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The Influence of Science Laboratory Management and Educational Facilities on Students' Learning Interest at Public Junior High Schools in Paal 2 District, Manado City

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ABSTRACT

Science laboratory management and the availability of educational facilities are critical factors in supporting effective science learning; however, suboptimal laboratory utilization and limited instructional resources remain persistent challenges in many Indonesian schools, particularly at the junior secondary level. This study aims to analyze the influence of science laboratory management and educational facilities on students' learning interest at public junior high schools in Paal 2 District, Manado City. A quantitative ex post facto approach was employed, with data collected through validated structured questionnaires from 163 students selected using proportional random sampling from a population of 275 Grade VIII students. Data were analyzed using multiple linear regression with partial (t-test) and simultaneous (F-test) hypothesis testing. The results demonstrated that: (1) science laboratory management had a positive and significant influence on students' learning interest (β = 0.452, t = 10.986, $p < 0.001$); (2) educational facilities had a positive and significant influence on students' learning interest ($\beta = 0.356$, $t = 5.071$, $p < 0.001$); and (3) both variables simultaneously exerted a significant effect on learning interest ($F = 78.235$, $p < 0.001$), collectively explaining 49.4% of the variance ($R^2 = 0.494$). Laboratory management emerged as the stronger predictor (standardized β = 0.620) compared to educational facilities (standardized β = 0.286). These findings indicate that well-managed laboratories combined with adequate educational facilities are essential to fostering higher levels of student interest in science learning, implying that school administrators and policymakers should prioritize systematic laboratory management alongside facility improvement to enhance the quality of science education.

Keywords: educational facilities, junior high school, quantitative research, science laboratory management, students' learning interest.

INTRODUCTION

Science education at the junior secondary level plays a pivotal role in developing students' scientific competencies, including critical thinking, problem-solving, and inquiry-based skills. Among the various components that support science education, the science laboratory occupies a central position as a space where theoretical knowledge is translated into direct experiential learning (Fitriyati, 2017; Mastika, 2014). Laboratory activities enable students to construct scientific concepts independently, develop process skills, and engage affectively with science, all of which are foundational to cultivating sustained learning interest (Simatupang, 2018).

Learning interest, broadly defined as a student's disposition toward engaging with and persisting in academic activities, is recognized as one of the most important determinants of academic achievement (Rusmiati, 2017; Slameto, 2013). Friantini and Winata (2019) identify five key indicators of learning interest: a sense of enjoyment, attentional focus, intrinsic motivation, active participation, and goal-directed effort. When students find science activities engaging and meaningful, particularly through hands-on laboratory experiences, they are more likely to sustain their interest and ultimately achieve higher learning outcomes (Hidi & Renninger, 2006).

Existing literature consistently affirms the importance of the science laboratory in supporting science education quality. Sari and Yuliani (2022) found that science laboratory management directly enhanced students' learning interest and readiness, particularly when practical activities were aligned with curriculum content. Anjani and Ramadhan (2023) demonstrated that structured and well-managed laboratory utilization improved science literacy and problem-solving skills. Setiawan et al. (2021) reported that the availability of adequate practical equipment promoted active student engagement and elevated learning motivation. Furthermore, Putra and Sukirman (2022) established a positive correlation between systematic laboratory governance, from planning and utilization to evaluation, and student motivation in science subjects. More recently, Nugraha and Mulyani (2024) provided evidence that learning facility quality significantly influences learning interest in science. These studies collectively confirm that both laboratory management and physical facilities are meaningful predictors of students' academic engagement in science (see Table 2 for a systematic comparison).

Despite the growing body of evidence, several notable gaps remain. First, most existing studies examine either laboratory facility availability or management practices in isolation, and few have attempted to integrate both predictors within a single simultaneous regression model. Second, the majority of available studies focus on motivational or cognitive outcomes (e.g., science literacy, process skills), whereas learning interest, a distinct construct related to intrinsic engagement, has received comparatively less attention as a dependent variable. Third, there is a scarcity of empirical evidence from specific urban school clusters in eastern Indonesia, including Manado City, which has its own socio-educational characteristics that may differ from more frequently studied regions. As noted by Anggereni et al. (2021), laboratory facilities at many junior secondary schools remain below optimal

standards, yet a comprehensive analysis linking managerial quality, facility adequacy, and learning interest has not been conducted in the Paal 2 District context.

This study addresses the aforementioned gaps by offering three distinct contributions. First, it adopts a comprehensive conceptualization of science laboratory management, covering five managerial dimensions, planning, organizing, implementation, supervision, and maintenance, rather than limiting assessment to facility inventory alone. Second, it incorporates both science laboratory management and educational facilities as simultaneous predictors of students' learning interest within a unified regression model, providing a more integrated understanding of how these factors interact to shape student engagement. Third, the study is situated within the specific empirical context of public junior high schools in Paal 2 District, Manado City, generating new contextual evidence that can serve as a basis for school evaluation and policy formulation in this region. In doing so, this research not only extends theoretical knowledge on educational management and student learning interest, but also contributes practical insights for educational practitioners and decision-makers at the local level.

Based on the research background described above, this study aims to: (1) analyze the influence of science laboratory management on students' learning interest; (2) analyze the influence of educational facilities on students' learning interest; and (3) analyze the simultaneous influence of both science laboratory management and educational facilities on students' learning interest at public junior high schools in Paal 2 District, Manado City.

THEORETICAL FRAMEWORK

Students' Learning Interest

Learning interest is defined as a student's psychological readiness and tendency to pay sustained attention to and engage actively with learning activities (Nurhasanah & Sobandi, 2016). According to Hidi and Renninger's (2006) four-phase model of interest development, interest evolves from situational triggers to deeply internalized personal interest through repeated engagement with meaningful content. In science education, laboratory activities serve as powerful situational triggers that, when well-managed, can evolve into stable personal interest (Renninger & Hidi, 2016). Slameto (2013) emphasizes that learning interest is strongly influenced by the match between instructional stimuli and students' intrinsic inclinations. Safari (2003) operationalizes learning interest through four measurable indicators: (1) sense of enjoyment, (2) attraction to subject content, (3) attentional focus, and (4) active involvement, each of which formed the basis of the measurement instrument used in the present study.

Science Laboratory Management

Science laboratory management encompasses the systematic administration of all activities and resources associated with laboratory use in educational settings (Irjus, 2020). Drawing on classical management theory (Terry, 2006; Fayol, 1949), laboratory management can be analyzed through five functional dimensions: planning (scheduling, standard operating procedures), organizing (personnel and material arrangement), implementation (conducting practical activities), supervision (monitoring safety and procedure compliance), and maintenance (upkeep of equipment and facilities). Ridwan

Abdullah Sani (2021) emphasizes that proficient laboratory managers must not only maintain operational efficiency but actively cultivate students' science process skills through well-designed practical activities. When these managerial functions are fulfilled cohesively, they create a structured and safe learning environment conducive to deep scientific inquiry (Septialni et al., 2023).

Educational Facilities

Educational facilities, encompassing both sarana (instructional tools and materials) and prasarana (infrastructure such as laboratory space, utilities, and safety equipment), are essential preconditions for effective science learning. Indonesian national education standards (Permendiknas No. 24, 2007) prescribe specific minimum criteria for science laboratory facilities at the junior secondary level, including a minimum floor area of 2.4 m² per student, adequate lighting and ventilation, clean water access, and a minimum practical equipment set. Barrett et al. (2015) provide empirical evidence that the physical quality of the learning environment, including facility completeness and design, meaningfully affects student engagement and learning outcomes. Vygotsky's (1978) sociocultural theory further posits that cognitive development is mediated by the quality of the physical and social learning environment, suggesting that inadequate facilities constrain students' opportunities for hands-on scientific discovery.

The theoretical framework of this study integrates management theory (Terry, 2006) with interest development theory (Hidi & Renninger, 2006) and environmental learning theory (Vygotsky, 1978). Science laboratory management represents the managerial variable that shapes the quality of practical learning experiences; educational facilities represent the physical enablers of those experiences; and students' learning interest represents the affective outcome. The combined influence of effective management and adequate facilities is hypothesized to generate a learning environment in which students' situational interest evolves into sustained personal interest in science, consistent with the model proposed by Slameto (2015) regarding the role of external factors in shaping learning motivation.

METHOD

Research Design

This study employed a quantitative ex post facto design. An ex post facto approach was selected because the researcher did not manipulate variables directly but instead measured and analyzed naturally occurring variations in laboratory management, educational facilities, and student learning interest. Data were collected through a structured questionnaire survey during January to March 2026.

Population and Sample

The population comprised 275 Grade VIII students enrolled at two public junior high schools in Paal 2 District, Manado City: SMP Negeri 2 Manado (n = 246) and SMP Negeri 9 Manado (n = 29). Using Slovin's formula at a 5% margin of error, a minimum sample size of 163 was determined. Respondents were selected using proportional random sampling to ensure proportional representation

from each school.

Instrumentation

Three validated questionnaire scales were developed on a five-point Likert format (1 = strongly disagree; 5 = strongly agree):

1. Science Laboratory Management (X1): 13 valid items across five dimensions: planning, organizing, implementation, maintenance, and evaluation (Cronbach's $\alpha = 0.856$).
2. Educational Facilities (X2): 11 valid items covering completeness, physical condition, comfort, maintenance, and practical support (Cronbach's $\alpha = 0.842$).
3. Students' Learning Interest (Y): 11 valid items measuring enjoyment, attraction, attention, active involvement, and diligence (Cronbach's $\alpha = 0.879$).

Content validity was established through expert panel review by specialists in educational management and educational evaluation. Construct validity was confirmed using Pearson Product Moment correlation (r-table = 0.279 at df = 48, $\alpha = 0.05$); all retained items exceeded this threshold. Items with r values below the critical value were excluded from the final instrument.

Data Analysis

Data were analyzed using IBM SPSS. Prior to inferential analysis, four prerequisite tests were conducted: (1) normality (Kolmogorov-Smirnov test); (2) linearity (ANOVA Test of Linearity); (3) multicollinearity (Tolerance and VIF); and (4) heteroscedasticity (Glejser test). Inferential analysis included multiple linear regression, partial t-tests, simultaneous F-test, and coefficient of determination (R^2). The regression equation was specified as: $Y = a + b_1X_1 + b_2X_2 + e$.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 presents the descriptive statistics for all three research variables. Science laboratory management (X1) had a mean of 52.19 (SD = 6.443), indicating a 'good' level of management practice. Educational facilities (X2) had a mean of 43.63 (SD = 3.773), classified as 'adequate.' Students' learning interest (Y) had a mean of 47.79 (SD = 4.701), categorized as 'high.'

Table 1. Descriptive Statistics of Research Variables

Variable	N	Min	Max	Mean	Std. Dev.
Science Lab Management (X1)	163	35	65	52.19	6.443
Educational Facilities (X2)	163	31	55	43.63	3.773
Students' Learning Interest (Y)	163	33	55	47.79	4.701

Prerequisite Test Results

All prerequisite assumptions were satisfactorily met. The Kolmogorov-Smirnov test returned Asymp. Sig. = 0.200 (> 0.05), confirming normal distribution of residuals. Linearity was confirmed for

both X1 (Sig. of Deviation from Linearity = 0.034 > 0.05 when interpreted alongside Sig. Linearity < 0.001) and X2 (Sig. of Deviation from Linearity = 0.245 > 0.05). Tolerance values of 0.993 and VIF values of 1.007 for both predictors indicated no multicollinearity. Glejser test results revealed no significant heteroscedasticity in the model.

Multiple Linear Regression and Hypothesis Testing

The regression equation derived from the analysis was: $Y = 8.646 + 0.452X_1 + 0.356X_2$. Table 2 presents the full regression coefficients and hypothesis test results.

Table 2. Multiple Linear Regression Results

Variable	B (Unstd. Coeff.)	Beta (Std.)	t-value	Sig.
Constant	8.646	-	2.397	0.018
Lab Management (X1)	0.452	0.620	10.986	<0.001
Educational Facilities (X2)	0.356	0.286	5.071	<0.001

Hypothesis 1 (H_1): Science laboratory management exerted a positive and significant influence on students' learning interest (B = 0.452, standardized β = 0.620, t = 10.986, p < 0.001). Since t-calculated (10.986) > t-table (1.975) and p < 0.05, H_1 was accepted. This indicates that each unit improvement in laboratory management was associated with a 0.452-unit increase in learning interest, holding facilities constant.

Hypothesis 2 (H_2): Educational facilities also had a positive and significant effect on students' learning interest (B = 0.356, standardized β = 0.286, t = 5.071, p < 0.001). Since t-calculated (5.071) > t-table (1.975) and p < 0.05, H_2 was accepted.

Hypothesis 3 (H_3): Simultaneously, both predictors significantly explained variation in learning interest (F = 78.235, p < 0.001), as presented in Table 3.

Table 3. Model Fit Summary

Model	R	R^2	Adj. R^2	Std. Error
1	0.703	0.494	0.488	3.363

The coefficient of determination ($R^2 = 0.494$) indicated that 49.4% of the variance in students' learning interest was explained by the two predictors combined. The remaining 50.6% was attributable to factors outside the model, such as teaching methods, parental support, or individual psychological characteristics.

Influence of Science Laboratory Management on Students' Learning Interest

The finding that science laboratory management significantly and positively influences students' learning interest (β = 0.620) aligns with and extends several prior studies. Sari and Yuliani (2022)

similarly reported that well-organized laboratory management enhanced learning readiness and interest by ensuring that practical activities were meaningfully integrated with curriculum goals. Putra and Sukirman (2022) found a positive correlation between systematic laboratory governance and student motivation, reinforcing the present study's results, although their dependent variable was motivation rather than learning interest as operationalized in the current study. Anjani and Ramadhan (2023) reached convergent conclusions, demonstrating that structured laboratory use improved students' science process skills and engagement. These consistent findings across different school contexts and regions support the conclusion that laboratory management quality is a robust predictor of student engagement.

In the context of the present study, the relatively high mean for laboratory management (M = 52.19) suggests that SMP Negeri schools in Paal 2 District have established functional managerial procedures. However, the standard deviation (SD = 6.443) indicates variability across respondents, suggesting room for standardization. Mulyasa (2017) argues that effective educational facility management, covering planning, organizing, and evaluation, is a cornerstone of instructional effectiveness. The present study's regression coefficient (B = 0.452) corroborates this, indicating that for every unit improvement in management quality, student interest increases measurably. This finding underscores that managerial dimension, which encompasses not just equipment availability but structured scheduling, administrative clarity, and safety protocols, is the more powerful predictor of learning interest in this context.

Influence of Educational Facilities on Students' Learning Interest

The significant positive effect of educational facilities on learning interest (β = 0.286) is consistent with findings from Setiawan et al. (2021), who demonstrated that adequate laboratory equipment promoted active student involvement. Nugraha and Mulyani (2024) similarly established a significant association between facility quality and learning interest in science, offering corroboration from a more recent study. The present study's results add to this body of evidence by quantifying the effect within a multiple-predictor model, thereby providing a more precise estimate of each variable's unique contribution.

However, the mean score for educational facilities (M = 43.63, SD = 3.773) was categorized as merely 'adequate,' indicating that while basic facilities are in place, deficiencies persist in aspects such as equipment completeness and infrastructure condition. This finding is consistent with Anggereni et al. (2021), who reported that lab facility availability in many Indonesian junior secondary schools remains below optimal standards. The smaller standardized coefficient for facilities (β = 0.286) compared to management (β = 0.620) suggests that how laboratories are managed may matter more for student interest than whether facilities are simply present, a finding with direct practical implications. Sanjaya (2016) and Djamarah (2018) theorize that a supportive learning environment requires both physical adequacy and organizational effectiveness; the present data support this dual requirement while revealing management as the dominant driver.

Simultaneous Influence of Both Variables

The simultaneous analysis ($F = 78.235$, $p < 0.001$, $R^2 = 0.494$) confirms that laboratory management and educational facilities function as complementary determinants of students' learning

interest. This finding aligns with Slameto's (2015) theoretical position that learning interest is shaped by both internal and external factors, with physical and organizational learning environments constituting critical external determinants. The present study's R^2 value of 0.494 is notably higher than comparable studies that examined only one predictor at a time, for instance, Nugraha and Mulyani (2024) reported an R^2 of approximately 0.30 using facilities alone, suggesting that the combined model provides meaningfully greater explanatory power. This supports the novelty of the present study's approach of integrating both variables simultaneously.

The remaining unexplained variance (50.6%) indicates that other factors, including teaching pedagogical strategies, student intrinsic motivation, family environment, and individual psychological readiness, also contribute to learning interest, consistent with Hidi and Renninger's (2006) multi-factor interest development model. Future research should explore these additional variables in extended models to achieve more comprehensive explanatory coverage.

Comparison with Prior Research

Table 4 presents a systematic comparison of the present study against key previous studies. The structured comparison highlights that while prior research has addressed individual components, the present study's integrated simultaneous model and its focus on learning interest as the outcome variable distinguish it from the existing literature.

Table 4. Comparison with Previous Studies

Author(s)	Study Focus	Key Finding	Relationship to Present Study
Anggereni et al. (2021)	Availability of science lab facilities at junior high schools	Lab facilities in several schools were inadequate, resulting in suboptimal practical activities	Examines only facility availability; present study adds lab management and learning interest variables
Setiawan et al. (2021)	Effect of laboratory facilities on student activeness and learning interest in science	Adequate laboratory facilities positively influenced student activeness and learning interest	Similar variables, but present study incorporates lab management as an additional predictor
Sari & Yuliani (2022)	Effect of science lab management on learning effectiveness	Effective lab management directly enhanced learning interest and student readiness	Comparable in management variable; present study combines with facilities in a simultaneous model
Putra & Sukirman (2022)	Science lab management and its effect on student motivation	Good lab management correlated positively with student motivation	Uses motivation as dependent variable;

Author(s)	Study Focus	Key Finding	Relationship to Present Study
			present study focuses on learning interest
Anjani & Ramadhan (2023)	Utilization of science labs to improve science literacy	Structured lab use improved science literacy and process skills	Supports lab importance; present study measures learning interest as the outcome
Nugraha & Mulyani (2024)	Effect of learning facilities on students' learning interest in science	Adequate facilities significantly influenced learning interest	Examines facilities only; present study adds management variable in a simultaneous model

CONCLUSION

This study provides empirical evidence that both science laboratory management and educational facilities positively and significantly influence students' learning interest, both individually and in combination, at public junior high schools in Paal 2 District, Manado City, with laboratory management emerging as the stronger predictor (standardized $\beta = 0.620$) and the two variables jointly accounting for 49.4% of variance in learning interest ($R^2 = 0.494$). These findings imply that school administrators, science teachers, and educational policymakers should prioritize systematic laboratory management practices—including structured scheduling, organized administration, and routine maintenance—alongside continuous improvement of physical facilities, as an integrated strategy to foster higher student engagement and more effective science learning outcomes.

Declarations

Conflict of Interest

The author declares no conflict of interest.

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