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Elevating Educational Quality: The Synergistic Impact of Principal Supervision, Learning Environment, and Teacher Pedagogy

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ABSTRACT

Improving learning quality in Integrated Islamic Elementary Schools (SDIT) in Merangin Regency requires principal academic supervision, a supportive learning environment, and teachers' pedagogical competence. This quantitative ex post facto survey examined the extent to which these three variables predicted learning quality. Data were collected from 86 teacher respondents through a Likert-type questionnaire using saturated sampling of the accessible SDIT teacher population. The data were analyzed using descriptive statistics, assumption tests, simple linear regression, multiple linear regression, t-tests, an F-test, and coefficients of determination. The results show that principal academic supervision significantly predicted learning quality ($R^2 = 0.232$ or 23.2%), the learning environment significantly predicted learning quality ($R^2 = 0.264$ or 26.4%), and Teacher Pedagogical Competence was the strongest individual predictor ($R^2 = 0.298$ or 29.8%). Simultaneously, the three predictors explained 46.5% of the variance in learning quality. These findings indicate that learning quality is associated with the combined strengthening of instructional leadership, school learning conditions, and teacher pedagogical capacity.

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1. INTRODUCTION

Learning quality remains a central concern in elementary education because it fundamentally shapes students' participation, achievement, creativity, behavior, and learning attitudes. Achieving this quality cannot be reduced to the mere transfer of subject matter. Instead, it requires highly organized instruction, active student engagement, relevant learning resources, and a classroom climate that supports meaningful interaction [1]. This level of interaction depends heavily on how teachers organize instruction, build rapport, and make complex learning tasks understandable to their students. Recent research on teaching characteristics emphasizes that instructional clarity and structured learning activities directly

shape students' learning experiences, especially when content and classroom dynamics are managed carefully [2]. Consequently, quality learning must create space for learners to contribute to classroom meaning-making. A whole-class co-creation approach further demonstrates that student participation is significantly strengthened when teachers actively invite learners to discuss, question, and refine learning activities together [3].

To cultivate an interactive, high-quality learning process, teachers require strong institutional support, primarily through principal-level academic supervision. Supervision plays a vital role by helping teachers plan instruction, select appropriate strategies, integrate learning media, assess student progress, and systematically reflect on classroom problems. However, to be effective, supervision must function as professional assistance that genuinely enhances teacher professionalism, rather than as a narrow, punitive inspection [4]. The collaborative dimension of this supervision is particularly important because teachers tend to improve more consistently when the feedback they receive is collegial. Such collaborative supervision encourages deep reflection and increases teachers' intensity in utilizing performance-based learning [5]. Furthermore, exercising this kind of academic leadership requires principals to develop their capacity to respond to institutional changes continuously. Recent leadership development research reinforces this by emphasizing that academic leaders themselves need clear support systems to effectively address contemporary educational challenges [6].

In addition to instructional leadership, the physical and psychosocial context in which teaching occurs, and the learning environment, significantly determine how instruction takes place. A genuinely supportive environment encompasses adequate physical facilities, safe and orderly classrooms, highly accessible learning resources, positive teacher-student relationships, and a robust school culture that encourages participation. Educational leadership studies confirm that school-level support is deeply connected to instructional quality precisely because it strengthens the daily conditions in which teachers and students work [7]. Beyond physical spaces, modern learning quality also relies heavily on the alignment between technological support, pedagogy, and learner outcomes. Technological and pedagogical models indicate that instructional media must serve specific learning goals rather than merely functioning as classroom accessories [8]. In digital learning environments, instructional quality depends on seamless alignment among digital tools, pedagogical methods, and learner readiness. This point is highly relevant for Integrated Islamic Elementary Schools (SDIT), which must continuously adapt their teaching practices to meet changing student experiences and integrate modern digital learning resources [9]. Ultimately, student engagement serves as a highly practical indicator of whether the overall learning environment effectively supports active learning, as studies on e-learning engagement consistently show that learning design and environmental support strongly influence learner participation [10].

While leadership and supportive environments lay the vital groundwork, the direct catalyst for quality learning is the teacher's pedagogical competence. Teachers must be able to understand learner characteristics, expertly design lesson plans, implement interactive teaching, analyze assessment results, and flexibly adjust strategies to meet specific student needs. Competency-domain studies conceptualize this educator competence as a complex

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blend of knowledge, skills, attitudes, and the professional judgment required to support learning [11]. Crucially, pedagogical competence should not be viewed in isolation; it is a professional domain developed through a combination of effective supervision, performance satisfaction, and robust institutional support. For instance, recent studies in Indonesian schools highlight that targeted academic supervision and high teacher satisfaction significantly contribute to stronger pedagogical competence [12].

Furthermore, evidence from teacher competence research indicates that pedagogical knowledge and physical learning facilities are deeply interconnected factors in determining teaching quality. Teachers not only need adequate facilities but also pedagogical knowledge to transform those facilities into meaningful learning activities [13]. Observations from pre-service teacher studies further reinforce the idea that pedagogical competence remains a key indicator of educational quality, shaping how educators interpret curriculum, assessment, and classroom interaction [14]. This competence has become increasingly vital as schools face rapid instructional changes, a fact underscored by research showing that teacher education and digital competence determine teachers' readiness to adapt instruction during unexpected disruptions such as school closures [15].

Despite the established theoretical importance of leadership, environment, and pedagogical competence, practical challenges frequently persist at the local level. In SDIT Merangin Regency, preliminary observations revealed several pressing learning problems. Specifically, some teachers still relied heavily on monotonous teaching methods, used limited instructional media, experienced noticeable gaps between their formal lesson planning and classroom implementation, and struggled in adapt to ongoing curriculum changes. These localized challenges demonstrate that learning quality in this context cannot be adequately explained or addressed by focusing solely on teacher factors. Leadership support and the overall learning environment clearly demand equal attention.

While previous studies have actively discussed academic supervision, learning environment, and teacher competence, many have examined these variables in isolation or within much broader, less specific school contexts. To date, limited academic attention has been given to understanding how these three specific variables jointly predict learning quality within the unique setting of Integrated Islamic Elementary Schools at the regency level. This study strategically addresses that gap by testing their individual and simultaneous predictive relationships with learning quality at SDIT Merangin Regency. Specifically, this study aimed to test four central hypotheses: H1, principal academic supervision significantly predicts learning quality; H2, the learning environment significantly predicts learning quality; H3, teacher pedagogical competence significantly predicts learning quality; and H4, the three variables simultaneously predict learning quality. Because the study employed a quantitative ex post facto survey design, it is important to note that the resulting analysis focused primarily on establishing statistical associations and predictions, rather than providing direct causal proof.

2. METHOD

This study used a quantitative survey method with an ex post facto design [16]. The design was selected because the variables had already occurred in the school context and

were not manipulated by the researcher. The study was conducted at Integrated Islamic Elementary Schools (SDIT) in Merangin Regency. The independent variables were principal academic supervision (X1), learning environment (X2), and teacher pedagogical competence (X3), while the dependent variable was learning quality (Y).

The accessible population consisted of teachers who taught at SDIT in Merangin Regency during the research period. The sample included 86 teacher respondents. The study used saturated sampling of the accessible population, meaning that all teachers who met the criteria and returned usable questionnaires were included in the analysis. This sampling decision was appropriate because the reachable population was limited and directly related to the research problem.

Principal academic supervision was operationally defined as the principal's professional assistance to teachers in improving the teaching and learning process. Its indicators covered inspection, advising, monitoring, coordinating, and reporting. The instrument for this variable consisted of 20 statement items. The learning environment was defined as the physical and psychosocial conditions that support classroom learning. Its indicators covered classroom facilities, learning resources, classroom comfort and safety, social interaction, and learning support. The instrument for this variable consisted of 25 items.

Teacher Pedagogical Competence was defined as the teacher's ability to understand students, plan instruction, implement learning activities, use learning resources, evaluate learning outcomes, and reflect on teaching practice. The instrument for this variable consisted of 22 items. Learning quality was defined as the extent to which learning encourages student participation, achieves learning outcomes, develops creativity and skills, supports positive behavior change, and builds constructive mental attitudes. The instrument for this variable consisted of 25 items.

Data were collected using a structured Likert-type questionnaire. Higher scores indicated stronger perceptions of each measured variable. Instrument quality was examined through content review and empirical item testing. Item validity was assessed using item-total correlation, while reliability was assessed using Cronbach's Alpha. Items that did not meet the validity and reliability criteria were excluded from the final variable scores.

Data analysis was conducted systematically. Descriptive statistics were used to summarize each variable. Assumption testing included normality and linearity tests, followed by checks for multicollinearity, heteroscedasticity, and error independence when the full regression output was available. Hypotheses H1, H2, and H3 were tested using simple linear regression and t-tests. Hypothesis H4 was tested using multiple linear regression and an F-test. The coefficient of determination (R^2) was used to interpret the proportion of variance in learning quality explained by each predictor and by the three predictors simultaneously. The significance level was set at 0.05.

3. RESULTS AND DISCUSSION

3.1. Description of Research Results

After the questionnaires were returned and screened, 86 valid responses were analyzed. The descriptive statistics in Tables 1-4 summarize the score distribution of each

research variable. In these descriptive tables, the column labeled Items refers to the number of questionnaire items per indicator, and the total number of respondents across all variables was 86.

Table 1. Descriptive Statistics of Principal Academic Supervision (n = 86 respondents)

	Items	Minimum	Maximum	Mean	Standard Deviation
Inspection	4	340	420	385.25	6.150
Advising	4	345	425	388.10	6.020
Monitoring	4	338	418	384.75	6.430
Coordinating	4	342	422	387.40	5.980
Reporting	4	344	426	389.55	6.110
Total Statement Items	20				

Table 2. Descriptive Statistics of Learning Environment (n = 86 respondents)

	Items	*Minimum*	*Maximum*	*Mean*	*Standard Deviation*
Classroom facilities and physical condition	*5*	*340*	*420*	*385.60*	6.120
Availability of learning resources and media	*5*	*345*	*425*	*390.20*	5.870
Classroom comfort, safety, and orderliness	*5*	*338*	*418*	*384.10*	6.450
Positive teacher-student and student-student interaction	*5*	*342*	*422*	*387.75*	5.930
School support for active and disciplined learning	*5*	*344*	*426*	*389.30*	6.210
Total Statement Items	*25*				

Table 3. Descriptive Statistics of Teacher Pedagogical Competence (n = 86 respondents)

	Items	Minimum	Maximum	Mean	Standard Deviation
Understanding student characteristics and learning needs	3	340	420	386.20	6.050
Planning instruction and assessment	3	345	425	388.40	6.180
Implementing interactive and meaningful learning activities	5	342	424	387.60	6.210
Using learning media, methods, and resources	4	344	426	389.10	6.070
Evaluating learning outcomes and reflecting on teaching practice	7	346	428	390.25	6.320
Total Statement Items	22				

Table 4. Descriptive Statistics of Learning Quality (n = 86 respondents)

	Items	Minimum	Maximum	Mean	Standard Deviation
Able to Maximize the Role of Students in the Learning Process.	5	348	428	389.75	6.180
Able to achieve the learning outcomes that have been determined.	4	346	426	388.20	6.050
Encouraging the Growth of Students' Creativity and Various Skills to the Maximum.	5	349	429	390.10	6.270
Able to Bring Positive and Constructive Changes in Student Behavior.	4	347	427	389.40	6.120
Cultivating Positive Mental Attitudes such as Love for the Development of Science and Technology, Tolerance, Cooperation, Multiculturalism, Democratic, Dynamic Mental Attitude and Obedience to God.	7	350	432	391.25	6.310
Total Statement Items	25				

Prerequisite Analysis Tests

Table 5. Results of the Kolmogorov-Smirnov Normality Test for the Regression Residuals

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		86
Normal Parameters [a,b]	Mean	0.0000000
	Standard Deviation	2.153421
Most Extreme Differences	Absolute	0.079
	Positive	0.062
	Negative	-0.079
Test Statistics		0.079
Asymp. Sig. (2-tailed)		0.200c,d

Test distribution is Normal.
Calculated from data.
Lilliefors Significance Correction.
This is a lower bound of the true significance.

Table 6. Results of the Linearity Test of Principal Academic Supervision (X1) on Learning Quality (Y)

ANOVA Table							
			Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Quality of Learning * Academic Supervision	Between Groups	(Combined)	1520.341	20	76.017	8.245	0.000
		Linearity	1380.221	1	1380.221	149.56	0.000
		Deviation from Linearity	140.120	19	7.374	0.798	0.697
	Within Groups		607.312	65	9.343		
	Total		2127.653	85			

Table 7. Results of the Linearity Test of the Learning Environment (X2) on Learning Quality (Y)

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Quality Learning * Learning Environment	Between Groups	(Combined)	1655.782	22	75.263	8.915	0.000
		Linearity	1501.437	1	1501.437	177.86	0.000
		Deviation from Linearity	154.345	21	7.350	0.870	0.635
	Within Groups		471.228	63	7.482		
	Total		2127.010	85			

Table 8. Results of the Linearity Test of Teacher Pedagogical Competence (X3) on Learning Quality (Y)

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Quality Learning * Teacher Pedagogical Competence	Between Groups	(Combined)	1702.556	18	94.586	10.257	0.000
		Linearity	1598.422	1	1598.422	173.92	0.000
		Deviation from Linearity	104.134	17	6.125	0.667	0.721
	Within Groups		424.454	67	6.336		
	Total		2127.010	85			

Testing the First Hypothesis (H1): Principal Academic Supervision as a Predictor of Learning Quality

Table 9. Results of the t-Test for Principal Academic Supervision and Learning Quality

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	15.324	3.452		4.438	0.061
	Academic Supervision	*0.532*	*0.107*	*0.482*	4.987	0.006

a. Dependent Variable: Learning Quality

Based on Table 9, principal academic supervision significantly predicted learning quality, with t = 4.987 and p = 0.006. Since p < 0.05 and tcount > ttable (4.987 > 1.662), H1 was accepted. The simple regression equation was Y = 15.324 + 0.532X1. This means that higher academic supervision scores were associated with higher learning quality scores.

Table 10. Coefficient of Determination for Principal Academic Supervision

Model Summary [b]

Model	**R**	**R Square**	**Adjusted R-Square**	**Standard Error of the Estimate**
1	*0.482*	*0.232*	*0.223*	4.215

Predictors: (Constant), Academic Supervision
Dependent Variable: Learning Quality

Based on Table 10, the R-squared value was 0.232. This means that principal academic supervision accounted for 23.2% of the variance in learning quality, while variables outside the simple regression model accounted for the remaining variance.

Testing the Second Hypothesis (H2): Learning Environment as a Predictor of Learning Quality

Table 11. Results of the t-Test for Learning Environment and Learning Quality

Coefficients [a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.876	3.298		3.904	0.011
	Learning Environment	*0.587*	*0.106*	*0.514*	5.568	0.002

a. Dependent Variable: Learning Quality

Based on Table 11, the learning environment significantly predicted learning quality, with t = 5.568 and p = 0.002. Since p < 0.05 and tcount > ttable (5.568 > 1.662), H2 was accepted. The simple regression equation was Y = 12.876 + 0.587X2. This means that a more supportive learning environment was associated with higher learning quality scores.

Table 12. Coefficient of Determination for Learning Environment

Model Summary [b]				
Model	**R**	**R Square**	**Adjusted R-Square**	**Standard Error of the Estimate**
1	0.514	0.264	0.255	4.089

Predictors: (Constant), Learning Environment
Dependent Variable: Learning Quality

Based on Table 12, the R-squared value was 0.264. This means that the learning environment accounted for 26.4% of the variance in learning quality, while variables beyond this simple regression model explained the remaining variance.

Testing the Third Hypothesis (H3): Teacher Pedagogical Competence as a Predictor of Learning Quality

Table 13. Results of the t-Test for Teacher Pedagogical Competence and Learning Quality

Coefficients [a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11.542	3.115		3.704	0.011
	Teacher Pedagogical Competence	0.615	0.101	0.546	6.081	0.006

Dependent Variable: Learning Quality

Based on Table 13, teacher pedagogical competence significantly predicted learning quality, with t = 6.081 and p = 0.006. Since p < 0.05 and tcount > ttable (6.081 > 1.662), H3 was accepted. The simple regression equation was Y = 11.542 + 0.615X3. This means that

higher teacher pedagogical competence scores were associated with higher learning quality scores.

Table 14. Coefficient of Determination for Teacher Pedagogical Competence

Model Summary [b]

Model	R	R Square	Adjusted R-Square	Standard Error of the Estimate
1	0.546	0.298	0.290	3.981

Predictors: (Constant), Teacher Pedagogical Competence
Dependent Variable: Learning Quality

Based on Table 14, the R-squared value was 0.298. This means that teacher pedagogical competence explained 29.8% of the variance in learning quality, while variables outside this simple regression model explained the remaining variance.

Testing the Fourth Hypothesis (H4): Simultaneous Prediction of Learning Quality

Table 15. Results of the F-Test for the Simultaneous Regression Model Learning Environment and Teacher Pedagogical Competence on Learning Quality

ANOVA [a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	912.534	3	304.178	28.976	0.000
	Residual	1051.349	82	12.820		
	Total	1963.883	85			

Dependent Variable: Learning Quality
Predictors: (Constant), Learning Environment, Academic Supervision, Teacher Pedagogical Competence

Based on Table 15, principal academic supervision, learning environment, and teacher pedagogical competence simultaneously predicted learning quality, with F = 28.976 and p = 0.000. Since p < 0.05 and Fcount > Ftable (28.976 > 2.716), H4 was accepted. The original manuscript did not provide the simultaneous Coefficients table, so the exact multiple regression equation cannot be verified from the available output. The Coefficients table should be inserted from the SPSS output before final submission.

Table 16. Coefficient of Determination for the Simultaneous Regression Model

Model Summary [b]

Model	R	R Square	Adjusted R-Square	Standard Error of the Estimate
1	0.682	0.465	0.445	3.242

Dependent Variable: Learning Quality
Predictors: (Constant), Learning Environment, Academic Supervision, Teacher Pedagogical Competence

Based on Table 16, the R-squared value was 0.465. This means that principal academic supervision, learning environment, and teacher pedagogical competence simultaneously explained 46.5% of the variance in learning quality, while 53.5% was explained by other variables not examined in this study.

3.2. DISCUSSION

The Relationship between Principal Academic Supervision and Learning Quality at SDIT Merangin Regency

The findings of this study demonstrate that principal academic supervision is significantly associated with learning quality, explaining 23.2% of its variance. This empirical result provides a strong quantitative basis for the argument that instructional leadership is not merely an administrative formality but a structural necessity for educational excellence. It indicates that supervision has substantial practical value, particularly when it actively supports teacher development through structured guidance, constructive feedback, continuous monitoring, strategic coordination, and transparent reporting. Consequently, learning quality in elementary schools is highly sensitive to the presence of active and engaged school leaders.

This result aligns with the contemporary view that supervision most effectively improves teacher performance when principals use it as professional assistance rather than a rigid evaluation tool [4]. Historically, supervision was often perceived by teachers as a fault-finding mission, which frequently resulted in anxiety rather than improvement. By shifting the paradigm toward professional assistance, principals can create a psychologically safe space where teachers feel comfortable discussing their pedagogical shortcomings. This supportive atmosphere is a fundamental prerequisite for any meaningful enhancement in classroom instruction.

In the specific context of SDIT Merangin Regency, academic supervision is critically important, as preliminary observations have revealed concrete pedagogical hurdles. Teachers reported ongoing challenges with selecting teaching methods, integrating instructional media, executing lesson plans, and developing a deeper understanding of evolving curricula [17]. These specific challenges cannot be resolved through individual trial and error alone; they require the diagnostic eye and targeted mentorship that only effective academic supervision can provide. Therefore, the 23.2% variance explained by this variable directly reflects the principal's role in mitigating these local instructional bottlenecks.

The teacher-coaching literature offers a profound explanation of why supervision must prioritize concrete, actionable feedback over mere administrative inspection. Coaching is strongly associated with genuine improvements in instruction when teachers receive focused guidance closely tied to their daily classroom practice [18]. When a principal observes a class and provides specific strategies for managing student behavior or explaining a complex mathematical concept, the teacher gains immediate, applicable knowledge. This micro-level intervention is what ultimately aggregates into macro-level improvements in school-wide learning quality.

Furthermore, the collaborative dimension of this supervisory process cannot be overstated. Collaborative supervision encourages deeper reflection and significantly increases teachers' intensity in using performance-based learning strategies [5]. When principals and teachers analyze classroom data together, the resulting instructional adjustments are more likely to be sustained. This collegial approach breaks down the traditional hierarchical barriers in school administration, fostering a community of practice

where continuous improvement becomes a shared cultural norm rather than a top-down mandate.

To sustain these improvements, professional development must be viewed as a continuous journey rather than an episodic event. Effective professional development works best when it includes integrated mechanisms that systematically build a teacher's insight, motivation, technique, and practical application. This means that supervision at SDIT must not stop at merely checking the administrative completeness of lesson plans. Instead, it must serve as the primary bridge connecting teachers with broader professional development activities that genuinely transform their instructional behavior [19].

The necessity of this ongoing approach is heavily supported by broader educational research. Continuous professional development (CPD) is highly relevant because true teacher growth requires recurring, iterative learning opportunities where new skills can be practiced, evaluated, and refined. A systematic review on CPD and teaching quality strongly confirms the universal need for ongoing development that directly and practically supports classroom instruction [20]. Academic supervision, therefore, serves as the localized engine driving this continuous professional development at the school level.

Finally, recent evidence from Indonesian primary schools strongly corroborates this study's findings, highlighting a robust link between academic supervision, pedagogical competence, and ultimate learning quality [21]. This reinforces the interpretation that the findings at SDIT Merangin are not isolated anomalies, but reflect wider national educational dynamics. The data simultaneously confirms that principal academic supervision, teacher competence, and the work environment must jointly support teacher productivity [22]. Thus, academic supervision remains the vital catalyst that activates and sustains the other elements of educational quality.

This interpretation is further strengthened by a large-scale synthesis of principal effects, which shows that effective principals influence student learning through instruction-focused work with teachers, productive school climate, personnel development, and organizational management [23]. For SDIT Merangin, this means that supervision should be embedded in routine leadership practice rather than treated as a separate administrative event. Principals need to convert classroom evidence into targeted mentoring because the strongest supervisory value lies in feedback that helps teachers improve lesson design, classroom interaction, and assessment practice.

The Relationship between Learning Environment and Learning Quality at SDIT Merangin Regency

The analysis reveals that the learning environment is a highly significant predictor, explaining 26.4% of the variance in learning quality. This substantial contribution highlights that cognitive development and academic achievement do not occur in a vacuum; they are deeply embedded in the student's physical and psychological surroundings. The result strongly suggests that learning quality improves when both teachers and students operate in classrooms that are not only structurally safe and orderly but also highly resourceful and psychologically nurturing.

Crucially, the concept of a learning environment extends far beyond mere physical buildings, desks, or infrastructural facilities. While physical safety is foundational, the

psychosocial dimensions, such as the quality of teacher-student interactions, the prevailing school culture, classroom discipline, and equitable access to learning resources, play an equally pivotal role [8]. A school might possess state-of-the-art facilities, but if the classroom atmosphere is highly stressful or socially disconnected, the overall quality of learning will inevitably suffer. Therefore, measuring the learning environment requires a holistic perspective.

The learning environment findings also reflect the science of learning and development, which emphasizes that learning improves when schools provide safe relationships, developmental support, meaningful learning opportunities, and coherent instructional conditions [24]. In this study, classroom comfort, resources, safety, interaction, and school support are therefore not peripheral factors. They create the emotional and cognitive conditions that allow students to engage with tasks, take academic risks, and participate in classroom dialogue.

This finding heavily supports the theoretical argument that optimal learning quality depends on a seamless alignment between instructional resources, teaching methodologies, student readiness, and the broader educational setting. When these elements are disjointed, for example, if an advanced curriculum is deployed in a poorly equipped or overcrowded classroom, the friction diminishes the learning experience. Educational leadership studies confirm that school-level support is linked to instructional quality because it strengthens the very conditions under which teachers and students interact daily [7].

In contemporary educational contexts, particularly in progressive institutions like SDIT, the digital learning environment has emerged as a critical sub-component of this variable. Modern learning quality increasingly depends on the sophisticated alignment between technological support, pedagogical frameworks, and learner outcomes. Technological and pedagogical models explicitly emphasize that instructional media and digital tools must rigorously serve defined learning goals rather than merely serve as modern classroom accessories [8].

The integration of these digital environments further demonstrates that learning quality is highly contingent upon the synergy between technological tools, teacher pedagogy, and learner readiness. This point is particularly relevant for SDIT Merangin, as Islamic elementary schools must adapt their traditional teaching practices to align with changing student experiences and the proliferation of digital learning resources [9]. A supportive learning environment today must seamlessly blend physical comfort with digital accessibility to maintain high instructional standards.

Furthermore, student engagement is the most visible and practical indicator of whether a school's learning environment is functioning as intended. Studies focusing on learning environments consistently show that careful learning design and robust environmental support directly influence the extent to which learners participate in the instructional process [10]. When a classroom is physically comfortable and emotionally supportive, students exhibit lower anxiety, higher willingness to ask questions, and a greater propensity for collaborative problem-solving.

The psychosocial dimension of the environment deserves special attention because school climate can shape students' academic self-efficacy and achievement [25]. A positive

climate helps students believe that they can complete learning tasks and receive support when they face difficulty. This mechanism is important for SDIT Merangin, where learning quality depends not only on facilities but also on students' confidence, classroom discipline, and the quality of teacher-student relationships.

From a practical implementation standpoint, this implies that school management at SDIT Merangin must adopt an integrated approach to school improvement. Administrators cannot afford to separate environmental upgrades from human resource development, because both profoundly shape how learning materializes in the classroom [8]. For instance, investing in new scientific equipment (environmental improvement) must be paired with training teachers to facilitate inquiry-based science lessons (human resource development).

Ultimately, creating and sustaining this high-quality learning environment is a core responsibility of school leadership. Implementation studies demonstrate that an environment conducive to learning is actively cultivated when principals treat supervision and environmental management as an integrated cycle of diagnosis, assistance, and continuous improvement [26]. By proactively identifying environmental deficits and allocating resources to resolve them, leadership directly clears the path for teachers to deliver high-quality instruction uninterrupted by logistical or psychosocial barriers.

The Relationship between Teacher Pedagogical Competence and Learning Quality at SDIT Merangin Regency

Among the three independent variables analyzed, Teacher Pedagogical Competence emerged with the highest individual explanatory power, accounting for 29.8% of the variance in learning quality. This empirically dominant position is highly logical, as pedagogical competence represents the variable situated closest to the actual point of instructional delivery. Regardless of the broader school vision or infrastructural investments, the teacher remains the ultimate filter through which the curriculum reaches the student, making their competence the most critical determinant of educational success.

The profound impact of this competence stems from the complex, multifaceted nature of a teacher's daily responsibilities. Teachers are tasked with translating abstract national curricula into concrete, digestible lesson plans. They must judiciously select teaching strategies, dynamically manage classroom interactions, accurately evaluate student progress, and continuously respond to highly diverse student learning needs. Because the teacher orchestrates all these moving parts simultaneously, educator competence stands as the absolute central requirement for achieving learning quality [11].

Pedagogical competence dictates not just *what* is taught, but *how* it is received. It exercises a stronger individual relationship with learning quality precisely because students experience the direct consequences of this competence in every single lesson. Even in scenarios where principal supervision is exceptionally supportive and school physical conditions are pristine, the ultimate quality of the learning experience will falter if the teacher lacks the pedagogical skill to design and deliver engaging instruction.

The dominant role of pedagogical competence is also consistent with evidence from elementary science education, which shows that teacher competence affects student outcomes through teaching quality, particularly cognitive activation, a supportive climate, and classroom management [27]. This supports the present finding because pedagogical

competence works through observable classroom behavior. Teachers who understand content, student characteristics, and assessment can transform supervision and facilities into learning experiences that are clearer, more interactive, and more responsive to student needs.

Furthermore, this competence is not an innate talent, but a deeply cultivated professional domain. It requires continuous nurturing through a combination of effective supervision, high performance satisfaction, and robust institutional support. A localized study in Indonesian schools directly corroborates this, finding that intensive academic supervision coupled with teacher satisfaction contributed substantially to stronger pedagogical competence [12]. This highlights that while teacher competence is the strongest predictor of student success, the competence itself relies heavily on organizational support to flourish.

The intersection between pedagogical knowledge and the learning environment also demands careful analysis. Evidence from comprehensive research on teacher competence indicates that pedagogical knowledge and physical learning facilities must be treated as deeply interconnected. Teachers absolutely need adequate facilities to teach effectively, but conversely, they also desperately need advanced pedagogical knowledge to transform those static facilities into dynamic, meaningful learning activities [13]. A laboratory is useless without a teacher competent in inquiry-based pedagogy.

This requirement for high-level pedagogical competence is further highlighted in studies examining pre-service educators. Research shows that pedagogical competence remains the definitive indicator of future education quality because it fundamentally shapes how new teachers understand curriculum frameworks, design fair assessments, and navigate complex classroom interactions [14]. If the pedagogical foundation is weak, the subsequent delivery of any subject matter will inherently lack depth, engagement, and adaptability.

The urgency of maintaining high pedagogical competence has only accelerated as schools face rapid, unprecedented instructional changes. Modern teaching demands flexibility, a fact distinctly highlighted by research on online teaching during sudden school closures. This research shows that foundational teacher education, combined with digital competence, directly determines a teacher's readiness to adapt their instruction under pressure [15]. In the current era, pedagogical competence must seamlessly integrate digital literacy [28].

Finally, a teacher-leadership perspective reinforces the notion that teacher quality grows most effectively through professional agency and shared institutional responsibility. This perspective strongly supports the finding that pedagogical competence should not be developed in isolation, but alongside principal supervision and institutional enhancements [29]. This aligns perfectly with elementary school research establishing pedagogical competence as a dominant predictor [30], confirming that investing directly in teacher capacity yields the highest return on learning quality.

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The Simultaneous Relationship among Principal Academic Supervision, Learning Environment, Teacher Pedagogical Competence, and Learning Quality

The simultaneous regression model reveals the most comprehensive insight of the study: principal academic supervision, the learning environment, and teacher pedagogical

competence collectively explain 46.5% of the variance in learning quality. This substantial percentage mathematically confirms that learning quality at SDIT Merangin Regency is not generated by any single isolated factor. Rather, it is the synergistic product of an interactive ecosystem where leadership support, institutional conditions, and human capacity continuously reinforce one another.

This simultaneous finding vividly illustrates the interconnected nature of school ecosystems. For instance, high teacher pedagogical competence cannot reach its maximum potential in a chaotic, under-resourced learning environment. Similarly, a pristine learning environment yields little academic benefit if the teachers lack the pedagogical skills to make use of it, or if the principal fails to provide the academic supervision necessary to align teaching with school goals. Collaborative supervision research perfectly encapsulates why these organizational factors must synchronize to produce optimal educational outcomes [5].

The simultaneous model further suggests that teacher growth depends on the professional environment in which the teacher operates. Evidence on school professional environments shows that teachers improve more over time when they work in settings with orderly discipline, collaboration, supportive leadership, effective professional development, trust, and fair evaluation [31]. This supports the 46.5% simultaneous contribution found in this study, as academic supervision, the learning environment, and teacher pedagogical competence form a single professional ecosystem rather than three isolated inputs.

While the explained variance of 46.5% is robustly statistically significant in social science research, it is crucial to acknowledge the remaining 53.5% of the variance analytically. This unexplained portion indicates that learning quality is also significantly shaped by variables deliberately outside the scope of this study. These unmeasured factors likely include students' socioeconomic backgrounds, inherent internal motivation, parental involvement at home, the specific design of the national curriculum, and students' nutritional or psychological well-being. Recognizing this missing variance ensures a balanced, scientifically modest interpretation of the data.

Despite the unmeasured variables, the practical implications derived from the 46.5% explained variance provide a clear, actionable roadmap for educational stakeholders. First, regarding leadership, school principals must internalize that academic supervision cannot be a sporadic, end-of-semester administrative chore. They must commit to conducting supervision regularly, supportively, and collaboratively, positioning themselves as instructional mentors who actively help teachers troubleshoot real-time classroom dilemmas.

Second, regarding structural conditions, school management boards and foundations must prioritize the continuous improvement of the learning environment. This intervention must be two-pronged: physically upgrading classrooms, ensuring adequate ventilation, safety, and modern learning resources; and psychologically fostering a school climate rooted in mutual respect, positive discipline, and strong teacher-student rapport. An environment that feels safe and resourceful naturally breeds higher student engagement.

Third, regarding human capital, policy emphasis must pivot strongly toward continuous professional development. Teachers require systemic support to regularly upgrade their pedagogical competence, with a specific focus on advanced lesson planning, differentiated learning strategies, authentic classroom assessment, and reflective practice.

Education policymakers at the regency level must allocate specific funding and time to support leadership training and teacher competence programs tailored for integrated Islamic elementary schools.

While these findings offer vital insights, it is necessary to outline the study's methodological limitations. The primary limitation is reliance on self-reported data from teacher questionnaires. Consequently, the data inherently reflect teacher perceptions and self-assessments, which may be subject to social desirability bias, rather than objective third-party classroom observations. Additionally, because the study utilized an ex post facto design, the statistical models can only definitively establish predictive associations, not absolute causal proof.

To build upon this foundation, future research must actively address these methodological constraints. Subsequent studies should aim to involve significantly broader geographical samples, comparing SDITs across multiple regencies or against public school equivalents. Crucially, future research must employ mixed-method designs that combine perceptual questionnaires with direct, rigorous classroom observation, in-depth qualitative interviews, and hard data on student academic achievement. Such comprehensive approaches will ultimately provide an even stronger, more granular understanding of how leadership, environment, and competence truly shape the realities of elementary education.

4. CONCLUSION

This study shows that learning quality at SDIT Merangin Regency is associated with three connected factors: principal academic supervision, the learning environment, and teacher pedagogical competence. Each variable significantly predicts learning quality, and the simultaneous model explains 46.5% of its variance. Teacher Pedagogical Competence has the strongest individual explanatory power, followed by the learning environment and principal academic supervision. The main insight is that learning quality improves when school leadership, classroom conditions, and teacher capacity develop together.

The findings suggest several practical recommendations. Principals should conduct regular, supportive, and collaborative academic supervision that helps teachers solve instructional problems. Schools should improve both physical and psychological learning environments, including classroom comfort, learning resources, student safety, and positive interaction. Teachers should receive continuous professional development in pedagogy, assessment, classroom management, and reflective teaching.

Future research should use broader samples from different school types and regions. It should also combine questionnaires with classroom observation, student achievement data, interviews, and document analysis. Such research can provide stronger evidence about how leadership, environment, and teacher competence shape learning quality in elementary education.

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