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Determinants of Pesantren Educational Effectiveness: The Mediating Role of Student Motivation

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A B S T R A C T

Previous studies have examined factors related to student motivation and educational effectiveness, but limited research has investigated these relationships within an integrated framework in the Pesantren context, particularly by considering student motivation as a mediating mechanism. This study examines the relationships between pedagogical approach, technology and learning media, the Pesantren environment, kiai leadership, student motivation, and Pesantren educational effectiveness. A quantitative cross-sectional study was conducted with 240 students selected through purposive sampling from selected Pesantren in Indonesia. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings show that pedagogical approach, the Pesantren environment, and kiai leadership are significantly and positively associated with student motivation, whereas technology and learning media are not significantly associated with student motivation. Student motivation is strongly and positively associated with Pesantren educational effectiveness. Significant indirect effects through student motivation were found for pedagogical approach, the Pesantren environment, and kiai leadership, whereas the indirect effect of technology and learning media was not significant. The study contributes by demonstrating the mediating role of student motivation in the relationships between key instructional, environmental, and leadership conditions and Pesantren educational effectiveness. The findings highlight the importance of strengthening pedagogical practices, supportive Pesantren environments, and effective kiai leadership, while technology integration should be aligned with pedagogical needs and contextual conditions.

1. Introduction

Pesantren, an Indonesian Islamic boarding-school tradition, is one of the oldest and most influential educational institutions in Indonesia (Gazali & Budiana, 2023). There are more than 42.391 Pesantren and more than 1.378.687 students, consisting of 726.880 male and 651.807 female students, distributed across Indonesia (Maheswara, 2025). In recent decades, Pesantren have not only increased in number but have also undergone institutional changes through the integration of formal education. Despite this quantitative growth and increasing institutionalization, improvements in the quality of learning have not been fully achieved (Umiarso, 2022; Zahra, 2025). This situation indicates a potential mismatch between institutional expansion and corresponding improvements in educational effectiveness, making the effectiveness of Pesantren education an important educational-management concern.

Digital acceleration in Indonesia has created new opportunities for educational transformation. The national internet penetration rate has exceeded 80.5% of the population

(Sari, 2025)., indicating the growing availability of digital connectivity in Indonesia. However, this national figure does not necessarily represent the actual level of technology access or use among Pesantren students. In practice, many Pesantren still face structural and cultural limitations in adopting technology and learning media (Azka et al., 2025). Poor infrastructure, limited digital literacy, and resistance to changes in teaching practices may constrain the effective use of technology to improve learning quality (Qianyi & Zhiqiang, 2024; Siregar, 2024). Thus, the digital challenge in Pesantren education concerns not only the availability of technology but also the institutional capacity to integrate technology and learning media effectively into the educational process.

The effectiveness of Pesantren education, however, cannot be attributed to technology alone, as it is also influenced by the internal dynamics of the institution (Nurtawab & Wahyudi, 2022). Teaching approaches in some Pesantren remain predominantly traditional and less interactive (Mokhtar et al., 2025; Wang, 2022), while the quality of the learning environment varies across Pesantren (Azhar & Gresik, 2024). In addition, the kiai has a strong leadership role within Pesantren, although leadership styles and capabilities may vary across institutions (Safitri, 2025; Umiarso, 2022). These conditions suggest that educational effectiveness is shaped by multiple and interrelated factors. Accordingly, pedagogical approaches may influence student motivation, technology and learning media may create opportunities for more engaging learning experiences, the Pesantren environment may shape students' learning conditions, and kiai leadership may influence students' educational experiences. These dimensions should therefore be examined simultaneously because considering them independently may provide only a partial explanation of educational effectiveness in Pesantren.

The relationships among these factors can be understood through Ajzen (1991) Theory of Planned Behavior (TPB), particularly its explanation of how contextual conditions may shape internal psychological processes that subsequently influence behavior. In this study, TPB provides a theoretical perspective for understanding student motivation as an internal mechanism through which educational conditions may be associated with educational effectiveness. Pedagogical approaches, technology and learning media, the Pesantren environment, and kiai leadership are therefore treated as educational and contextual factors rather than being directly equated with the TPB constructs of attitude, subjective norm, or perceived behavioral control. Previous studies have examined several aspects of Pesantren education, including curriculum (Hasanah et al., 2025), facilities (Gazali & Budiana, 2023), or institutional management (Asifudin, 2016; Mansir, 2020). However, the existing evidence remains fragmented because many studies focus on individual variables or specific institutional aspects rather than examining their relationships within an integrated structural model. More importantly, the mechanism through which educational conditions may influence educational effectiveness through student motivation has received limited empirical attention in the Pesantren context.

Based on the literature, three research gaps can be identified. First, an empirical gap exists because previous studies have largely examined pedagogical, technological, environmental, and leadership factors separately. Second, a theoretical and mechanistic gap exists because limited research has examined student motivation as a mediating mechanism linking educational conditions to educational effectiveness. Third, a contextual gap remains

because the distinctive characteristics of Pesantren as a value-based Islamic educational system have not been sufficiently incorporated into an integrated model.

Therefore, this study addresses these gaps by developing and empirically testing an integrated model examining pedagogical approaches, technology and learning media, the Pesantren environment, and kiai leadership as predictors of educational effectiveness, with student motivation as a mediating mechanism. The study aims to explain how these educational and contextual factors contribute to educational effectiveness through students' motivational processes. The findings are expected to contribute to Islamic education and educational management, while providing practical insights for improving instructional management, kiai leadership, learning environments, student motivation, and technology integration in Pesantren.

Literature Review and Hypothesis Development

1.1. Background Theory

The Theory of Planned Behavior (TPB) proposed by cexplains that human behavior is shaped through a process involving attitudes, subjective norms, perceived behavioral control, behavioral intentions, and subsequent behavior. The theory emphasizes that individual behavior does not arise solely from external conditions but is also influenced by internal psychological processes and perceptions of the surrounding environment. In the educational context, students' learning-related behavior may be influenced by their perceptions of the learning process, social environment, and their perceived ability to engage in learning activities. Previous studies have demonstrated that teaching approaches, learning environments, and social support are associated with students' motivation and engagement in learning (Alemayehu & Chen, 2023; Wang et al., 2020; Xiong, 2025).

In the context of Pesantren education, the learning process takes place within an educational environment characterized by Islamic values, distinctive pedagogical practices, and a strong leadership role of the kiai (Azka et al., 2025; Siregar, 2024). Based on this context, the present study does not equate pedagogical approaches, technology and learning media, the Pesantren environment, or kiai leadership with the specific TPB constructs of attitude, subjective norm, or perceived behavioral control. Instead, these variables are conceptualized as educational and contextual conditions that may shape students' psychological responses and learning motivation. Interactive pedagogical approaches, appropriate use of technology and learning media, a supportive Pesantren environment, and effective kiai leadership may create conditions that encourage students to engage more actively in learning and develop stronger motivation.

Student motivation is therefore positioned in this study as a mediating mechanism rather than as a direct TPB construct. The underlying theoretical chain is that favorable educational conditions may contribute to stronger student motivation, which in turn may encourage more active learning behavior and contribute to educational effectiveness. Students with stronger motivation are more likely to demonstrate active participation, persistence, commitment, and engagement in learning activities, which can ultimately support better educational outcomes (Alemayehu & Chen, 2023; Huang et al., 2025). Accordingly, TPB provides a theoretical perspective for explaining the mechanism through which educational and contextual conditions may be associated with students' learning-related responses and educational effectiveness. Within this framework, the present study extends the application of TPB to the Pesantren context by examining whether student

motivation mediates the relationships between pedagogical approaches, technology and learning media, the Pesantren environment, and kiai leadership and educational effectiveness.

1.2. Hypothesis Development

1.2.1.Pedagogical Approach

Pedagogical approach refers to the strategies, methods, and practices used by educators to facilitate students' learning and influence their understanding, participation, and engagement in the learning process (Poon & Tang, 2025). In the context of Pesantren, the use of interactive, varied, and student-centered pedagogical approaches can create more engaging learning experiences and encourage students to participate actively in educational activities. When teaching approaches are appropriate to students' learning needs and encourage active participation, students may develop stronger interest and motivation to learn. Previous studies have shown that pedagogical approaches are significantly associated with students' learning motivation and engagement (Kannan et al., 2025; Xiong, 2025). Therefore, a more effective pedagogical approach is expected to strengthen students' motivation to learn.

H1: Pedagogical approach has a significant positive effect on student motivation.

1.2.2. Technology and Learning Media

Technology and learning media are resources used to support the learning process by facilitating access to information, communication, interaction, and learning activities (Bond et al., 2020). In the context of Pesantren, the effective integration of technology and learning media can provide students with broader access to learning resources and create more flexible and engaging learning experiences. Appropriate use of digital platforms and learning media may also facilitate interaction and participation, which can strengthen students' interest and motivation to learn. Previous studies have shown that the use of technology in education is associated with students' learning motivation (Alqahtani & Rajkhan, 2020; Qianyi & Zhiqiang, 2024). Furthermore, Yani et al. (2024), through an analytical mapping of previous research, found substantial evidence that the integration of technology in learning can contribute to improved student learning outcomes. These findings suggest that the effective use of technology and learning media may create learning conditions that encourage students to become more motivated and actively involved in the learning process.

H2: Technology and learning media have a significant positive effect on student motivation.

1.2.3. Pesantren Environment

The Pesantren environment refers to the social, cultural, and educational setting in which students live, interact, and participate in learning activities (Kurniady et al., 2024). In Pesantren, the learning environment extends beyond the classroom because students typically experience learning within a shared residential and social setting. A conducive, disciplined, and supportive environment can provide students with a sense of comfort, security, and belonging, while also encouraging positive interactions and active participation in learning activities (Nurhasanah et al., 2024). These conditions may strengthen students' willingness and motivation to engage in the learning process. Previous research has shown that a positive learning environment has a significant effect on student motivation and

engagement (Alemayehu & Chen, 2023). Therefore, a supportive Pesantren environment is expected to contribute positively to students' motivation to learn.
H3: The Pesantren environment has a significant positive effect on student motivation.

1.2.4. Kiai Leadership

Kiai leadership refers to the role of the kiai in providing direction, guidance, support, and exemplary behavior to students within the Pesantren environment. As a central figure in Pesantren, the kiai not only performs an administrative leadership function but also plays an important role in shaping students' attitudes, values, and learning experiences (Safitri, 2025). Visionary, supportive, and participatory leadership can create a positive educational atmosphere, strengthen students' sense of direction and support, and encourage greater enthusiasm for learning. When students perceive their leaders as supportive and inspirational, they may be more willing to participate actively in learning activities and develop stronger motivation to learn. Previous studies have shown that effective leadership has a positive relationship with students' motivation and learning (Afriza et al., 2024; Haryaka et al., 2023). Therefore, effective kiai leadership is expected to strengthen students' motivation to learn.
H4: Kiai leadership has a significant positive effect on student motivation.

1.2.5. Student Motivation

Student motivation refers to the internal drive that encourages students to initiate, sustain, and actively engage in the learning process. It influences students' enthusiasm, persistence, effort, and involvement in learning activities (Haryaka et al., 2023). In the context of Pesantren, strong student motivation is particularly important because students participate in learning within an educational environment that combines academic activities with daily social and religious experiences. Students with higher levels of motivation are more likely to demonstrate active participation, persistence in completing learning activities, and greater commitment to achieving their learning goals. These behaviors can contribute to more effective educational processes and outcomes. Previous research has shown that student motivation is significantly associated with learning success and educational outcomes (Alemayehu & Chen, 2023; Huang et al., 2025). Therefore, higher student motivation is expected to contribute positively to the effectiveness of Pesantren education.
H5: Student motivation has a significant positive effect on the effectiveness of Pesantren education.

1.2.6. Mediation of Student Motivation

Student motivation can function as a mediating mechanism through which educational and contextual conditions influence educational effectiveness. Motivation develops through the interaction between students and the conditions in which learning takes place (Zhou et al., 2025). An interactive and student-centered pedagogical approach can increase students' engagement, interest, and willingness to participate in learning activities (Christidamayani & Kristanto, 2020). Similarly, the effective use of technology and learning media can provide broader access to information, facilitate interaction, and create more engaging learning experiences, which may strengthen students' motivation (Lacka et al., 2021). However, the influence of these factors may depend on the learning environment in which students study. A conducive, disciplined, and supportive environment can facilitate learning activities and encourage stronger student motivation (Wang et al., 2020).

In the context of Pesantren, kiai leadership represents another important contextual factor that may contribute to students' motivation. As a central figure in Pesantren, the kiai provides direction, guidance, exemplary behavior, and social support that can shape students' attitudes toward learning. Previous studies have demonstrated that effective leadership contributes to organizational and educational outcomes, including students' motivation and learning behavior (Afriza et al., 2024; Akram et al., 2026; Haryaka et al., 2023). These relationships suggest that pedagogical approaches, technology and learning media, the Pesantren environment, and kiai leadership may contribute to educational effectiveness not only directly but also indirectly by strengthening student motivation. When these educational and contextual conditions are favorable, students may become more motivated, engaged, persistent, and committed to learning, which can subsequently contribute to greater educational effectiveness. Therefore, student motivation is positioned in this study as a mediating mechanism that connects these four factors with the effectiveness of Pesantren education.

H6: Student motivation significantly mediates the relationship between pedagogical approach and the effectiveness of Pesantren education.

H7: Student motivation significantly mediates the relationship between technology and learning media and the effectiveness of Pesantren education.

H8: Student motivation significantly mediates the relationship between the Pesantren environment and the effectiveness of Pesantren education.

H9: Student motivation significantly mediates the relationship between kiai leadership and the effectiveness of Pesantren education.

2. Methods

2.1. Research Design

This study employed a quantitative research design with a descriptive and explanatory approach to examine the relationships among pedagogical approach, technology and learning media, Pesantren environment, kiai leadership, student motivation, and Pesantren educational effectiveness. The proposed model examines the relationships of pedagogical approach, technology and learning media, Pesantren environment, and kiai leadership with student motivation, and subsequently examines the relationship between student motivation and Pesantren educational effectiveness. Student motivation is positioned as the mediating variable through which the four educational and contextual factors are associated with Pesantren educational effectiveness. Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to test the proposed relationships and the specific indirect effects through student motivation.

2.2. Sample Size and Sampling

The study involved students from selected Pesantren in Indonesia. A purposive sampling technique was employed based on predefined inclusion criteria. Respondents were required to: (1) be currently enrolled as students in a Pesantren; (2) have studied at the Pesantren for at least one year; and (3) participate in both formal and non-formal educational activities within the Pesantren. Respondents were recruited through institutional contacts and academic networks. Eligibility was confirmed through screening questions in the questionnaire, requiring participants to confirm their current enrollment in a Pesantren and their compliance with the predefined inclusion criteria. The sample was determined based on predefined eligibility criteria and the purposive sampling procedure employed in the

study. Participants were recruited through institutional contacts and academic networks and were included if they met all of the specified inclusion criteria. Data collection continued until 240 eligible responses had been obtained. Thus, the sample size of 240 was determined by the number of eligible respondents obtained through the sampling procedure, rather than by multiplying the number of measurement indicators by ten following Hair et al. (2017) and Harahap et al. (2023).

After data screening, all 240 responses were considered valid and retained for the final analysis. Thus, the final sample size corresponded to the predetermined target of 240 respondents. Before the main survey, the questionnaire was pilot-tested with 30 Pesantren students who were not included in the final sample. The pilot test was conducted to assess the clarity, comprehensibility, relevance, and preliminary reliability of the measurement items. The results indicated that the questionnaire items were sufficiently clear and relevant to the target respondents. Minor adjustments were made to improve the wording and clarity of several items before the main data collection. The main questionnaire was distributed online through Google Forms and disseminated through institutional contacts and academic networks. All measurement items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

2.3. Ethical Considerations

This study was conducted in accordance with ethical principles for research involving human participants. Institutional permission was obtained from the participating Pesantren before data collection. The purpose and procedures of the study were explained to the participants, and participation was voluntary. Before completing the questionnaire, participants were informed that they could decline to participate or discontinue their participation at any time without any consequences. Because the respondents included students who may be under the age of 18, appropriate consent and assent procedures were applied in accordance with the requirements of the participating institutions. Where applicable, informed consent was obtained from the students' parents or legal guardians, while student assent was obtained from the participants themselves. The questionnaire did not request personally identifying information, and all responses were treated confidentially and used solely for academic research purposes. The data were stored securely and were accessible only to the research team. No individual participant or Pesantren is identifiable in the reporting of the findings.

2.4. Data Analysis

The data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 3.0. The analysis consisted of two stages: evaluation of the measurement model and structural model. The measurement model was assessed based on outer loadings, Cronbach's alpha, composite reliability, Average Variance Extracted (AVE), and discriminant validity using the Fornell–Larcker criterion (Billah, 2022; Harahap et al., 2023). The structural model was evaluated using path coefficients, t-statistics, p-values, R^2, f^2, and Q^2. Hypotheses and mediation effects were tested using bootstrapping. The mediation analysis examined the specific indirect effects of PA, TLM, PE, and KL on PEE through Student Motivation. An indirect effect was considered significant when $p < 0.05$ and $t > 1.96$ (Hair et al., 2017). Because direct paths from PA, TLM, PE, and KL to PEE were not included

in the reported structural model, the mediation effects were interpreted only as significant or non-significant indirect effects, without classifying them as full or partial mediation.

Table 1. Variables, Deficiencies, Indicators and Research Sources

Variable	Definition	Indicator	Source
Pedagogical Approach	The methods and strategies used in the learning process to deliver materials effectively and facilitate student learning.	Learning methods Variety of learning strategies Participant engagement Clarity of material delivery	(Christidamayani & Kristanto, 2020; Xiong, 2025)
Technology and Learning Media	The use of various technological tools, platforms, and learning media to support and improve the quality of the learning process.	Use of technology Learning media Access information Facility support	(Alqahtani & Rajkhan, 2020; Lacka et al., 2021)
Pesantren Environment	The social, cultural, and learning environment that shapes student behavior and supports the educational process.	Culture Discipline Social interaction Learning atmosphere	(Mansir, 2020; Umiarso, 2022)
Kiai Leadership	The role of the kiai in directing, guiding, and providing an example to students throughout the educational process.	Example Visionary leadership Motivation Support for education	(Haryaka et al., 2023; Safitri, 2025)
Student Motivation	Internal and external motivational factors that influence students' enthusiasm and perseverance in learning.	Internal motivation Passion for learning Perseverance Learning objectives	(Alemayehu & Chen, 2023; Huang et al., 2025)
Pesantren Educational Effectiveness	The extent to which the educational process successfully achieves its intended goals, as reflected in students' understanding, behavioral changes, application of Islamic values, and learning outcomes.	Understanding of the material Behavior change Application of Islamic values Learning outcomes	(Safitri, 2025; Zahra, 2025)

3. Results

3.1. Demographic Analysis of Respondents

The demographic analysis was conducted to describe the characteristics of the respondents included in the study. A total of 240 valid responses were retained for analysis. In terms of gender, 111 respondents (46.25%) were male and 129 respondents (53.75%) were female, indicating a relatively balanced gender distribution, with a slightly higher proportion of female respondents. Regarding the location of the Pesantren based on Indonesian time zones, 142 respondents (59.17%) were from Pesantren located in the Western Indonesia Time Zone (WIB), 76 respondents (31.67%) were from the Central Indonesia Time Zone (WITA), and 22 respondents (9.17%) were from the Eastern Indonesia Time Zone (WIT). Thus, the respondents were more concentrated in the WIB region.

In terms of education level, 73 respondents (30.42%) were at the Tsanawiyah/junior high school level, while 167 respondents (69.58%) were at the Aliyah/senior high school level. Therefore, the sample was predominantly composed of students at the upper secondary level. Regarding the Pesantren programs followed by respondents, 83

respondents (34.58%) participated in Tahfidz Al-Qur'an programs, 79 respondents (32.92%) participated in formal education programs, 49 respondents (20.42%) participated in skills programs, and 29 respondents (12.08%) participated in Yellow Book/Dirasah Islamiyah programs. Overall, the respondent profile indicates that the sample included students with different educational levels and Pesantren program experiences.

Table 2. Respondent Data Results

Characteristics	Frequency	Percentage (%)
Gender		
Male	111	46.25
Women	129	53.75
Total	240	100
Location of Pesantren by Time Region		
Western Indonesia Time (WIB)	142	59.17
Central Indonesia Time (WITA)	76	31.67
Eastern Indonesia Time (WIT)	22	9.17
Total	240	100
Education Level		
Tsanawiyah/Junior High School	73	30.42
Aliyah/High School	167	69.58
Total	240	100
Islamic Boarding School Programs Followed		
Tahfidz Al-Qur'an	83	34.58
The Yellow Book / Felt Islamic	29	12.08
Formal Education	79	32.92
Skills Program	49	20.42
Total	240	100

3.2. Measurement Model Analysis (Outer Model)

The external measurement model in this study aims to assess the relationship between the indicators and latent constructs used in the research model. The Partial Least Squares Structural Equation Modeling (PLS-SEM) approach was used to assess the quality of the research instruments by examining the reliability and validity of the constructs, including Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE) (Harahap et al., 2023). The test results show that all constructs in the model have satisfactory reliability. Cronbach's alpha values range from 0.951 to 0.969, while the Composite Reliability values range from 0.964 to 0.978. According to the criteria set by Hair et al. (2023), a reliability value above 0.70 indicates adequate internal consistency. Therefore, all constructs in this study meet the required reliability standards.

Convergent validity was assessed using outer loading and AVE values. All indicators had an outer loading value above 0.70, indicating that each indicator adequately represents its respective latent construct. In addition, the AVE values for all constructs range from 0.871 to 0.916, exceeding the minimum threshold of 0.50 recommended in the literature (Billah, 2022). These findings indicate that the constructs explain a substantial proportion of the variance in their respective indicators. Overall, the evaluation of the measurement model indicates satisfactory internal consistency reliability and convergent validity, and no indicator falls below the minimum outer loading criterion. Therefore, all questionnaire items meet the required criteria for subsequent structural model analysis

Table 3. Measurement Model Results

Variable	Code	Loadings	Weight
Pedagogical Approach (α=0.951, CR= 0.964, and AVE= 0.871)			
The learning method at the Pesantren is easy for me to understand	PA.1	0.922	0.262
Ustadz/ustadzah uses various learning methods	PA.2	0.937	0.272
I am actively involved in the learning process	PA.3	0.943	0.271
The material is delivered clearly and systematically	PA.4	0.931	0.266
Technology and Learning Media (α=0.955, CR= 0.968, and AVE= 0.882)			
Pesantren use technology in learning	TLM.1	0.923	0.255
The learning media used is interesting	TLM.2	0.944	0.268
I have easy access to learning materials	TLM.3	0.938	0.272
Technology helps me understand material	TLM.4	0.950	0.270
Pesantren Environment (α=0.954, CR= 0.967, and AVE= 0.881)			
The Pesantren environment supports learning activities	PE.1	0.914	0.259
I feel comfortable living in a Pesantren	PE.2	0.950	0.267
Discipline in Pesantren helped me learn	PE.3	0.949	0.268
The relationship between students is well established	PE.4	0.943	0.270
Kiai Leadership (α=0.964, CR= 0.974, and AVE= 0.903)			
Kiai set a good example for students	KL.1	0.951	0.262
Kiai has a clear vision of education	KL.2	0.953	0.263
Kiai motivates students to learn	KL.3	0.947	0.266
Kiai supports learning activities	KL.4	0.950	0.261
Student Motivation (α=0.952, CR= 0.965, and AVE= 0.873)			
I have a strong desire to learn	SM.1	0.953	0.277
I am enthusiastic about participating in learning activities	SM.2	0.923	0.271
I continued to study despite the difficulties	SM.3	0.947	0.268
I have a clear goal in learning	SM.4	0.913	0.254
Pesantren Educational Effectiveness (α=0.969, CR= 0.978, and AVE= 0.916)			
I understand the material taught at the Pesantren	PEE.1	0.961	0.269
I experienced a change in behavior for the better	PEE.2	0.961	0.253
I apply Islamic values in my daily life	PEE.3	0.957	0.265
Learning at the Pesantren helped me develop myself	PEE.4	0.950	0.257

Discriminant validity was assessed using the Fornell–Larcker criterion. The diagonal values in Table 4 represent the square root of the Average Variance Extracted (AVE), while the off-diagonal values represent the correlations between constructs. The results indicate that the square root of the AVE for each construct is higher than the corresponding correlations with the other constructs. Therefore, the Fornell–Larcker criterion is satisfied. Although several inter-construct correlations are relatively high, the diagonal values remain higher than the corresponding correlations for each construct. Accordingly, the results provide evidence of discriminant validity based on the Fornell–Larcker criterion. However, these findings are interpreted within the scope of the Fornell–Larcker assessment applied in

this study, and the relatively high correlations suggest that the constructs are closely related conceptually and empirically.

Table 4. Fornell-Larcker Criterion Result

	PEE	PE	KL	TLM	PA	SM
PEE	**0.957**					
PE	0.872	**0.939**				
KL	0.851	0.884	**0.950**			
TLM	0.823	0.867	0.879	**0.939**		
PA	0.841	0.858	0.846	0.831	**0.933**	
SM	0.856	0.875	0.889	0.862	0.827	**0.934**

3.3. Structural Model Analysis (Inner Model)

The internal model testing in this study aims to examine the relationships between the latent constructs and evaluate the hypotheses formulated in the research model. The structural model was evaluated using the path coefficient, t-value, p-value, R^2, Q^2, and effect size (f^2) to assess the strength, explanatory power, predictive relevance, and contribution of each relationship in the PLS-SEM model (Billah, 2022; Harahap et al., 2023). Table 5 presents the structural model and hypothesis testing results. Pedagogical Approach (PA) has a positive and significant relationship with Student Motivation (SM) ($\beta = 0.237$, $t = 3.128$, $p = 0.002$), with a small effect size ($f^2 = 0.064$), supporting H1. Technology and Learning Media (TLM) has a positive but non-significant relationship with SM ($\beta = 0.161$, $t = 1.741$, $p = 0.082$), with a small effect size ($f^2 = 0.019$); therefore, H2 is not supported. Pesantren Environment (PE) has a positive and significant relationship with SM ($\beta = 0.236$, $t = 2.467$, $p = 0.014$), with a small effect size ($f^2 = 0.031$), supporting H3.

Kiai Leadership (KL) also has a positive and significant relationship with SM ($\beta = 0.320$, $t = 3.323$, $p = 0.001$), with a small effect size ($f^2 = 0.067$), supporting H4. Among the predictors of SM, KL has the largest path coefficient. Furthermore, Student Motivation has a strong positive and significant relationship with Pesantren Educational Effectiveness (PEE) ($\beta = 0.882$, $t = 56.043$, $p < 0.001$), with a large effect size ($f^2 = 0.510$), supporting H5. Overall, the results indicate that PA, PE, and KL are significantly associated with student motivation, while TLM does not show a statistically significant relationship. Student motivation demonstrates the strongest structural relationship with educational effectiveness.

Table 5. Structural Model and Hypothesis Testing Results

Relationship	Original Sample (β)	t-statistic	P-value	f^2	Decision
PA → SM	0.237	3.128	0.002	0.064	Supported
TLM → SM	0.161	1.741	0.082	0.019	Not Supported
PE → SM	0.236	2.467	0.014	0.031	Supported
KL → SM	0.320	3.323	0.001	0.067	Supported
SM → PEE	0.882	56.043	<0.001	0.510	Supported

Table 6 presents the specific indirect effects of the independent variables on Pesantren Educational Effectiveness (PEE) through Student Motivation (SM). Pedagogical Approach (PA) has a positive and significant indirect effect on PEE through SM ($\beta = 0.210$, $t = 3.121$, $p = 0.002$), indicating that PA is associated with higher educational effectiveness through student motivation. Pesantren Environment (PE) also shows a positive and significant indirect effect through SM ($\beta = 0.209$, $t = 2.462$, $p = 0.014$), while Kiai Leadership (KL) has a positive and significant indirect effect ($\beta = 0.283$, $t = 3.263$, $p = 0.001$). These results indicate that student

motivation represents an important indirect pathway linking PA, PE, and KL with educational effectiveness. In contrast, Technology and Learning Media (TLM) has a positive but non-significant indirect effect on PEE through SM (β = 0.142, t = 1.751, p = 0.080). Thus, there is insufficient statistical evidence to conclude that TLM is indirectly associated with PEE through student motivation. Overall, the results support significant indirect effects for PA, PE, and KL, whereas the indirect effect of TLM through SM is not significant.

Table 6. Indirect Effects through Student Motivation

Indirect Relationship	Original Sample (β)	t-statistic	P-value	Decision
PA → SM → PEE	0.210	3.121	0.002	Significant
TLM → SM → PEE	0.142	1.751	0.080	Not Significant
PE → SM → PEE	0.209	2.462	0.014	Significant
KL → SM → PEE	0.283	3.263	0.001	Significant

Table 7 presents the coefficient of determination (R^2) and predictive relevance (Q^2) of the endogenous constructs. Student Motivation (SM) has an R^2 value of 0.854, indicating that 85.4% of its variance is explained by Pedagogical Approach, Technology and Learning Media, Pesantren Environment, and Kiai Leadership. Pesantren Educational Effectiveness (PEE) has an R^2 value of 0.778, indicating that 77.8% of its variance is explained by the model, particularly through Student Motivation. The Q^2 values for SM (0.682) and PEE (0.594) are both greater than zero, indicating that the structural model has predictive relevance for both endogenous constructs. Overall, the results demonstrate substantial explanatory power and predictive relevance of the proposed model.

Table 7. Coefficient of Determination and Predictive Relevance

Endogenous Construct	R^2	Q^2
Student Motivation (SM)	0.854	0.682
Pesantren Educational Effectiveness (PEE)	0.778	0.594

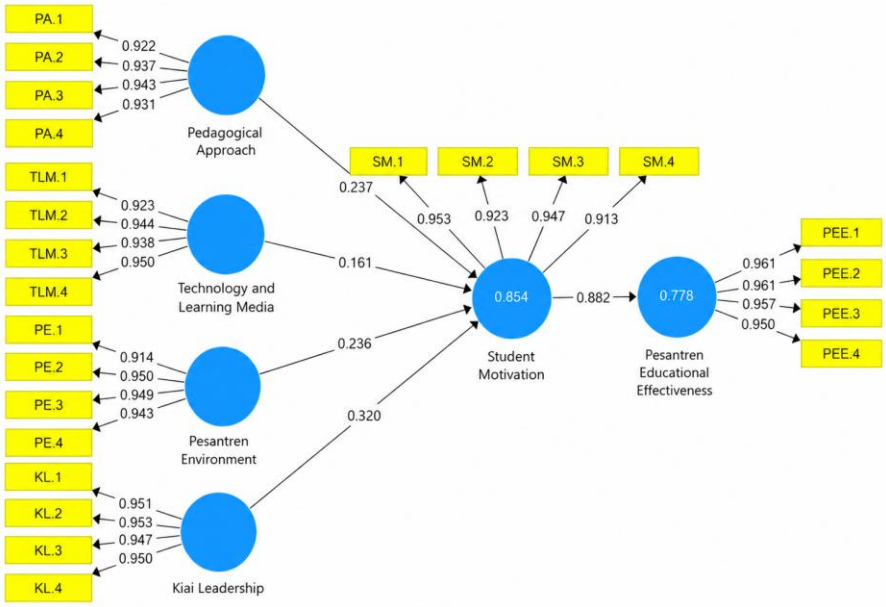

Figure 1. Path Model in Research

4. Discussion

The findings indicate that student motivation is significantly associated with pedagogical approach, the Pesantren environment, and kiai leadership, while technology and learning media show a positive but non-significant relationship with motivation. These findings suggest that student motivation in Pesantren is influenced by a combination of instructional, environmental, and leadership conditions rather than by technology use alone. The results also contextualize previous research by showing that the relative importance of these factors may differ within the distinctive residential and religious setting of Pesantren.

The significant relationship between pedagogical approach and student motivation confirms previous research indicating that interactive, student-centered, and engaging instructional practices can strengthen students' motivation and engagement (Kannan et al., 2025; Xiong, 2025). In the Pesantren context, varied learning activities, systematic material delivery, and active student participation may be particularly important because students experience learning as part of a broader residential and religious environment. Thus, the finding contextualizes previous evidence by highlighting the importance of instructional practices within Pesantren education. However, because the study is cross-sectional, this relationship should be interpreted as an association rather than evidence of causality.

Technology and learning media show a positive but non-significant relationship with student motivation. This result qualifies previous findings suggesting that multimedia and educational technology can enhance learning motivation (Alqahtani & Rajkhan, 2020; Qianyi & Zhiqiang, 2024). The difference may reflect the specific conditions of Pesantren education, where technology may not automatically translate into greater motivation if its use is not closely integrated with teaching practices. Digital literacy, infrastructure, teacher readiness, and alignment with learning objectives may be relevant factors, but these were not directly measured in this study. Therefore, they should be considered possible explanations rather than established causes of the non-significant finding.

The Pesantren environment has a significant positive relationship with student motivation. This finding confirms previous research showing that supportive learning environments are associated with stronger student motivation and engagement (Alemayehu & Chen, 2023). However, the Pesantren context provides an important qualification because students live, study, interact socially, and participate in religious activities within the same institutional environment. Consequently, discipline, comfort, social relationships, and institutional support may become more closely connected to students' motivational experiences than in conventional day-school settings. The result therefore contextualizes existing evidence within the distinctive residential character of Pesantren education.

Kiai leadership also has a significant positive relationship with student motivation. This finding supports previous studies linking educational leadership with student motivation and learning behavior (Afriza et al., 2024; Haryaka et al., 2023). The distinctive contribution of the present study lies in the Pesantren context, where the kiai is not merely an administrative leader but may also function as an educational guide, role model, and source of religious and institutional direction. This finding therefore contextualizes leadership research by emphasizing the multidimensional role of kiai leadership in shaping students' educational experiences. However, the study does not specifically measure transformational leadership; therefore, the result should not be interpreted as evidence of transformational leadership.

Student motivation demonstrates the strongest relationship with Pesantren educational effectiveness. This finding confirms previous research emphasizing the role of motivation in learning engagement, persistence, and educational outcomes (Alemayehu & Chen, 2023; Huang et al., 2025). In Pesantren, motivation may be particularly important because students are expected to maintain engagement across formal education, religious learning, and residential activities. The strong relationship therefore positions student motivation as an important mechanism for understanding educational effectiveness. Nevertheless, the cross-sectional design prevents causal conclusions.

The indirect-effect results further show significant relationships for pedagogical approach, the Pesantren environment, and kiai leadership with educational effectiveness through student motivation. These findings suggest that motivation may function as an important pathway linking educational conditions with educational effectiveness. However, because the direct effects of these antecedent variables on educational effectiveness were not reported, the results should be interpreted as significant indirect effects rather than as evidence of full or partial mediation.

The significant indirect effect of pedagogical approach through motivation indicates that instructional conditions may be associated with educational effectiveness partly through students' motivational responses. This finding supports research emphasizing the importance of interactive and student-centered learning for student engagement (Christidamayani & Kristanto, 2020). Similarly, the indirect effect of the Pesantren environment suggests that supportive and orderly residential conditions may contribute to educational effectiveness through stronger student motivation, consistent with previous research on learning environments and motivation (Wang et al., 2020). The significant indirect effect of kiai leadership further indicates that leadership may be associated with educational effectiveness through its relationship with student motivation (Afriza et al., 2024; Haryaka et al., 2023).

In contrast, technology and learning media do not show a significant indirect relationship with educational effectiveness through student motivation. This finding qualifies previous research on the motivational benefits of educational technology (Qianyi & Zhiqiang, 2024). It does not indicate that technology is unimportant in Pesantren education; rather, its contribution may depend on how technology is integrated into pedagogy and supported by digital competence and infrastructure. Since these factors were not measured, future research should examine them directly

From a theoretical perspective, this study provides a TPB-informed interpretation rather than a direct test or validation of the Theory of Planned Behavior. The original TPB constructs were not directly measured in the present model. Instead, the findings contextualize the broader idea that behavioral and educational conditions may be related to motivational processes within a specific institutional setting. The Pesantren context is particularly relevant because educational experiences are influenced simultaneously by instructional practices, residential conditions, religious values, and kiai leadership.

From a practical perspective, Pesantren management should prioritize interactive pedagogical practices, supportive and disciplined environments, and effective kiai leadership to strengthen students' motivation. Technology integration should be implemented strategically rather than assuming that increased technology use will automatically improve motivation. Attention should also be given to digital competence,

teacher readiness, infrastructure, and pedagogical alignment. Future studies should use longitudinal designs, broader samples, and multiple data sources to strengthen causal interpretation and reduce potential common method bias. Further research should also examine digital literacy and technology readiness to explain why technology and learning media were not significantly associated with student motivation in this study.

5. Conclusion

This study finds that student motivation is strongly associated with the effectiveness of Pesantren education. Pedagogical approach, the Pesantren environment, and kiai leadership show significant positive relationships with student motivation, whereas technology and learning media do not. Student motivation also has a strong positive relationship with Pesantren educational effectiveness and represents a significant indirect pathway linking pedagogical approach, the Pesantren environment, and kiai leadership with educational effectiveness. The indirect pathway involving technology and learning media is not significant.

The specific contribution of this study is to contextualize these relationships within Pesantren education, where instructional practices, residential environments, and kiai leadership operate together as part of students' educational experiences. The findings indicate that student motivation should be considered alongside pedagogical, environmental, and leadership conditions when understanding educational effectiveness in Pesantren. The study also qualifies the assumption that technology use necessarily strengthens student motivation, suggesting that its contribution may depend on contextual conditions that were not examined in this study.

Theoretically, the study provides a TPB-informed interpretation of student motivation within the Pesantren context rather than directly testing or validating the original Theory of Planned Behavior, as its core TPB constructs were not explicitly measured. Practically, Pesantren administrators and educators should strengthen interactive pedagogical practices, supportive learning environments, and constructive kiai leadership. Technology integration should be aligned with pedagogical objectives and supported by appropriate competencies and infrastructure.

This study has several limitations. Its cross-sectional design limits causal interpretation, purposive sampling limits the generalizability of the findings, and the use of self-reported measures may introduce common method bias. In addition, technology-related factors such as digital literacy, teacher readiness, technology integration practices, and infrastructure readiness were not directly measured. Future research should therefore employ longitudinal or mixed-method designs, use broader and more diverse Pesantren samples, and incorporate multiple data sources such as teacher assessments, institutional records, and observations. Future studies should also directly examine digital literacy, teacher readiness, technology integration, and infrastructure readiness to clarify the conditions under which technology and learning media may contribute to student motivation and educational effectiveness. Overall, student motivation represents a central factor in understanding Pesantren educational effectiveness, linking the quality of pedagogical practices, the Pesantren environment, and kiai leadership with students' educational experiences and outcomes.

Declarations

Author Contribution Statement

Ricka Handayani conceived the study, conducted the data analysis, and drafted the manuscript. Esli Zuraidah Siregar contributed to the research design, data interpretation, and manuscript revision. Ahmad Afandi contributed to the theoretical framework and critically reviewed the manuscript. Izra Berakon supervised the research, provided methodological guidance, and approved the final manuscript. All authors read and approved the final version of the manuscript.

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Additional Information

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