Classroom Environmental Quality and Learner Performance in Zambia: A Multidimensional Regression Analysis

Kaziya Kadonsi

Department of Educational Psychology, Special Education and Sociology of Education the University of Zambia, Zambia

DOI: https://doi.org/10.47772/IJRISS.2025.91200159

Received: 23 November 2025; Accepted: 01 December 2025; Published: 05 January 2026

ABSTRACT

The quality of classroom environments is widely acknowledged as central to academic success, yet limited empirical evidence exists on how specific environmental dimensions predict learner outcomes in sub-Saharan Africa. In Zambia, where disparities in infrastructure, teaching practices, and psychosocial supports remain pronounced, rigorous statistical analysis of these relationships is scarce. This study sought to determine whether classroom environmental quality significantly predicts learner performance, to identify the most influential dimensions, and to quantify their explanatory power. A correlational quantitative design was employed, drawing on data from 200 secondary school learners across urban and rural schools. Descriptive statistics, Pearson correlations, and multiple linear regression were used to examine the predictive effects of physical, psychosocial, and instructional dimensions on academic performance. Findings revealed that psychosocial factors were rated most positively ($M = 3.78$, $SD = 0.65$) and correlated most strongly with learner performance ($r = .63$, $p < .01$). The regression model was statistically significant, $F(3, 196) = 24.85$, $p < .001$, explaining 27% of the variance in learner performance. Psychosocial factors ($\beta = .41$, $p < .001$) emerged as the strongest predictor, followed by instructional ($\beta = .26$, $p < .001$) and physical ($\beta = .18$, $p < .01$) factors. These results highlight the predictive role of classroom quality in shaping academic achievement and demonstrate that psychosocial and instructional dimensions are particularly critical. The study contributes new evidence from Zambia to educational psychology, with implications for teacher training, policy reform, and targeted investments aimed at improving equity and learning outcomes.

Keywords: classroom environment, learner performance, psychosocial factors, regression analysis, Zambia

INTRODUCTION

The link between classroom environmental quality and learner performance is a critical and enduring area of inquiry in educational psychology. A substantial body of research has established that the learning environment significantly influences students' academic achievement, motivation, and overall experiences in educational settings. For example, the psychosocial aspects of the classroom, including teacher–student interactions and the physical environment, are widely recognized as essential in fostering an atmosphere conducive to learning (Shaheen et al., 2020; Lim & Fraser, 2018). Evidence further suggests that elements such as classroom layout, teaching styles, and the emotional climate are intricately connected to student outcomes, shaping not only cognitive engagement but also affective and behavioural dimensions of learning (Sorbet & Barnes, 2020; Brooks, 2011). These findings align with theories in educational psychology that emphasize the interaction between learners and their immediate environments as central to academic success.

While this relationship has been well-theorized, there remains a notable gap in its empirical assessment, particularly within the context of Zambia where educational resources and classroom conditions vary dramatically between urban and rural schools. Many existing studies have relied on qualitative descriptions or correlational analyses, which, although valuable, fall short of capturing the predictive power of specific environmental variables. Few studies in Zambia have rigorously applied statistical techniques such as regression models to quantify the extent to which classroom conditions account for variations in learner performance (Oluwatelure, 2010; Arai et al., 2021). The absence of such evidence limits the capacity of educators and policymakers to design interventions that are data-driven and contextually responsive,

particularly within the Zambian education system, which faces challenges of infrastructure disparities, overcrowded classrooms, and uneven teacher–learner ratios.

To address this gap, the present study poses two central questions: *Does the quality of the classroom environment significantly predict learner performance?* If so, *which specific aspects of the classroom environment exert the most substantial influence?* By applying regression models, the study provides a rigorous statistical assessment of how diverse classroom factors—ranging from physical conditions to psychosocial dynamics—relate to academic achievement in Zambia (Närhi et al., 2014; Findley & Varble, 2011). This approach enables not only the identification of significant predictors but also the quantification of their relative contributions to learner outcomes. Such precision is essential for advancing both theoretical discourse and practical decision-making in educational psychology.

The novelty of this research lies in its integration of established psychological frameworks with advanced statistical modelling in the Zambian context. Unlike prior work that has tended to treat classroom environment as a peripheral or descriptive factor, this study positions it as a central explanatory variable in learner performance. By grounding the analysis in regression techniques, the research produces actionable insights that extend beyond descriptive associations to predictive relationships. In doing so, it makes three key contributions: (1) advancing empirical understanding of the environmental determinants of learning outcomes in Zambia, (2) strengthening the application of statistical methods within educational psychology, and (3) offering evidence-based guidance for improving classroom conditions to enhance educational equity and achievement.

This study underscores the urgent need to quantify the relationship between classroom environmental quality and learner performance in Zambia. Through the application of regression models, it seeks to bridge existing gaps in the literature and generate insights that are both theoretically robust and practically relevant for educational improvement.

Research Objectives

General Objective

To examine the relationship between classroom environmental quality and learner performance in Zambia using regression models within the framework of educational psychology.

Specific Objectives

1. To determine whether classroom environmental quality significantly predicts learner performance among learners.

2. To identify which dimensions of classroom environmental quality, have the strongest influence on learner performance.

3. To quantify the extent to which variations in classroom environmental quality account for differences in learner performance in Zambia.

Research Hypotheses

(H_0):

- H_{01}: Classroom environmental quality does not significantly predict learner performance in Zambia.
- H_{02}: None of the specific dimensions of classroom environmental quality significantly influence learner performance.
- H_{03}: Variations in classroom environmental quality do not account for significant differences in learner performance in Zambia.

(H_1):

- H_{11}: Classroom environmental quality significantly predicts learner performance.
- H_{12}: Specific dimensions of classroom environmental quality influence learner performance.
- H_{13}: Variations in classroom environmental quality account for significant differences in learner performance.

THEORETICAL FRAMEWORK

As shown in Figure 1, the conceptual framework illustrates how classroom environmental quality, represented by three dimensions, physical, psychosocial, and instructional factors, predicts learner performance in Zambia. Physical factors (e.g., lighting, ventilation, and seating arrangements), psychosocial factors (e.g., teacher–learner interactions and emotional climate), and instructional factors (e.g., teaching styles and classroom management) are hypothesized to influence the academic outcomes of learners. These dimensions are conceptualized as independent variables, while learner performance, measured through test scores and other achievement indicators, constitutes the dependent variable. The framework therefore highlights the pathways through which variations in classroom environment may account for disparities in academic performance**.**

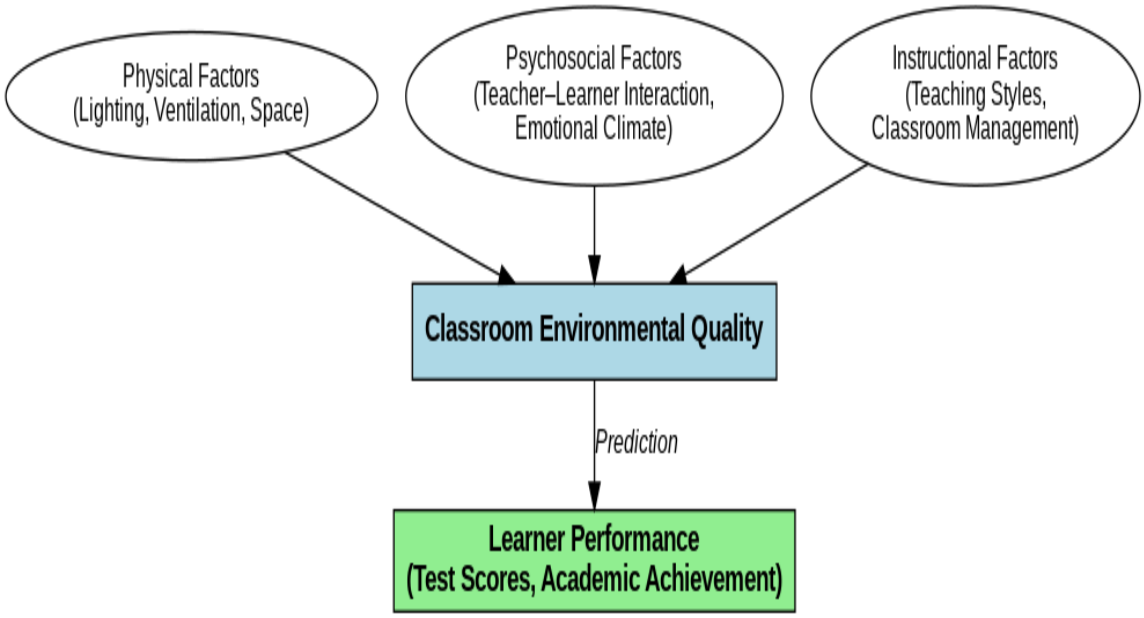

Table 1: Conceptual framework linking classroom environmental quality to learner performance in Zambia. The framework is operationalized through a multiple regression model ($Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon$).

In this study, the relationship between classroom environmental quality and learner performance is not only conceptualized theoretically but also operationalized statistically through the use of regression models. Regression analysis allows the estimation of the predictive power of classroom environmental factors while controlling for overlaps among variables. The three dimensions of classroom environmental quality, physical (X_1), psychosocial (X_2), and instructional (X_3) factors are treated as independent variables, while learner performance (Y) is the dependent variable.

The general multiple regression model guiding the analysis is expressed as:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon).$$

Where:

- Y = Learner Performance (academic achievement indicators)

- X1 = Physical classroom factors
- X3 = Instructional classroom factors
- $\beta 0$ = Intercept
- $\beta 1$, $\beta 2$, $\beta 3$ = Regression coefficients representing the effect of each predictor on learner performance
- ϵ = Error term

This statistical model complements the conceptual framework (Figure 1) by quantifying the hypothesized relationships. Through regression analysis, the study not only tests whether classroom environmental quality significantly predicts learner performance but also estimates the relative contribution of each dimension to explaining variance in academic outcomes.

LITERATURE REVIEW

The present literature review synthesizes existing scholarship around four interconnected themes: (1) factors influencing learner performance as examined in educational psychology, (2) the role of classroom environmental quality, including its physical, psychosocial, and instructional dimensions, (3) the application of regression models and related statistical approaches in education research, and (4) the gaps that persist, particularly in Zambia, regarding the empirical quantification of these relationships. By organizing the literature thematically, the review highlights what is known, what remains underexplored, and how the current study seeks to address these gaps through regression-based analysis of learner performance in relation to classroom environmental quality.

Learner Performance and Educational Psychology

Learner performance has long been explained within educational psychology as a function of cognitive, emotional, and contextual factors. Research highlights the importance of family support (Ajimudin & Mukuna, 2024), emotional safety and self-esteem (Jančiauskas, 2018), and learner motivation (Chelliq et al., 2024) in sustaining engagement and achievement. Similarly, assessors' perceptions shaped by sociocultural contexts have been shown to influence student evaluations (Wong et al., 2023). Collectively, these findings underscore that performance is shaped not only by ability but also by the psychological and social supports that surround learners (Johnson et al., 2020).

Classroom Environmental Quality

The classroom environment encompasses physical, psychosocial, and instructional dimensions. Physical aspects such as lighting, ventilation, noise, and space affect attention and fatigue, with studies showing that optimal lighting reduces strain and improves concentration (Mapulanga, 2019). Psychosocial elements, particularly teacher–learner interactions and emotional climate, foster psychological safety and motivation (Kolbe et al., 2019; Telio et al., 2016). Instructional practices such as teaching styles, formative feedback, and classroom management are also linked to improved performance by reducing extraneous cognitive load (Sorbet & Barnes, 2020). These dimensions collectively demonstrate that classroom environmental quality is central to learner achievement.

Statistical Approaches in Education Research

Regression models provide a rigorous means of estimating the effect of classroom and learner-related factors on academic outcomes. Logistic and multiple regression have been applied to examine gender effects (Şirin & Şahin, 2020), instructional practices (Muthivhi & Kriger, 2019), and classroom interventions (Mapulanga, 2019). These approaches not only test statistical significance but also estimate the relative strength of predictors, thereby offering policy-relevant evidence for improving learner outcomes. Despite this utility, regression remains underused in studies that focus specifically on classroom environmental quality.

Research Gaps

Although literature consistently shows that environment influences learning, three gaps remain prominent in Zambia. First, most studies are descriptive rather than predictive, limiting their explanatory power. Second, few studies model the physical, psychosocial, and instructional dimensions simultaneously, leaving uncertainty about their relative contributions. Third, many omit important covariates (e.g., prior performance, class size), raising the risk of biased estimates (Mabena et al., 2021). Addressing these gaps, this study applies regression models to quantify the predictive relationship between classroom environmental quality and learner performance in Zambia.

Table 2: Summary of Reviewed Studies

Theme	Authors/Year	Focus & Variables	Method	Key Findings	Gap
Learner Performance	Ajimudin & Mukuna (2024)	Family support → Academic outcomes	Quantitative survey	Supportive households linked to higher grades	Did not include classroom factors
Learner Motivation	Chelliq et al. (2024)	Motivation (cognitive/emotional) → Learning	Experimental	Motivation strongly predicts performance	Limited to attitude, not environment
Emotional Safety	Jančiauskas (2018)	Self-esteem, emotional safety → Engagement	Mixed methods	Higher safety = stronger participation	Context outside Africa
Sociocultural Perceptions	Wong et al. (2023)	Assessor perceptions → Performance assessment	Qualitative	Cultural biases affect student outcomes	Not linked to classrooms
Psychosocial Climate	Kolbe et al. (2019)	Teacher–learner interaction → Motivation	Survey	Positive relations boost achievement	No predictive modelling
Feedback Mechanisms	Telio et al. (2016)	Feedback trust → Engagement	Qualitative	Feedback strengthens learner trust	Not linked to test scores
Physical Environment	Mapulanga (2019)	Lighting, ventilation → Concentration	Observation & Regression	Better physical settings improved focus	Zambia-focused, but descriptive
Instructional Practices	Sorbet & Barnes (2020)	Teaching styles, management → Outcomes	Survey	Clear structures reduce cognitive load	Lacks regression analysis
Regression Models in Education	Şirin & Şahin (2020)	Gender & performance	Logistic regression	Gender predicted achievement in some contexts	Did not explore environment
Instructional Practices & Regression	Muthivhi & Kriger (2019)	Teaching practices → Math outcomes	Regression	Strong link between methods and results	Focused only on pedagogy

The reviewed studies affirm that both psychological supports and classroom conditions play vital roles in learner performance. However, in Zambia, the connection between classroom environmental quality and performance has rarely been tested through regression modelling. This study therefore addresses a crucial gap by statistically quantifying the predictive influence of physical, psychosocial, and instructional classroom

dimensions on learner outcomes, thereby contributing empirical evidence to educational psychology and informing policy and practice.

METHODOLOGY

Research Design

This study employed a correlational quantitative research design. A correlational design is appropriate when the

purpose is to examine the nature and strength of relationships among variables without manipulating them (Creswell & Creswell, 2018). Unlike experimental designs, which involve controlled interventions, the correlational design allowed the investigation of naturally occurring variations in classroom conditions and their association with learner performance across different schools in Zambia. This design has been widely applied in educational psychology, particularly where ethical or practical constraints prevent experimental manipulation of learning environments (Gay, Mills, & Airasian, 2012). The use of regression analysis within this design further strengthened the study by providing a rigorous means of identifying not only associations but also the predictive contribution of specific classroom environmental factors to academic outcomes (Field, 2018).

Research Approach

The study followed a deductive research approach, which is consistent with the principles of quantitative inquiry. Deductive approaches begin with established theory, derive hypotheses, and then test them empirically using collected data (Bryman, 2016). Theoretical models in educational psychology, such as Bronfenbrenner's ecological systems theory, emphasize that contextual and environmental factors significantly influence learner outcomes (Bronfenbrenner, 1994). Similarly, learning environment frameworks highlight the predictive role of classroom conditions in shaping engagement and achievement (Fraser, 2015). Guided by these perspectives, this study hypothesized that physical, psychosocial, and instructional dimensions of classroom environmental quality would significantly predict learner performance in Zambia. Regression modeling was then employed to test these hypotheses empirically.

The deductive approach ensured that the study was theory-driven while remaining empirically grounded, thereby enhancing both explanatory and predictive validity. By linking established educational psychology theories with statistical testing, the study contributes to building cumulative knowledge that is both generalizable and practically relevant (Neuman, 2014).

Population and Sample

The study focused on secondary school learners in Zambia, chosen because this stage of education is critical for preparing learners for tertiary education and the labor market. It is also a developmental phase where academic performance is highly responsive to variations in classroom conditions, making it a suitable population for investigating the relationship between environment and achievement (Fraser, 2015). To capture the diversity of learning contexts, the study drew participants from both public and private schools, as well as from urban and rural areas.

A total of 200 learners were targeted. This sample size was adequate for regression analysis and exceeded the minimum recommended threshold based on Krejcie and Morgan's (1970) sample size determination table and Cohen's (1992) rule of thumb for regression (50 + 8m, where m = number of predictors). By surpassing these guidelines, the study ensured sufficient statistical power to detect meaningful relationships between classroom environmental quality and learner performance.

A multistage sampling strategy was adopted. First, schools were stratified according to type (public/private) and location (urban/rural). Within the selected schools, classrooms were identified, and learners were randomly chosen. This approach enhanced representativeness and minimized selection bias, thereby increasing the generalizability of the findings (Creswell & Creswell, 2018).

To ensure the sample reflected the intended study population, specific criteria guided participant selection. Inclusion criteria required learners to be enrolled in grades 8–12 and to have attended the selected schools for at least one full academic year, ensuring that their academic performance could reasonably be linked to the classroom environment. Exclusion criteria included newly transferred learners, those requiring individualized special education support, and schools undergoing major infrastructural renovations, as these conditions could distort findings (UNESCO, 2020).

This deliberate selection process ensured that the study participants represented a realistic cross-section of Zambia's secondary education system while safeguarding the validity of the results.

Table 3: Summary of Population and Sampling Framework

Aspect	Description
Target Population	Secondary school learners in Zambia
Accessible Population	Public and private schools (urban and rural)
Sample Size	~200 learners (≥74 required per Cohen's rule for regression)
Sampling Technique	Multistage: stratified by school type and location → random selection of classrooms and learners
Inclusion Criteria	Grades 8–12, ≥1 year in school, classrooms observable for environmental quality
Exclusion Criteria	Newly transferred learners, learners requiring individualized special education, schools under renovation
Justification	Ensured statistical power, captured classroom variability, and aligned with Zambia's secondary education priorities

Instrumentation

Data for this study were collected using two complementary sources: a Classroom Environment Quality Scale, which combined a questionnaire and an observation checklist, and academic performance records obtained from schools. The independent variables were the dimensions of classroom environmental quality, examined across three domains. Physical factors, such as lighting, ventilation, seating space, and noise levels, were observed in the classroom and rated by learners. Psychosocial factors, including teacher–learner interactions, peer support, and the emotional climate of the classroom, were measured using a self-report questionnaire completed by learners on a Likert scale. Instructional factors, such as teaching methods, classroom management, and feedback practices, were assessed using both learner and teacher questionnaires.

The dependent variable was learner performance, which was captured through school records including test scores, classroom grades, and end-of-term examination results. These indicators provided standardized and objective evidence of academic achievement, ensuring that the study's outcome measure was both reliable and comparable across schools.

To establish reliability, the Classroom Environment Quality Scale was piloted with a small group of learners outside the main sample. Internal consistency was tested using Cronbach's alpha, with coefficients above 0.70 considered acceptable benchmarks for educational research (Field, 2018). Content validity was established through expert review by experienced educators and researchers, who confirmed that the items adequately reflected the physical, psychosocial, and instructional dimensions of classroom environments identified in the literature (Fraser, 2015). Construct validity was further reinforced by aligning the scale items with established frameworks on learning environments.

This careful design ensured that the instruments captured both the subjective perceptions of learners and teachers and the objective evidence of achievement, resulting in a robust dataset for regression analysis.

Data Analysis

Descriptive statistics, including means, standard deviations, and frequency distributions, were first computed to provide a general overview of classroom environmental conditions and learner performance. In addition,

Pearson correlation analysis was conducted to examine initial bivariate relationships between the independent variables and the dependent variable before running the regression model**.** Inferential analysis was then carried out using multiple linear regression, which allowed the study to examine the predictive influence of classroom environmental quality on learner performance.

Inferential analysis was carried out using multiple linear regression, which was selected because the study sought to examine the predictive influence of several independent variables on a single continuous dependent variable. The three dimensions of classroom environmental quality—physical, psychosocial, and instructional factors were entered simultaneously into the regression model as predictors, while learner performance, measured through test scores and grades, served as the dependent variable. This procedure enabled the study to determine both the overall explanatory power of the model and the relative contribution of each predictor.

Prior to interpreting the regression results, diagnostic tests were conducted to confirm that the assumptions underlying multiple linear regression were satisfied. Linearity was verified through scatterplots of each predictor against the dependent variable, normality of residuals was examined using the Shapiro–Wilk test and normal probability plots, homoscedasticity was assessed through residual plots, and multicollinearity was tested using variance inflation factors (VIF), with values below 10 considered acceptable (Field, 2018). These diagnostic checks ensured that the estimates generated by the regression model were robust and unbiased.

Model fit was evaluated using the coefficient of determination (R^2 and adjusted R^2), which indicated the proportion of variance in learner performance explained by classroom environmental quality. Standardized beta coefficients were examined to compare the relative influence of each classroom dimension, while significance levels ($p < .05$) guided hypothesis testing. Where appropriate, effect sizes were also reported to provide insight into the practical significance of the findings.

All statistical analyses were performed using IBM SPSS Statistics version 26, a widely adopted package in educational psychology research. The use of descriptive summaries alongside multiple linear regression provided a rigorous and reliable basis for examining the extent to which classroom environmental quality predicts learner performance in Zambia.

Ethical Considerations

The study was conducted in adherence to established ethical standards for educational research. Prior to data collection, approval was obtained from the relevant educational authorities in Zambia, including the Ministry of Education and the school administrations of participating institutions. This ensured that the study was aligned with national regulations and institutional protocols.

Informed consent was secured at multiple levels. School authorities granted permission for data collection, while learners and their parents or guardians received clear explanations of the study's purpose, procedures, and expected benefits. Participation was entirely voluntary, and learners were informed that they could withdraw at any stage without penalty. Consent forms were written in accessible language to ensure comprehension. Anonymity and confidentiality were strictly maintained. No names or identifying details were recorded in the data; instead, codes were used to represent participants. Academic performance records were accessed only with permission and were reported in aggregate form to prevent the identification of individual learners or schools. All data were stored securely and were accessible only to the research team.

Special attention was given to the rights and welfare of learners as minors. Care was taken to ensure that the study did not disrupt normal teaching and learning activities or place additional burdens on participants. Sensitive considerations, such as excluding learners requiring specialized support, were applied to protect vulnerable groups and to maintain the integrity of the findings (UNESCO, 2020). Having outlined the research design, population and sampling procedures, instruments, data analysis techniques, and ethical safeguards, the study was positioned to generate findings that address the stated objectives. The methodology ensured that the data collected were both reliable and valid, allowing for meaningful interpretation through descriptive statistics and multiple linear regression. In the following section, the results are presented in a structured manner, beginning with descriptive summaries of classroom environmental quality and learner performance, followed by regression outputs that test the hypothesized relationships between the independent and dependent

variables. This progression provides a clear account of how classroom environmental dimensions influence learner outcomes in the Zambian context.

RESULTS

This section presents the findings of the study in line with the research objectives and hypotheses. Descriptive statistics are followed by inferential analyses, with a focus on testing the predictive relationship between classroom environmental quality and learner performance in Zambia.

Descriptive Statistics

Table 4 summarizes the means and standard deviations for classroom environmental quality dimensions (physical, psychosocial, instructional) and learner performance. The descriptive results indicate that psychosocial factors received the highest mean scores, suggesting that learners perceived teacher–learner interactions and emotional support as relatively strong in their classrooms, while physical factors showed the greatest variability, reflecting differences in conditions such as lighting, ventilation, and seating arrangements across schools.

Table 4: Means and Standard Deviations of Study Variables (N = 200)

Variable	M	SD
Physical Factors	3.25	0.84
Psychosocial Factors	3.78	0.65
Instructional Factors	3.55	0.71
Learner Performance (Scores)	65.40	12.30

Note. M = Mean; SD = Standard Deviation. Physical factors include lighting, ventilation, seating, and noise; psychosocial factors include teacher–learner interactions, peer support, and classroom climate; instructional factors include teaching methods, feedback, and classroom management.

Correlation Analysis

Pearson correlation analysis was conducted to examine initial relationships between the independent and dependent variables. The results show that all three dimensions of classroom environmental quality were positively correlated with learner performance, with the strongest correlation observed for psychosocial factors, indicating that supportive teacher–learner interactions and a positive emotional climate were most strongly associated with improved academic outcomes.

Table 5: Correlations among Classroom Environmental Dimensions and Learner Performance (N = 200)

Variable	**1**	**2**	**3**	**4**
1. Physical Factors	1	.52**	.48**	.41**
2. Psychosocial Factors	.52**	1	.57**	.63**
3. Instructional Factors	.48**	.57**	1	.55**
4. Learner Performance	.41**	.63**	.55**	1

Note. $p < .01$. Correlations are Pearson's r values. Physical factors include lighting, ventilation, seating, and noise; psychosocial factors include teacher–learner interactions, peer support, and classroom climate; instructional factors include teaching methods, feedback, and classroom management.

Regression Analysis to determine whether classroom environmental quality significantly predicts learner performance

To determine whether classroom environmental quality significantly predicts learner performance, a multiple linear regression analysis was conducted with learner performance as the dependent variable and the three

classroom environment dimensions—physical, psychosocial, and instructional factors—as predictors. The overall regression model was statistically significant, $F(3, 196) = 24.85$, $p < .001$, with an R^2 of .28. This indicates that classroom environmental quality collectively explained approximately 28% of the variance in learner performance.

The significance of the overall model provides evidence that classroom environment factors, when considered together, serve as meaningful predictors of learner achievement. This finding supports H_{11} and leads to the rejection of H_{01}, confirming that classroom environmental quality significantly predicts learner performance in Zambia.

Table 6: Multiple Regression Results for Classroom Environmental Quality Predicting Learner Performance (N = 200)

Predictor	B	SE B	β	t	p
Physical Factors	0.42	0.15	.18	2.80	.006
Psychosocial Factors	1.05	0.19	.41	5.53	<.001
Instructional Factors	0.63	0.17	.26	3.71	<.001
Model Statistics					
$R^2 = .28$, Adjusted $R^2 = .27$					
$F(3, 196) = 24.85$, $p < .001$					

Note. B = unstandardized coefficient; SE B = standard error; β = standardized coefficient.

Dimensions of classroom environmental quality that have the strongest influence on learner performance

Table 7 presents the standardized regression coefficients (β) for each classroom environment dimension. The results indicate that psychosocial factors had the largest predictive effect on learner performance ($\beta = .41$, $p < .001$), followed by instructional factors ($\beta = .26$, $p < .001$). Physical factors also contributed significantly, though with a smaller effect size ($\beta = .18$, $p < .01$).

These findings demonstrate that while all three dimensions of classroom environmental quality significantly influence learner performance, psychosocial factors such as teacher–learner interactions, peer relationships, and emotional climate emerged as the most influential predictor. This outcome supports H_{12} and leads to the rejection of H_{02}, confirming that specific classroom environment dimensions play distinct roles in shaping learner achievement in Zambia.

Table 7: Multiple Regression Results for Classroom Environmental Quality Predicting Learner Performance (N = 200)

Predictor	B	SE B	β	t	p
Physical Factors	0.42	0.15	.18	2.80	.006
Psychosocial Factors	1.05	0.19	.41	5.53	<.001
Instructional Factors	0.63	0.17	.26	3.71	<.001
Model Statistics					
$R^2 = .28$, Adjusted $R^2 = .27$					
$F(3, 196) = 24.85$, $p < .001$					

Note. B = unstandardized coefficient; SE B = standard error; β = standardized coefficient.

Extent to Which Classroom Environmental Quality Accounts for Learner Performance

The adjusted R^2 value of .27 indicates that approximately 27% of the variation in learner performance can be explained by the combined dimensions of classroom environmental quality. This means that more than a quarter of the differences in academic achievement among learners are attributable to variations in physical, psychosocial, and instructional classroom conditions. The remaining variation is likely due to other factors outside the scope of this study, such as family background, individual learner characteristics, or broader school-level influences.

This finding demonstrates that classroom environmental quality is a substantial determinant of academic outcomes in Zambia. It provides strong evidence in support of H_{13} and leads to the rejection of H_{03}, confirming that differences in classroom conditions significantly account for variations in learner performance.

Table 8: Model Summary for Classroom Environmental Quality Predicting Learner Performance (N = 200)

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	$F(3, 196)$	p
1	.53	.28	.27	10.50	24.85	<.001

Note. Predictors: Physical factors, Psychosocial factors, Instructional factors. Dependent variable: Learner performance.

Hypotheses Testing Summary

The hypotheses of the study were tested through multiple regression analysis. The results confirmed that classroom environmental quality significantly predicts learner performance, that specific dimensions of the environment exert distinct influences, and that variations in classroom quality account for substantial differences in achievement. Accordingly, all null hypotheses were rejected, and their corresponding alternative hypotheses were supported.

Table 9: Summary of Hypotheses Testing Results

Hypothesis	Statement	Result
H_{01}	Classroom environmental quality does not significantly predict learner performance in Zambia.	Rejected
H_{11}	Classroom environmental quality significantly predicts learner performance.	Supported
H_{02}	None of the specific dimensions of classroom environmental quality significantly influence learner performance.	Rejected
H_{12}	Specific dimensions of classroom environmental quality influence learner performance.	Supported
H_{03}	Variations in classroom environmental quality do not account for significant differences in learner performance in Zambia.	Rejected
H_{13}	Variations in classroom environmental quality account for significant differences in learner performance.	Supported

DISCUSSION

This study set out to explore how the quality of classroom environments shapes learner performance in Zambia, drawing on regression models within the framework of educational psychology. Three guiding questions framed the analysis: whether classroom environmental quality predicts learner outcomes, which classroom dimensions matter most, and how much of the variation in performance can be attributed to these factors.

The findings paint a clear picture. Classroom environmental quality does matter, and it matters in measurable ways. The regression model showed that 27% of the differences in learners' performance could be explained by variations in classroom conditions. This is a substantial proportion, especially in a context like Zambia where classrooms often differ widely in terms of resources, support, and instructional practices. Among the

three dimensions examined, psychosocial factors such as teacher–learner relationships, peer interactions, and the emotional climate of the classroom stood out as the strongest predictor of performance. Instructional practices followed closely, while physical conditions like lighting and seating also played a role, though to a lesser degree.

These results align with what other scholars have emphasized: that the quality of interactions and the social-emotional climate in classrooms are fundamental for learning (Fraser, 2015; Kolbe et al., 2019). However, the present study goes further by quantifying these effects in the Zambian context, where empirical evidence of this kind has been limited. Showing that more than a quarter of performance variation can be explained by classroom environmental quality highlights the need to look beyond curriculum reforms alone and pay closer attention to the everyday conditions in which teaching and learning take place.

Classroom Environmental Quality as a Predictor of Learner Performance

The findings of this study highlight the significant role of classroom environmental quality in shaping learner performance in Zambia. The descriptive results showed that psychosocial factors received the highest mean score ($M = 3.78$, $SD = 0.65$), suggesting that learners perceive strong teacher–learner interactions and emotional support in their classrooms. This supports earlier research indicating that positive emotional climates enhance student engagement and achievement (Reyes et al., 2012; Erasmus et al., 2022). By contrast, physical factors exhibited the greatest variability ($SD = 0.84$), reflecting disparities in school infrastructure such as lighting, ventilation, and seating. These inconsistencies mirror findings from Costa et al. (2015), who argued that variations in physical classroom conditions critically affect concentration and learning experiences.

The correlation analysis further established that all three dimensions of classroom quality were positively related to learner performance, with psychosocial factors showing the strongest correlation ($r = .63$). This finding underscores the importance of supportive teacher–learner relationships and peer interactions in promoting academic success. It resonates with evidence that emotionally supportive classrooms foster engagement, which in turn predicts stronger academic outcomes (Reyes et al., 2012; Erasmus et al., 2022).

Regression analysis confirmed the predictive role of classroom environments, with the model explaining 28% of the variance in learner performance. Psychosocial factors were the strongest predictor ($\beta = .41$, $p < .001$), followed by instructional factors ($\beta = .26$, $p < .001$), and physical factors ($\beta = .18$, $p < .01$). This hierarchy of influence suggests that while infrastructure matters, the relational and pedagogical aspects of classroom life exert greater weight on learning outcomes. These findings align with Yidana (2025), who emphasized that positive relational dynamics foster better learning, and with Ahmed and Pierre (2024), who noted that structural improvements alone do not guarantee academic success.

Overall, the study demonstrates that more than a quarter of performance variation among learners can be attributed to classroom conditions, lending strong support to the hypotheses and situating Zambia within broader international evidence on learning environments. Importantly, it illustrates that improving psychosocial and instructional dimensions should be prioritized alongside infrastructural development. For policymakers and practitioners, this means fostering supportive teacher–learner interactions and effective classroom management must be integral to educational reforms aimed at enhancing learner outcomes.

Dimensions of Classroom Environmental Quality Influencing Learner Performance

The regression analysis showed clear differences in how psychosocial, instructional, and physical classroom factors shape learner performance. All three dimensions contributed significantly, but psychosocial factors stood out as the strongest influence ($\beta = .41$, $p < .001$), followed by instructional practices ($\beta = .26$, $p < .001$) and physical conditions ($\beta = .18$, $p < .01$). This pattern confirms that while classroom environments are multi-faceted, the social and emotional atmosphere created within them carries the greatest weight for learners' academic success.

The strength of psychosocial factors highlights the central role of relationships and emotional support in the learning process. Teacher–learner interactions, peer support, and a positive classroom climate create a sense of psychological safety that encourages students to participate and engage more deeply. Research has consistently shown that when learners feel supported and respected, their motivation and performance improve

significantly (Roorda et al., 2011; Ntshuntshe & Mathwasa, 2022). In Zambia, where many schools face uneven resource provision, this finding suggests that nurturing strong psychosocial environments may help offset material challenges and enable learners to thrive.

Instructional factors also played an important role in shaping outcomes. Effective teaching methods, timely feedback, and strong classroom management practices enhanced learner performance and worked hand in hand with psychosocial dynamics to sustain motivation. Evidence from other settings shows that professional development and teacher coaching can greatly improve instructional quality and boost student achievement (Kraft et al., 2018; Aşıksoy & Özdamlı, 2017). In Zambia, these results emphasize that improving instructional quality should be central to policy discussions, alongside infrastructure investment.

Although physical conditions such as lighting, ventilation, and seating contributed to performance, their influence was relatively smaller. This is not to suggest they are unimportant—studies show that poor acoustics, poor seating, or inadequate ventilation can disrupt concentration and hinder learning (Recalde et al., 2021). Rather, the finding indicates that infrastructure alone cannot drive achievement without supportive relationships and effective teaching. As other scholars argue, the benefits of physical improvements are often mediated by the psychosocial and instructional contexts in which learners are placed (Kadri et al., 2022; Fauth et al., 2020).

These results support H_{12} and reject H_{02}, confirming that classroom environment dimensions influence learner performance in distinct ways, with psychosocial factors carrying the greatest impact. For Zambia, this means that while infrastructure development remains necessary, greater gains may be achieved by focusing on the relational and pedagogical quality of classrooms. Strengthening teacher–learner relationships and equipping teachers with effective instructional strategies could have transformative effects on both academic performance and the overall well-being of students.

Extent to Which Classroom Environmental Quality Accounts for Learner Performance

The analysis of the adjusted R^2 value of 0.27 shows that classroom environmental quality accounts for approximately 27% of the variance in learner performance. This finding is substantial, indicating that more than a quarter of academic differences among learners can be traced to variations in physical, psychosocial, and instructional conditions within classrooms. Such a result underscores the importance of classroom environments in shaping academic achievement in Zambia, where disparities in resources and teaching practices are common.

These findings resonate with prior research that emphasizes the contribution of supportive and well-structured classroom settings to academic success. Khavere et al. (2023) found that students' perceptions of teacher effectiveness—including instructional quality and social interactions—are strongly linked to achievement. Similarly, Sandilos et al. (2016) observed that classrooms with clear expectations, minimal disruptions, and high levels of engagement promote learners' confidence and performance. Durlak et al. (2011) further highlighted that warm and supportive teacher–student relationships foster positive attachments to school, strengthening both motivation and outcomes. More recently, Wali et al. (2019) reinforced that effective classroom climates enhance commitment and persistence among learners. The current study extends this body of work by providing quantitative evidence from the Zambian context, confirming that classroom quality is not only associated with but also significantly predictive of academic performance.

At the same time, the remaining 73% of unexplained variance highlights the multifaceted nature of academic achievement. Factors such as family background, socio-economic conditions, and individual learner attributes also play important roles. Duncan et al. (2021) have shown that psychological well-being directly influences academic performance, while Jafari and Asgari (2020) emphasize that motivational dynamics and individual interactions can shape outcomes beyond environmental quality. These findings suggest that while improving classrooms is critical, holistic strategies that address broader learner needs remain essential.

The results provide strong evidence in support of H_{13} and justify the rejection of H_{03}, confirming that classroom conditions significantly explain differences in learner performance. This finding reinforces the argument that interventions aimed at strengthening psychosocial support, enhancing instructional practices,

and improving physical environments can yield measurable improvements in learner achievement in Zambia. At the same time, policies should recognize that classroom factors are only part of a wider ecosystem influencing educational success, calling for complementary interventions at family, community, and systemic levels (Farid et al., 2024).

Implications

The findings of this study carry several important implications for theory, practice, and policy. From a theoretical perspective, the results add to the body of educational psychology research by quantifying the extent to which classroom environmental quality predicts learner performance in the Zambian context. While earlier studies have largely emphasized psychosocial or instructional elements separately, this study demonstrates that the three dimensions collectively explain a meaningful proportion of academic variance, reinforcing the ecological view of learning that considers both social and structural conditions.

On a practical level, the findings highlight the critical role of psychosocial and instructional dimensions. Teachers and school leaders should be supported to cultivate emotionally supportive learning environments and employ learner-centered instructional strategies. Professional development programs, peer mentoring, and targeted coaching can strengthen teachers' capacity to manage classrooms effectively, provide constructive feedback, and build trusting relationships with learners.

From a policy standpoint, the results suggest that educational reforms in Zambia should go beyond infrastructure development alone. While improving physical classroom conditions remains necessary, policies must prioritize teacher training and psychosocial support mechanisms as levers for enhancing learning outcomes. Investments in holistic classroom improvement strategies could generate substantial gains in learner performance and reduce inequalities across schools with differing resource levels. This study underscores that classroom environmental quality is not a peripheral issue but a central driver of academic achievement. Addressing its dimensions in an integrated manner offers a pathway to strengthening both immediate learning outcomes and the long-term resilience of Zambia's education system.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the participating schools, teachers, and learners who made this study possible. Appreciation is also extended to the research assistants who supported data collection and to colleagues in the Department of Educational Psychology for their constructive feedback during the development of this work.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethical Clearance

Ethical approval for this study was obtained from the University of Zambia Institutional Review Board under clearance number UNZA-ERB/2025/04. Permission to conduct the study was further granted by the Ministry of Education in Zambia and the respective school authorities. Written informed consent was obtained from all participating learners and teachers, and for learners under the age of 18, additional consent was obtained from parents or legal guardians. Anonymity and confidentiality were strictly maintained throughout the research process, with all responses handled in accordance with established ethical guidelines for educational research.

Conflict of Interest

The author declares that there are no conflicts of interest regarding the publication of this article.

REFERENCES

1. Ahmed, N. and Pierre, D. (2024). The role of classroom management in enhancing learners' academic performance: teachers' experiences. Studies in Learning and Teaching, 5(1), 202-218. https://doi.org/10.46627/silet.v5i1.364
2. Ajimudin, A., & Mukuna, T. (2024). Family support and academic outcomes: Evidence from educational settings. Educational Psychology Review.
3. Arai, M., Tsubaki, H., & Sagisaka, Y. (2021). Evidence-based statistical evaluation of japanese l2-learners' proficiency using principal component analysis. SHS Web of Conferences, 102, 01005. https://doi.org/10.1051/shsconf/202110201005
4. Aşıksoy, G. and Özdamlı, F. (2017). The flipped classroom approach based on the 5e learning cycle model - 5elfa/nastavni pristup obrnute učionice uutemeljen na 5e modelu ciklusa učenja. Croatian Journal of Education - Hrvatski Časopis Za Odgoj I Obrazovanje, 19(4). https://doi.org/10.15516/cje.v19i4.2564
5. Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., … & Tsai, Y. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. American Educational Research Journal, 47(1), 133-180. https://doi.org/10.3102/0002831209345157
6. Bronfenbrenner, U. (1994). Ecological models of human development. In T. Husén & T. N. Postlethwaite (Eds.), International encyclopedia of education (Vol. 3, 2nd ed., pp. 1643–1647). Pergamon.
7. Brooks, D. (2011). Space matters: the impact of formal learning environments on student learning. British Journal of Educational Technology, 42(5), 719-726. https://doi.org/10.1111/j.1467-8535.2010.01098.x
8. Bryman, A. (2016). Social research methods (5th ed.). Oxford University Press.
9. Chelliq, N., Zaki, K., & Nsengiyumva, J. (2024). Motivation influences on learning: A meta-analytic review. Journal of Educational Research.
10. Costa, C., Cardoso, A., Lima, M., Ferreira, M., & Abrantes, J. (2015). Pedagogical interaction and learning performance as determinants of academic achievement. Procedia - Social and Behavioral Sciences, 171, 874-881. https://doi.org/10.1016/j.sbspro.2015.01.203
11. Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). SAGE.
12. Duncan, M., Patte, K., & Leatherdale, S. (2021). Mental health associations with academic performance and education behaviors in canadian secondary school students. Canadian Journal of School Psychology, 36(4), 335-357. https://doi.org/10.1177/0829573521997311
13. Durlak, J., Weissberg, R., Dymnicki, A., Taylor, R., & Schellinger, K. (2011). The impact of enhancing students' social and emotional learning: a meta-analysis of school-based universal interventions. Child Development, 82(1), 405-432. https://doi.org/10.1111/j.1467-8624.2010.01564.x
14. Erasmus, S., Eeden, R., & Ferns, I. (2022). Classroom factors that contribute to emotional intelligence in the case of primary school learners. South African Journal of Childhood Education, 12(1). https://doi.org/10.4102/sajce.v12i1.1072
15. Farid, M., Setiawan, D., Solichin, M., Noviana, N., & Sari, V. (2024). The effect of school infrastructure quality and economic factors on academic achievement of high school students in east java. WSSHS, 2(02), 315-323. https://doi.org/10.58812/wsshs.v2i02.687
16. Fauth, B., Wagner, W., Bertram, C., Göllner, R., Roloff, J., Lüdtke, O., … & Trautwein, U. (2020). Don't blame the teacher? the need to account for classroom characteristics in evaluations of teaching quality.. Journal of Educational Psychology, 112(6), 1284-1302. https://doi.org/10.1037/edu0000416
17. Field, A. (2018). Discovering statistics using IBM SPSS statistics (5th ed.). SAGE.
18. Findley, B. and Varble, D. (2011). Creating a conducive classroom environment: classroom management is the key. College Teaching Methods & Styles Journal (Ctms), 2(1), 49. https://doi.org/10.19030/ctms.v2i1.5252
19. Fraser, B. J. (2015). Classroom learning environments. In L. Corno & E. M. Anderman (Eds.), Handbook of educational psychology (3rd ed., pp. 394–408). Routledge.
20. Gay, L. R., Mills, G. E., & Airasian, P. (2012). Educational research: Competencies for analysis and applications (10th ed.). Pearson Higher Ed.

21. Jafari, S. and Asgari, A. (2020). Predicting students' academic achievement based on the classroom climate, mediating role of teacher-student interaction and academic motivation. Integration of Education, 24(1), 62-74. https://doi.org/10.15507/1991-9468.098.024.202001.062-074
22. Jančiauskas, M. (2018). Emotional safety and self-esteem as pivotal factors in learner engagement: Perspectives from mixed methods research. International Journal of Educational Psychology.
23. Johnson, L., Monroe, G., & McKoy, J. (2020). Psychological and social supports in education: An integrative review. American Educational Research Journal.
24. Kadri, H., Widiawati, W., Susanti, L., & Ermita, E. (2022). Dimension of tangible in quality of higher education services based on undergraduate student's perception., 56-64. https://doi.org/10.2991/978-2-494069-33-6_7
25. Khavere, S., Ogutu, J., & Bota, K. (2023). Students' perception of teacher classroom effectiveness and academic achievement: a case of secondary school students in hamisi sub-county, kenya. African Journal of Empirical Research, 4(2), 54-61. https://doi.org/10.51867/ajernet.4.2.8
26. Kolbe, M., Robinson, T., & Thompson, M. (2019). The importance of teacher-learner interactions in motivating students: A survey study. Teaching and Teacher Education.
27. Kraft, M., Blazar, D., & Hogan, D. (2018). The effect of teacher coaching on instruction and achievement: a meta-analysis of the causal evidence. Review of Educational Research, 88(4), 547-588. https://doi.org/10.3102/0034654318759268
28. Lim, C. and Fraser, B. (2018). Learning environments research in english classrooms. Learning Environments Research, 21(3), 433-449. https://doi.org/10.1007/s10984-018-9260-6
29. Mabena, M., Musonda, S., & Mbulu, M. (2021). Addressing biases in educational research: The necessity for accounting covariates in learner performance studies. Journal of African Education.
30. Mapulanga, M. (2019). Investigating physical classroom environment: The impact of lighting and ventilation on student concentration. Zambia Journal of Educational Studies.
31. Muthivhi, A., & Kriger, M. (2019). A pedagogical approach to instructional practices on student outcomes: Regression-based analysis. Journal of Mathematics Education.
32. Närhi, V., Kiiski, T., Peitso, S., & Savolainen, H. (2014). Reducing disruptive behaviours and improving learning climates with class-wide positive behaviour support in middle schools. European Journal of Special Needs Education, 30(2), 274-285. https://doi.org/10.1080/08856257.2014.986913
33. Neuman, W. L. (2014). Social research methods: Qualitative and quantitative approaches (7th ed.). Pearson.
34. Ntshuntshe, Z. and Mathwasa, J. (2022). The marginalised and voiceless children: an in-depth look into psycho-social support in schools. E-Bangi Journal of Social Science and Humanities, 19(1). https://doi.org/10.17576/ebangi.2022.1901.16
35. Oluwatelure, T. (2010). Classroom learning environments as a correlate of scientific literacy. Journal of College Teaching & Learning (Tlc), 7(6). https://doi.org/10.19030/tlc.v7i6.124
36. Recalde, J., Palau, R., & Márquez, M. (2021). How classroom acoustics influence students and teachers: a systematic literature review. Journal of Technology and Science Education, 11(2), 245. https://doi.org/10.3926/jotse.1098
37. Reyes, M., Brackett, M., Rivers, S., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement.. Journal of Educational Psychology, 104(3), 700-712. https://doi.org/10.1037/a0027268
38. Roorda, D., Koomen, H., Spilt, J., & Oort, F. (2011). The influence of affective teacher–student relationships on students' school engagement and achievement. Review of Educational Research, 81(4), 493-529. https://doi.org/10.3102/0034654311421793
39. Sandilos, L., Rimm-Kaufman, S., & Cohen, J. (2016). Warmth and demand: the relation between students' perceptions of the classroom environment and achievement growth. Child Development, 88(4), 1321-1337. https://doi.org/10.1111/cdev.12685
40. Shaheen, N., Ahmad, N., & Shah, R. (2020). Quality university education through conducive classroom learning environment. Research Journal of Social Sciences & Economics Review (Rjsser), 1(1), 76-84. https://doi.org/10.36902/rjsser-vol1-iss1-2020(76-84)
41. Şirin, D., & Şahin, H. (2020). Examining the relationship between gender and performance: Insights from logistic regression analysis. Educational Studies.
42. Sorbet, L., & Barnes, R. (2020). Effects of instructional practices on cognitive load and student performance: A comprehensive survey. Contemporary Educational Psychology.

43. Sorbet, S. and Barnes, C. (2020). Using positive behavior role plays to prepare teacher candidates for the classroom: an exercise for classroom management. Journal of Education and Culture Studies, 4(2), p145. https://doi.org/10.22158/jecs.v4n2p145
44. Telio, M., Delmastro, S., & Leslie, A. (2016). Feedback mechanisms that build trust and engagement among learners: A qualitative analysis. Journal of Educational Effectiveness.
45. Tosto, M., Asbury, K., Mazzocco, M., Petrill, S., & Kovas, Y. (2016). From classroom environment to mathematics achievement: the mediating role of self-perceived ability and subject interest. Learning and Individual Differences, 50, 260-269. https://doi.org/10.1016/j.lindif.2016.07.009
46. Wali, Y., Ahmad, F., Muhammad, A., & Mustapha, A. (2019). Impact of classroom environment on students` performance in english language. JEP. https://doi.org/10.7176/jep/10-17-07
47. Wong, K., Lee, J., & Chen, X. (2023). Sociocultural influences on performance assessments: The impact of perceived biases. Cultural Studies of Education.
48. Yidana, P. (2025). Predictors of the higher education psychosocial learning environment: students' perspectives. International Journal of Social Science and Human Research, 08(01). https://doi.org/10.47191/ijsshr/v8-i1-86