are summed to produce a total score that may be treated as interval data for correlational analyses.

Questionnaire items were developed based on psychological scale construction principles, including clarity of indicators, balance between positive and negative statements, and content validity evaluation through expert judgment by biology lecturers/teachers and educational assessment experts (Azwar, 2014). The psychometric quality of the questionnaire was examined using item validity testing and internal reliability assessment via Cronbach's alpha coefficient. Biology learning outcomes were measured using a 10-item essay test developed from competency indicators for the coordination system topic and designed to assess conceptual understanding, reasoning, and the application of biological concepts. Essay tests were chosen because they are considered better at capturing complex, integrative learning achievement than relying solely on objective tests. The development and scoring of the learning outcome test followed learning assessment procedures emphasizing alignment among objectives, content, and item formats, as well as validity and reliability testing of the instrument. Data collection procedures included obtaining permission and coordinating with the school, piloting the instruments, administering the initial motivation questionnaire, implementing guided inquiry-based biology instruction according to the lesson plan, and administering the learning outcomes test and final motivation questionnaire to students at the end of the instructional sequence.

Table 1. Grouping of Motivation Questionnaire Statements by Criterion and Condition

No.	Motivation Questionnaire Condition	Positive Item Numbers	Negative Item Numbers
1	Attention	2, 8, 9, 11, 17, 20, 23, 24, 28	12, 15, 22, 29
2	Relevance	16, 18, 30, 33	26, 31

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No.	Motivation Questionnaire Condition	Positive Item Numbers	Negative Item Numbers
3	Confidence	1, 4, 13, 25, 35	3, 7, 19
4	Satisfaction	5, 6, 10, 14, 21, 27, 32, 36	34

Source: Keller (2009).

Table 2. Scoring Scheme for the Learning Motivation Questionnaire

Criteria	Score (Positive Statements)	Score (Negative Statements)
Strongly agree (SA)	5	1
Agree (A)	4	2
Undecided (U)	3	3
Disagree (D)	2	4
Strongly disagree (SD)	1	5

Source: Keller (2009).

Data Analysis Technique

The collected data were analyzed using descriptive and inferential statistics with the assistance of Jamovi software (Jamovi, 2024). Descriptive analyses were conducted to describe students' profiles of learning motivation and learning outcomes using measures of central tendency and dispersion (mean, standard deviation, minimum–maximum scores). Before correlation testing, statistical assumptions underlying correlation and regression analyses were examined, including linearity between motivation and learning outcomes, residual normality, and homoscedasticity (Nurhaswinda et al., 2025). The relationship between learning motivation and learning outcomes was analyzed using Pearson's product-moment correlation, as both variables were treated as quantitative interval-scale measures, followed by simple linear regression to estimate the magnitude of motivation's contribution to the variance in learning outcomes via the coefficient of determination (Kurniasih, 2025). The significance level was set at alpha = 0.05; thus, the null hypothesis was rejected when $p < 0.05$ and not rejected when $p >= 0.05$. The strength of the relationship was interpreted using correlation coefficient categories (very low to very strong) (Table 3).

Table 3. Criteria for Correlation Coefficients

Correlation Coefficient Interval	Interpretation
0.00–0.199	Very low
0.20–0.399	Low
0.40–0.599	Moderate
0.60–0.799	Strong
0.80–0.999	Very strong

Result and Discussion

Research Results

Research data were obtained from 19 students of Class XI IPA 1 at SMA Hidayatun Najah Proppo, Pamekasan, as the sample class. The analyzed variables included learning motivation and biology learning outcomes after guided inquiry-based instruction on the coordination system. Descriptively, the mean post-test scores for learning motivation and learning outcomes are presented in Table 4.

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Table 4. Mean Post-test Scores for Learning Motivation and Learning Outcomes

No.	Variable	Mean (Post-test)
1	Learning Motivation	80.20
2	Learning Outcomes	75.89

Overall, students' mean learning motivation was in the high category, while the mean learning outcome score indicated fairly good achievement, though still leaving room for improvement. This information suggests that, in aggregate, students reported relatively high levels of motivation toward biology learning; however, individual variation in learning outcomes persisted, warranting further analysis of the relationship using correlation and regression models.

Hypothesis Testing: Correlation and Regression Analyses

The relationship between learning motivation and learning outcomes was analyzed using simple linear regression with learning motivation as the predictor and learning outcomes as the criterion variable. A summary of model fit measures is presented in Table 5.

Table 5. Model Fit Measures (Overall Model Test)

Model	R	R^2	F	df1	df2	p
1	0.0373	0.00139	0.0237	1	17	0.880

The correlation coefficient (R = 0.0373) indicates a very weak linear relationship between learning motivation and learning outcomes. The coefficient of determination (R^2 = 0.00139) suggests that only about 0.139% of the variance in learning outcomes is explained by variation in learning motivation, whereas other factors outside the model influence more than 99%. The F value, F(1,17) = 0.0237, with p = 0.880 (> 0.05) indicates that the regression model is not statistically significant; therefore, inferentially, there is insufficient evidence to state that learning motivation is a reliable linear predictor of biology learning outcomes in this sample. The model's variance structure is further described in Table 6 using an omnibus ANOVA.

Table 6. Omnibus ANOVA Test

Source	Sum of Squares	df	Mean Square	F	p
Motivation	1.77	1	1.77	0.0237	0.880
Residuals	1272.02	17	74.82		

Note. Type 3 sum of squares.

The sum of squares (SS) for the motivation variable is far smaller than the residual SS, reinforcing that motivation's contribution to variance in learning outcomes is minimal and statistically non-significant. In other words, differences in learning outcome scores among students in this sample are predominantly influenced by other factors not included in the regression model. Regression coefficients for predicting learning outcomes from learning motivation are presented in Table 7.

Table 7. Regression Coefficients for Learning Outcomes

Predictor	Estimate	SE	95% CI (Lower)	95% CI (Upper)	t	p	Standardized Estimate
Intercept	78.3947	16.373	43.852	112.938	4.788	< .001	
Motivation	-0.0312	0.203	-0.459	0.396	-0.154	0.880	-0.0373

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Based on Table 7, the regression equation is: Y = 78.3947 - 0.0312X + e, where Y denotes biology learning outcomes and X denotes learning motivation scores. Substantively, the unstandardized regression coefficient (B = -0.0312) indicates a very small tendency for learning outcomes to decrease with each one-unit increase in motivation score; however, this effect is not statistically significant (p = 0.880), and the 95% confidence interval includes zero, so it cannot be interpreted as a meaningful negative effect. Thus, the null hypothesis that there is no linear relationship between learning motivation and learning outcomes cannot be rejected.

Discussion

The main finding of this study is that learning motivation is not significantly associated with biology learning outcomes among Grade XI science students at SMA Hidayatun Najah Proppo, Pamekasan, as evidenced by a very weak correlation and near-zero explained variance ($R = 0.0373$; $R^2 = 0.00139$; $p = 0.880$). At first glance, this result appears to contradict theoretical frameworks that position motivation as a key determinant of the direction, intensity, and persistence of learning behavior, as elaborated in various theories of educational motivation (Urhahne & Wijnia, 2023). These frameworks suggest that motivation should meaningfully influence learning outcomes through a process chain encompassing situation, self, goals, actions, outcomes, and consequences. However, in the empirical context of this study, the direct influence of motivation on learning outcomes was not statistically detectable.

Compared with prior studies that consistently report positive relationships between learning motivation and learning outcomes, the present finding is an "anomaly" and warrants deeper analysis. Wini et al. (2022) reported a significant relationship between learning motivation and biology learning outcomes among Grade XI students in another senior high school, with a sufficiently strong correlation to conclude that improving motivation contributes to improved biology achievement. Similar findings were reported by Adawiyah et al. (2023), who showed that learning motivation mediates the influence of creative thinking skills on learning outcomes, positioning motivation as a key component among internal factors driving academic achievement. Beyond biology, numerous studies have shown similar patterns across subjects and levels, including mathematics (Maghfiroh et al., 2023), primary education (Attakhidijah, 2022), and learning contexts using reciprocal teaching (Muthik et al., 2022). These findings reinforce the view that motivation is a strong predictor of learning outcomes. Therefore, the absence of a relationship in this study should be understood as indicating the possible presence of strong contextual and methodological factors, rather than as a refutation of motivation's role in general.

Several explanations may account for the difference. First, from a methodological perspective, the relatively small sample size (n = 19) reduces statistical power to detect relationships that may exist but are small to moderate in magnitude. In correlational studies involving psychological variables such as learning motivation, limited variance, and small samples, the risk of Type II error (failing to reject the null hypothesis when a true relationship exists) increases. Second, a motivation score distribution that is relatively homogeneous and predominantly in the high category may produce a ceiling effect, leaving insufficient variability in motivation to account for differences in learning outcomes. This differs from studies reporting significant correlations, in which motivation ranges are more heterogeneous (e.g., Wini et al., 2022, in biology, and Maghfiroh et al., 2023, in mathematics).

Third, the learning context during the post-COVID-19 "new normal" period and the specific characteristics of a pesantren-based school may be important moderating factors for the motivation–achievement relationship. Learning at SMA Hidayatun Najah took place with limited face-to-face time. It overlapped with students' pesantren obligations, including competition activities and preparations for the end-of-year program (akhirus sanah)

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approaching Ramadan. In this context, students often must divide their attention between formal school demands and religious/pesantren commitments, potentially creating a mismatch between self-reported motivation on questionnaires (e.g., a general desire to achieve) and consistent study behaviors toward specific academic goals. Theoretically, Urhahne and Wijnia (2023) argue that motivation leads to academic outcomes only when the process chain from situation–goals–actions operates intact; if learning actions are disrupted by time pressure, dual activity loads, or a less supportive environment, the direct correlation between motivation and learning outcomes may weaken or become non-evident in data.

Fourth, the quality of motivation measurement may also contribute to the weak relationship found. Although the motivation questionnaire was constructed based on the ARCS model and used standardized scoring procedures, students' honesty and seriousness in responding to the questionnaire in a densely scheduled learning context may reduce score validity. Some students may respond quickly without adequate reflection or provide socially desirable answers, so the motivation scores do not fully reflect their actual motivational dispositions. This is consistent with findings indicating that the motivation–achievement relationship becomes clearer when motivation is carefully measured and linked to concrete learning experiences, as shown by Lo et al. (2022) in service-learning and by Hendrawati and Wuryandani (2023) in Pancasila and Civic Education.

Importantly, the present findings do not negate the importance of motivation; rather, they highlight that motivation alone is insufficient to guarantee high academic achievement, especially when situational and instructional factors are not supportive. Several studies show that motivation interacts with other factors such as learning experiences, instructional models, and learning environments. For example, Lo et al. (2022) demonstrated that meaningful, structured learning experiences can strengthen the impact of motivation on cognitive outcomes in service-learning contexts. Muthik et al. (2022) and Adawiyah et al. (2023) showed that pedagogical interventions such as reciprocal teaching and creative-thinking-oriented learning can improve both motivation and learning outcomes, allowing a relationship to emerge within an appropriate instructional design. Similarly, Attakhidijah (2022) and Hendrawati and Wuryandani (2023) emphasized that discipline and a supportive learning environment function as enabling conditions through which motivation can be actualized into achievement. Thus, in the context of biology learning at SMA Hidayatun Najah, factors such as limited study time, dense activity schedules, study discipline, and the quality of guided inquiry implementation may play a more dominant role than motivation as measured in a general way.

In practice, these findings imply that efforts to improve biology learning outcomes should not focus solely on declarative motivational strengthening (e.g., advice or encouragement). Still, they must also be accompanied by learning-environment engineering and instructional design that enable motivation to manifest as consistent learning behavior. This aligns with recommendations in the literature that emphasize integrating motivation, learning experience, and effective teaching strategies (Adawiyah et al., 2023; Lo et al., 2022; Muthik et al., 2022; Maghfiroh et al., 2023). At SMA Hidayatun Najah, this may be realized through strengthening the fidelity and consistency of guided inquiry implementation that truly provides room for meaningful observation, experimentation, and discussion; reorganizing schedules and balancing students' school–pesantren activity loads to avoid interference; and developing more intensive monitoring and academic support mechanisms.

Overall, this study contributes to the literature by demonstrating that the relationship between learning motivation and learning outcomes is neither universal nor automatic, but depends strongly on contextual characteristics, measurement quality, and instructional design. The findings confirm an integrative perspective that theories of motivation should be considered alongside situational and instructional factors (Urhahne & Wijnia, 2023), and open

space for further research examining mediating and moderating variables—such as study discipline, learning experience quality, and environmental support—in linking motivation to biology learning outcomes across diverse school contexts.

Conclusion

Based on a simple linear regression analysis of 19 Grade XI IPA 1 students at SMA Hidayatun Najah Proppo, Pamekasan, this study concludes that although students' learning motivation was descriptively in the relatively high category and biology learning outcomes showed fairly good achievement, learning motivation was not demonstrated to be a significant predictor of biology learning outcomes in this context ($R = 0.0373$; $R^2 = 0.00139$; $p = 0.880$), explaining only 0.139% of the variance. These findings indicate that students' success in biology learning in this pesantren-based school environment is more strongly influenced by other factors beyond the measured motivation, such as study discipline, time management between school and pesantren activities, the quality of guided inquiry implementation, support within the learning environment, and possible differences in prior ability and students' learning strategies. Accordingly, the absence of a significant relationship between learning motivation and learning outcomes in this study does not deny the theoretical importance of motivation. Still, it emphasizes that motivation will not automatically translate into academic achievement without instructional and contextual conditions that allow students to realize their motivational drives through directed, intensive, and sustained learning behaviors.

Recommendation

Based on these findings, efforts to improve biology learning outcomes at SMA Hidayatun Najah Proppo, Pamekasan, should not focus solely on strengthening declarative motivation, but should instead be directed toward arranging the learning environment and instructional design that enable motivation to translate into effective learning behavior. This may include strengthening the quality and consistency of guided inquiry implementation, managing school–pesantren schedules and activity loads so they do not overlap and interfere, developing students' discipline and independent learning skills, and utilizing formative evaluation and continuous motivation monitoring through multiple instruments (questionnaires, observation, and reflection) so that teachers can design more targeted pedagogical interventions to optimize biology learning achievement.

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