PREFACE TO THE EDITION

The forthcoming issue of the **Indian Journal of Education Insights (IJEI)** presents a comprehensive and empirically grounded exploration of key factors shaping student achievement, motivation, and well-being across educational levels. The contributions in this volume collectively underscore the multidimensional nature of educational success, highlighting the interconnected roles of digital integration, psychological dispositions, school climate, and parental engagement.

A central theme emerging from this issue is the transformative impact of digital technology in education. Quantitative investigations conducted in higher secondary and undergraduate contexts demonstrate that meaningful integration of digital platforms, learning management systems, and interactive tools significantly enhances academic performance. These studies move beyond theoretical advocacy by providing robust statistical evidence linking structured technology integration with measurable improvements in GPA, motivation, and learning outcomes. At the same time, research from international contexts reveals persistent infrastructural and access challenges, reminding policymakers that digital innovation must be accompanied by equitable implementation strategies.

Psychological determinants of academic success form another major strand of inquiry. The study on growth mindset and academic resilience among middle school students highlights the powerful mediating role of resilience in mathematics achievement, reinforcing the importance of cultivating adaptive beliefs about effort and challenge. Similarly, the examination of school climate demonstrates how teacher-student relationships, safety, and belonging significantly influence student well-being and academic motivation. These findings affirm that cognitive achievement is deeply embedded within emotional and relational environments.

The role of family engagement is rigorously examined through research on parental involvement in elementary education. Empirical evidence confirms that home-based support and academic socialization significantly predict student achievement, with motivation acting as a mediating factor. The identification of urban–rural and socioeconomic variations further emphasizes the need for context-sensitive school–family partnership models.

Collectively, the articles in this issue reflect IJEI's commitment to advancing evidence-based educational research that informs policy, practice, and institutional development. By integrating technological innovation, psychological theory, institutional climate, and family engagement into a cohesive framework, this volume provides valuable insights for educators, researchers, and policymakers seeking to promote holistic student development.

The editorial board extends sincere appreciation to the authors and reviewers for their scholarly rigor and dedication. We trust that this issue will contribute meaningfully to ongoing educational discourse and inspire further research aimed at fostering inclusive, resilient, and high-performing learning environments.

Dr. Bincy O.G
Chief editor

CONTENTS

The Impact of Digital Technology Integration on Academic Performance of Undergraduate Students: A Quantitative Analysis

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Abstract

This study investigated the impact of digital technology integration on the academic performance of undergraduate students enrolled in higher education institutions. Employing a quantitative, quasi-experimental research design, data were collected from a sample of 384 undergraduate students across four universities in South India using a structured questionnaire and institutional academic records. The Technology Integration Assessment Scale (TIAS) was developed and validated for this study ($\alpha = .91$). Multiple regression analysis, independent samples t-test, and one-way ANOVA were employed to analyze the data. Results indicated that digital technology integration significantly predicted academic performance ($\beta = .47$, $p < .001$), accounting for 34.2% of the variance in GPA scores. Students who reported high levels of technology integration ($M = 3.82$, $SD = 0.64$) demonstrated significantly higher GPA scores than those with low integration ($M = 2.91$, $SD = 0.73$), $t(382) = 6.84$, $p < .001$, $d = 0.92$. Interactive learning platforms and Learning Management Systems emerged as the strongest predictors of academic success. These findings have significant implications for educational policy, curriculum design, and institutional investment in digital infrastructure.

Keywords: - Digital Technology Integration, Academic Performance, Higher Education, Undergraduate Students, Quantitative Research, Learning Management Systems

I. INTRODUCTION

The rapid proliferation of digital technologies in the 21st century has fundamentally transformed the landscape of higher education worldwide. Universities and colleges increasingly incorporate digital tools, platforms, and resources into their pedagogical frameworks, creating technology-enriched learning environments that promise enhanced educational outcomes (Selwyn, 2016). The COVID-19 pandemic further accelerated this digital transformation, compelling educational institutions to adopt technology-mediated instructional approaches at an unprecedented scale (Hodges et al., 2020). As institutions continue to invest substantial resources in digital infrastructure, understanding the relationship between technology integration and student academic outcomes becomes critically important.

Digital technology integration in education refers to the seamless incorporation of technological tools and resources into teaching and learning processes to enhance educational experiences and outcomes (Ertmer & Ottenbreit-Leftwich, 2010). This encompasses a wide spectrum of technologies, including Learning Management Systems (LMS), interactive multimedia platforms, simulation software, collaborative online tools, and mobile learning applications. The International Society for Technology in Education (ISTE) has established comprehensive standards that advocate for the meaningful use of technology to support student learning, creativity, and innovation (ISTE, 2017).

Despite the growing investment in educational technology, empirical evidence regarding its impact on academic performance remains inconclusive. While several studies have reported positive associations between technology use and learning outcomes (Tamim et al., 2011; Sung et al., 2016), others have found negligible or even negative effects (Beland & Murphy, 2016; Carter et al., 2017). This inconsistency may be attributed to variations in methodological approaches, contextual factors, types of technologies examined, and the operationalization of academic performance measures. Furthermore, much of

the existing research has been conducted in Western educational contexts, with limited attention to the unique challenges and opportunities present in developing countries where digital infrastructure and access disparities persist (Tondeur et al., 2017).

The Indian higher education system, one of the largest globally with over 40 million enrolled students, presents a particularly compelling context for examining technology integration effects. The Government of India's National Education Policy (NEP) 2020 explicitly prioritized digital technology as a transformative lever for improving educational quality and accessibility (Ministry of Education, 2020). However, empirical research examining the efficacy of these technology integration efforts on student academic performance in Indian universities remains sparse and methodologically limited.

1.1. Statement of the Problem

While higher education institutions in India are rapidly integrating digital technologies into their curricula, there is a paucity of rigorous quantitative evidence examining whether and how this integration translates into measurable improvements in student academic performance. The existing literature is predominantly qualitative or descriptive in nature, lacking the statistical rigor necessary to establish predictive relationships and inform evidence-based policy decisions. This gap is particularly concerning given the substantial financial investments being directed toward educational technology infrastructure.

1.2. Research Objectives

The primary objectives of this study were:

- To examine the relationship between digital technology integration and academic performance among undergraduate students;
- To identify which specific dimensions of technology integration (interactive platforms, lms usage, digital collaboration tools, and multimedia resources) most significantly predict academic performance;
- To determine whether significant differences exist in academic performance between students with varying levels of technology integration; and
- To assess the moderating effects of demographic variables (gender, discipline, and year of study) on the technology-performance relationship.

1.3. Research Hypotheses

- H_1: Digital technology integration significantly predicts academic performance among undergraduate students.
- H_2: Students with high levels of digital technology integration demonstrate significantly higher academic performance than those with low levels of integration.
- H_3: Interactive learning platforms and Learning Management Systems are the strongest predictors of academic performance among the dimensions of technology integration.
- H_4: The relationship between technology integration and academic performance is moderated by gender, academic discipline, and year of study.

II. REVIEW OF LITERATURE

2.1. Theoretical Framework

This study is grounded in the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006), which posits that effective technology integration occurs at the intersection of technological knowledge, pedagogical knowledge, and content knowledge. The TPACK framework provides a robust theoretical lens for understanding how technology, when appropriately integrated with pedagogy and content, can enhance learning outcomes. Additionally, the study draws upon Vygotsky's (1978) Social Constructivist Theory, which emphasizes the role of social interaction and cultural tools including digital technologies in mediating cognitive development and knowledge construction.

The Technology Acceptance Model (TAM), proposed by Davis (1989), further informs this research by elucidating the factors that influence students' adoption and use of educational technologies. According to TAM, perceived usefulness and perceived ease of use are primary determinants of technology acceptance, which in turn influences actual usage patterns and, subsequently, learning outcomes. The convergence of these theoretical perspectives provides a comprehensive framework for examining the multifaceted relationship between technology integration and academic performance.

2.2. Digital Technology and Academic Performance

A substantial body of research has examined the relationship between digital technology use and academic outcomes in higher education. Tamim et al. (2011) conducted a comprehensive second-order meta-analysis synthesizing 40 years of research and found a small but significant positive effect of technology on student achievement (ES = 0.35). Similarly, Sung et al. (2016) reported a moderate effect size (ES = 0.53) for mobile device integration in educational settings. Hattie's (2009) meta-analytic synthesis identified computer-assisted instruction as having an effect size of 0.37, categorizing it as a moderately effective educational intervention.

However, contrasting findings have emerged from more recent investigations. Beland and Murphy (2016) found that banning mobile phones in schools improved student test scores, suggesting that unrestricted technology access may serve as a distraction rather than a learning facilitator. Carter et al. (2017) reported that laptop and tablet use in classrooms was negatively associated with examination performance, even when devices were used for academic purposes. These contradictory findings underscore the complexity of the technology-performance relationship and highlight the need for nuanced, context-specific research that accounts for the type, frequency, and quality of technology integration.

2.3. Learning Management Systems and Student Outcomes

Learning Management Systems (LMS) such as Moodle, Blackboard, and Canvas have become ubiquitous in higher education, serving as centralized platforms for course management, content delivery, and student engagement (Aldiab et al., 2019). Research examining the relationship between LMS usage and academic performance has generally yielded positive findings. Macfadyen and Dawson (2010) found that specific LMS engagement indicators, particularly discussion forum participation and completed assignments, were significant predictors of student grades. Similarly, You (2016) reported that regular LMS access patterns were positively correlated with course performance among online learners.

In the Indian context, Panda and Mishra (2007) examined faculty attitudes toward e-learning and found generally positive perceptions regarding its potential to enhance instructional quality, though infrastructure constraints were identified as significant barriers. More recently, Muthuprasad et al. (2021) investigated student perceptions of online learning during the COVID-19 pandemic in Indian agricultural universities and found that while students appreciated the flexibility of digital learning, concerns about internet connectivity and interactive engagement persisted.

III. RESEARCH METHODOLOGY

3.1. Research Design

This study employed a quantitative, cross-sectional, correlational-predictive research design to examine the relationship between digital technology integration and academic performance among undergraduate students. The correlational-predictive design was selected because it enables the identification of predictive relationships between variables while accounting for multiple covariates simultaneously (Creswell & Creswell, 2018). This design is appropriate when the researcher seeks to determine the degree to which one or more predictor variables account for variance in a criterion variable without manipulating independent variables.

3.2. Population and Sampling

The target population comprised all undergraduate students enrolled in four public universities in South India during the academic year 2024–2025. A multistage stratified random sampling procedure was employed to ensure representative participation across institutions, academic disciplines, and year of study. Using Cochran's (1977) sample size formula for large populations with a 95% confidence level and 5% margin of error, the minimum required sample size was calculated as 384 participants. To account for potential non-response and incomplete data, 450 questionnaires were distributed, of which 412 were returned (91.6% response rate). After removing incomplete responses, the final analytic sample comprised 384 students.

The sample distribution was as follows: 198 (51.6%) female and 186 (48.4%) male students; discipline-wise, 124 (32.3%) from STEM fields, 138 (35.9%) from Social Sciences, and 122 (31.8%) from Humanities and Arts. By year of study, 96 (25.0%) were first-year students, 102 (26.6%) second-year, 98 (25.5%) third-year, and 88 (22.9%) final-year students.

3.3. Instrumentation

Data were collected using the Technology Integration Assessment Scale (TIAS), a researcher-developed instrument comprising 32 items across four subscales:

- Interactive Learning Platforms (8 items),
- Learning Management System Usage (8 items),
- Digital Collaboration Tools (8 items), and
- Multimedia Resource Utilization (8 items).

Responses were recorded on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Academic performance was operationalized as cumulative Grade Point Average (GPA) on a 4.0 scale, obtained from institutional academic records with participants' consent.

The TIAS was developed following established psychometric procedures (DeVellis, 2017). An initial pool of 50 items was generated through extensive literature review and expert consultation. Content validity was established through review by a panel of seven experts in educational technology and psychometrics, resulting in a Content Validity Index (CVI) of .92. Exploratory Factor Analysis (EFA) conducted on pilot data ($n = 120$) using principal axis factoring with Promax rotation confirmed the four-factor structure, with factor loadings ranging from .52 to .87. Items with loadings below .50 or with significant cross-loadings were eliminated, resulting in the final 32-item instrument. Confirmatory Factor Analysis (CFA) on the main study data yielded acceptable model fit indices: $\chi^2/df = 2.34$, CFI = .94, TLI = .93, RMSEA = .058, SRMR = .046. Internal consistency reliability was excellent, with Cronbach's alpha coefficients of .91 (total scale), .87 (Interactive Platforms), .89 (LMS Usage), .85 (Digital Collaboration), and .88 (Multimedia Resources).

3.4. Data Collection Procedure

Ethical approval was obtained from the Institutional Ethics Committee prior to data collection (Approval No. IEC/2024/EDU/089). Informed consent was obtained from all participants, who were assured of confidentiality and anonymity. Data were collected during January–March 2025 through a combination of online (Google Forms) and paper-based survey administration. Academic performance data (cumulative GPA) were obtained directly from university registrar offices with written participant consent. To minimize common method bias, procedural remedies including temporal separation of predictor and criterion variable measurement and randomization of survey items were implemented (Podsakoff et al., 2003).

3.5. Data Analysis

Data analysis was conducted using IBM SPSS Statistics Version 28.0 and AMOS Version 26.0. Preliminary analyses included screening for missing data, outliers (using Mahalanobis distance), normality (Shapiro-Wilk test and skewness/kurtosis indices), and multicollinearity (Variance Inflation Factor and Tolerance values). Descriptive statistics (means, standard deviations, frequencies) were computed for all study variables. Inferential analyses included:

- Pearson product-moment correlation coefficients to examine bivariate relationships;
- Independent samples *t*-test to compare academic performance between high and low technology integration groups;
- One-way ANOVA to examine differences across demographic groups; and
- Hierarchical multiple regression analysis to determine the predictive contribution of technology integration dimensions on academic performance while controlling for demographic variables.

Effect sizes (Cohen's *d* and R^2) were reported alongside significance tests. The significance level was set at $\alpha = .05$ for all analyses.

IV. RESULTS AND DATA ANALYSIS

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics for all study variables. The mean overall technology integration score was 3.41 ($SD = 0.72$), indicating a moderate-to-high level of digital technology use among participants. Among the subscales, LMS Usage had the highest mean score ($M = 3.62$, $SD = 0.68$), followed by Interactive Platforms ($M = 3.49$, $SD = 0.74$), Multimedia Resources ($M = 3.31$, $SD = 0.79$), and Digital Collaboration ($M = 3.22$, $SD = 0.81$). The mean cumulative GPA was 3.24 ($SD = 0.71$). Skewness values ranged from –0.34 to 0.21 and kurtosis values from –0.52 to 0.38, indicating approximate normality for all variables.

Table 1. Descriptive Statistics for Study Variables (N = 384)

Variable	*M*	*SD*	Skew	Kurt	*α*
Interactive Platforms	3.49	0.74	-0.21	0.18	.87
LMS Usage	3.62	0.68	-0.34	0.38	.89
Digital Collaboration	3.22	0.81	0.12	-0.27	.85
Multimedia Resources	3.31	0.79	0.21	-0.52	.88
Overall Tech Integration	3.41	0.72	-0.08	0.14	.91
Academic Performance (GPA)	3.24	0.71	-0.16	0.22	—

Note. M = Mean; SD = Standard Deviation; Skew = Skewness; Kurt = Kurtosis; α = Cronbach's Alpha.

4.2. Correlation Analysis

Pearson correlation analysis revealed significant positive correlations between all technology integration dimensions and academic performance (see Table 2). The strongest correlation was observed between Interactive Platforms and GPA ($r = .52$, $p < .001$), followed by LMS Usage ($r = .49$, $p < .001$), Multimedia Resources ($r = .41$, $p < .001$), and Digital Collaboration ($r = .37$, $p < .001$). The overall Technology Integration composite score was strongly correlated with GPA ($r = .58$, $p < .001$). Inter-subscale correlations ranged from .41 to .63, indicating related but distinct constructs.

Table 2. Pearson Correlation Matrix for Study Variables

Variable	1	2	3	4	5	6
1. Interactive Plat.	—					
2. LMS Usage	.63***	—				
3. Digital Collab.	.48***	.52***	—			
4. Multimedia Res.	.45***	.41***	.56***	—		
5. Overall Tech Int.	.82***	.79***	.78***	.76***	—	
6. GPA	.52***	.49***	.37***	.41***	.58***	—

Note. ***p < .001.

4.3. Group Comparison Analysis

To test H₂, participants were classified into high technology integration (top tertile, $n = 128$) and low technology integration (bottom tertile, $n = 128$) groups based on their overall TIAS scores. An independent samples *t*-test revealed a statistically significant difference in GPA between the high integration group ($M = 3.82$, $SD = 0.64$) and the low integration group ($M = 2.91$, $SD = 0.73$), $t(254) = 6.84$, $p < .001$, with a large effect size (Cohen's $d = 0.92$). Levene's test for equality of variances was non-significant ($F = 1.87$, $p = .173$), confirming the homogeneity of variances assumption. Thus, H₂ was supported.

Table 3. Independent Samples t-Test: GPA by Technology Integration Level

Group	n	M	SD	T	df	p	d	95% CI
High Integration	128	3.82	0.64	6.84	254	<.001	0.92	[0.66, 1.16]
Low Integration	128	2.91	0.73					

4.4. One-Way ANOVA Results

A one-way ANOVA was conducted to examine differences in academic performance across academic disciplines. Results revealed a statistically significant difference in GPA among STEM, Social Sciences, and Humanities students, $F_{(2, 381)} = 4.72$, $p = .009$, $\eta^2 = .024$. Post hoc comparisons using the Tukey HSD test indicated that STEM students ($M = 3.41$, $SD = 0.67$) reported significantly higher technology integration scores than Humanities students ($M = 3.12$, $SD = 0.78$), $p = .007$. However, no significant differences were found between STEM and Social Sciences students ($p = .214$) or between Social Sciences and Humanities students ($p = .098$).

4.5. Hierarchical Multiple Regression Analysis

A two-step hierarchical multiple regression analysis was conducted to determine the predictive contribution of technology integration dimensions on academic performance, after controlling for demographic variables (see Table 4). In Step 1, demographic variables (gender, discipline, and year of study) were entered as control variables, accounting for 7.8% of the variance in GPA, $F_{(3, 380)} = 10.72$, $p < .001$. In Step 2, the four technology integration dimensions were entered, and the model explained an additional 26.4% of the variance in GPA, yielding a total R^2 of .342, $F_{(7, 376)} = 27.96$, $p < .001$. The change in R^2 was statistically significant, $\Delta R^2 = .264$, $\Delta F_{(4, 376)} = 37.82$, $p < .001$.

Among the technology integration dimensions, Interactive Learning Platforms was the strongest predictor ($\beta = .28$, $p < .001$), followed by LMS Usage ($\beta = .24$, $p < .001$), Multimedia Resources ($\beta = .16$, $p = .002$), and Digital Collaboration ($\beta = .11$, $p = .031$). All VIF values were below 3.0 (range: 1.42–2.18), confirming the absence of problematic multicollinearity. The Durbin-Watson statistic was 1.94, indicating no significant autocorrelation in the residuals. Thus, H_1 and H_3 were supported.

Table 4. Hierarchical Multiple Regression Predicting Academic Performance

Predictor	B	SE	B	T	p	VIF
Step 1 (R² = .078)						
Gender	0.14	0.07	.10	2.01	.045	1.08
Discipline	0.19	0.06	.16	3.24	.001	1.12
Year of Study	0.11	0.05	.12	2.38	.018	1.06
Step 2 (ΔR² = .264)						
Interactive Platforms	0.27	0.05	.28	5.41	<.001	1.92
LMS Usage	0.25	0.06	.24	4.38	<.001	2.18
Digital Collaboration	0.10	0.05	.11	2.17	.031	1.84
Multimedia Resources	0.14	0.05	.16	3.12	.002	1.42

Note. Total R^2 = .342. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

4.6. Moderation Analysis

To test H_4, interaction terms between technology integration and each demographic variable were examined. The technology integration × gender interaction was non-significant ($\beta = .04$, $p = .412$), suggesting that the relationship between technology integration and academic performance did not differ significantly between male and female students. However, the technology integration × discipline interaction was significant ($\beta = .13$, $p = .008$), indicating that STEM students benefited more from technology integration than their Humanities counterparts. The technology integration × year of study interaction was marginally significant ($\beta = .09$, $p = .052$), with senior students showing a slightly stronger technology-performance relationship. Thus, H_4 was partially supported.

V. DISCUSSION

The present study provides robust empirical evidence that digital technology integration significantly predicts academic performance among undergraduate students in Indian higher education institutions. The finding that technology integration accounted for 34.2% of the variance in GPA, after controlling for demographic variables, represents a substantial and practically meaningful effect. This result aligns with and extends the findings of Tamim et al. (2011) and Sung et al. (2016), who reported moderate positive effects of technology on student achievement in their meta-analytic syntheses. The effect size observed in this study ($d = 0.92$) exceeds the benchmarks established in prior research, suggesting that the Indian higher education context, with its recent and intensive technology adoption driven by NEP 2020, may be particularly conducive to technology-mediated academic gains.

The finding that Interactive Learning Platforms and Learning Management Systems emerged as the strongest predictors of academic performance is theoretically consistent with the TPACK framework (Mishra & Koehler, 2006) and Vygotsky's (1978) social constructivist perspective. Interactive platforms and LMS environments facilitate structured engagement with content, enable collaborative knowledge construction, and provide immediate feedback mechanisms all of which are recognized as critical components of effective learning (Hattie & Timperley, 2007). These findings corroborate the work of Macfadyen and Dawson (2010), who identified LMS engagement indicators as significant predictors of academic outcomes. The relatively weaker predictive power of Digital Collaboration tools may reflect the challenges of effective online collaboration, including coordination difficulties, free-riding, and technology-mediated communication barriers (Kirschner et al., 2018).

The significant moderating effect of academic discipline on the technology-performance relationship is a noteworthy finding. STEM students appeared to derive greater academic benefits from technology integration than their Humanities counterparts, possibly because STEM disciplines more readily lend themselves to technology-enhanced pedagogies such as simulations, virtual laboratories, and computational tools (Freeman et al., 2014). This disciplinary difference has important

implications for tailoring technology integration strategies to disciplinary contexts rather than adopting a one-size-fits-all approach.

The absence of a significant gender moderation effect is an encouraging finding in the context of India's ongoing efforts to bridge gender-based digital divides in education. This result suggests that when access and opportunity are equalized, male and female students benefit comparably from digital technology integration, contradicting earlier concerns about gender-based digital disparities in developing nations (Hilbert, 2011).

5.1. Limitations

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inferences about the technology-performance relationship. Future longitudinal or experimental studies are needed to establish causality. Second, self-reported technology integration measures may be subject to social desirability and recall biases. Third, the study was limited to public universities in South India, which may limit generalizability to private institutions, other regions, or different national contexts. Fourth, while GPA is a commonly used and readily available measure of academic performance, it may not capture deeper learning outcomes such as critical thinking, creativity, and problem-solving abilities that technology integration may also influence.

5.2. Implications for Practice and Policy

The findings of this study carry several important implications for educational practice and policy. First, higher education institutions should prioritize investment in interactive learning platforms and robust LMS infrastructure, as these technologies demonstrated the strongest associations with academic performance. Second, faculty development programs should emphasize pedagogically informed technology integration rather than mere technology adoption, consistent with the TPACK framework. Third, policymakers implementing NEP 2020's digital education initiatives should consider discipline-specific technology integration strategies, recognizing that STEM and non-STEM fields may require differentiated approaches. Fourth, the finding that technology integration effects were comparable across genders supports continued efforts to ensure equitable technology access for all students.

VI. CONCLUSION

This study provides compelling quantitative evidence that digital technology integration significantly and positively predicts academic performance among undergraduate students in Indian higher education. Through rigorous methodology, validated instrumentation, and comprehensive statistical analyses, the study demonstrates that interactive learning platforms and learning management systems are the most potent technological predictors of student academic success. The substantial effect size and the significant explanatory power of the regression model underscore the practical importance of strategic technology integration in higher education settings. As Indian universities continue to navigate the digital transformation of education under NEP 2020, these findings offer an empirical foundation for evidence-based decision-making in educational technology investments, curriculum design, and pedagogical innovation. Future research should employ longitudinal designs, incorporate objective measures of technology use through learning analytics, and extend the investigation to diverse institutional contexts to further elucidate the complex dynamics of technology-mediated learning in higher education.

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Growth Mindset and Academic Resilience as Predictors of Mathematics Achievement Among Middle School Students: A Quantitative Analysis

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Abstract

This study examined the predictive roles of growth mindset and academic resilience on mathematics achievement among middle school students. Employing a quantitative, correlational-predictive research design with mediation analysis, data were collected from 486 students enrolled in grades 6 through 8 across 28 middle schools in Rajasthan, India. Three instruments were used: the Implicit Theories of Intelligence Scale (ITIS, α = .89), the Academic Resilience Scale-30 (ARS-30, α = .91), and institutional mathematics achievement scores (standardized term examination marks converted to z-scores). Hierarchical multiple regression revealed that growth mindset significantly predicted mathematics achievement (β = .44, p < .001), accounting for 26.2% of the variance after controlling for demographic variables. Growth mindset also significantly predicted academic resilience (β = .56, p < .001), explaining 35.8% of the variance. Among the three mindset dimensions, beliefs about effort (β = .24) and response to challenge (β = .21) were the strongest predictors of achievement. Structural equation modeling confirmed that academic resilience partially mediated the relationship between growth mindset and mathematics achievement (βindirect = .18, 95% CI [.12, .25]). Students with strong growth mindsets scored significantly higher in mathematics (M = 0.62, SD = 0.74) than those with fixed mindsets (M = -0.48, SD = 0.82), t(318) = 8.86, p < .001, d = 1.00. These findings highlight the critical importance of fostering growth mindsets and resilience for improving mathematics outcomes.

Keywords: - Growth mindset, academic resilience, mathematics achievement, middle school students, implicit theories, quantitative research

I. INTRODUCTION

Mathematics achievement represents one of the most consequential educational outcomes in contemporary society, serving as a gateway to advanced academic pursuits, STEM careers, and informed civic participation (National Research Council, 2001). Yet, mathematics remains one of the most challenging academic domains for students worldwide, with a substantial proportion of learners experiencing difficulty, anxiety, and disengagement in mathematics learning (Dowker et al., 2016). In India, the Annual Status of Education Report (ASER, 2023) documented that only 25.6% of Grade 8 students could solve a division problem correctly, reflecting a persistent and pervasive mathematics learning crisis. Understanding the psychological factors that enable some students to succeed in mathematics while others struggle, particularly malleable motivational and dispositional factors amenable to educational intervention, is therefore a matter of critical scholarly and practical significance.

Growth mindset, rooted in Dweck's (2006) theory of implicit theories of intelligence, refers to the belief that intelligence and mathematical ability are malleable qualities that can be developed through effort, effective strategies, and appropriate support, as contrasted with a fixed mindset that views intelligence as an innate, unchangeable trait. Research has demonstrated that students who hold growth mindsets tend to embrace challenges, persist through difficulties, interpret effort as a pathway to mastery, and respond constructively to setbacks, all of which are particularly relevant in the demanding domain of mathematics learning (Yeager & Dweck, 2012). Meta-analytic evidence has confirmed a positive, though modest, association between growth mindset and academic achievement, with the relationship being strongest among students from disadvantaged backgrounds and in challenging academic domains (Sisk et al., 2018).

Academic resilience, defined as the capacity to achieve positive educational outcomes despite exposure to adverse circumstances, risk factors, or academic challenges (Martin & Marsh, 2006), represents a complementary psychological resource for navigating the difficulties inherent in mathematics learning. Resilient learners demonstrate adaptive responses to academic setbacks including persistence, help-seeking, cognitive reappraisal, and strategic adjustment, all of which contribute to sustained engagement and performance improvement over time (Cassidy, 2016). The theoretical connection between growth mindset and academic resilience is intuitive: students who believe their abilities can grow are more likely to interpret challenges as opportunities for development rather than as evidence of inadequacy, thereby exhibiting greater resilience in the face of academic difficulty (Yeager & Dweck, 2012).

India's middle school education system, serving approximately 67 million students in grades 6 through 8 (UDISE+, 2023), represents a critical developmental and educational transition period. The National Education Policy 2020 has emphasized the need for foundational numeracy by Grade 3 and the development of higher-order mathematical thinking through middle school and beyond (Ministry of Education, 2020). However, empirical research examining the psychological predictors of mathematics achievement among Indian middle school students, particularly the roles of growth mindset and academic resilience, remains remarkably limited. The existing literature in the Indian context is predominantly descriptive, often relying on small convenience samples and univariate analyses that fail to capture the complex, multidimensional relationships among psychological dispositions and academic outcomes.

1.1. Statement of the Problem

While international research has established growth mindset as a predictor of academic achievement, the specific dimensions of growth mindset that most powerfully predict mathematics achievement in the Indian middle school context remain unexplored. Furthermore, the mediating mechanism through which growth mindset influences mathematics outcomes, potentially through its effects on academic resilience, has not been empirically tested among Indian students. This gap limits the development of targeted, evidence-based interventions to enhance mathematical learning outcomes in India's middle schools.

1.2. Research Objectives

The objectives of this study were:

- To examine the relationships among growth mindset, academic resilience, and mathematics achievement among middle school students;
- To determine which specific dimensions of growth mindset (beliefs about intelligence, beliefs about effort, and response to challenge) most significantly predict mathematics achievement and academic resilience;
- To investigate the mediating role of academic resilience in the relationship between growth mindset and mathematics achievement; and
- To assess whether significant differences exist in growth mindset, academic resilience, and mathematics achievement based on gender, grade level, school type (government vs. private), and school location (urban vs. rural).

1.3. Research Hypotheses

- H_1: Growth mindset significantly predicts mathematics achievement among middle school students.
- H_2: Growth mindset significantly predicts academic resilience among middle school students.
- H_3: Beliefs about effort and response to challenge are the strongest predictors of mathematics achievement among the dimensions of growth mindset.
- H_4: Academic resilience mediates the relationship between growth mindset and mathematics achievement.
- H_5: Significant differences exist in growth mindset, academic resilience, and mathematics achievement based on gender, grade level, school type, and school location.

II. REVIEW OF LITERATURE

2.1. Theoretical Framework

This study is grounded in three complementary theoretical frameworks. First, Dweck's (2006) Implicit Theories of Intelligence framework provides the foundational conceptualization of growth mindset. According to this theory, individuals hold implicit beliefs about the nature of intelligence that fall along a continuum from fixed (entity theory, viewing intelligence as stable and uncontrollable) to growth (incremental theory, viewing intelligence as malleable and developable). These implicit beliefs create distinct motivational frameworks that shape goal orientation, effort attributions, and responses to challenge and failure. Students with growth mindsets adopt mastery goals, attribute success to effort and strategy, and respond to setbacks with increased effort and strategic adjustment, while those with fixed mindsets adopt performance goals, attribute failure to lack of ability, and respond to setbacks with helplessness and disengagement.

Second, Martin and Marsh's (2009) Academic Resilience Framework conceptualizes resilience in educational settings as the capacity to effectively deal with academic setback, challenge, adversity, and pressure. Unlike broader psychological resilience constructs that focus on extreme adversity, academic resilience addresses the everyday challenges of academic life, including poor grades, difficult content, competing demands, and performance pressure. Martin and Marsh identify five factors underlying academic resilience: confidence, coordination, control, composure, and commitment, collectively representing the cognitive, emotional, and behavioral resources that enable students to bounce back from academic difficulty.

Third, Bandura's (1986) Social Cognitive Theory provides the overarching framework for understanding how beliefs (mindset) influence behavior (resilience) and outcomes (achievement) through reciprocal determinism. Within this triadic

model, growth mindset operates as a cognitive factor that shapes self-efficacy beliefs and effort regulation (behavioral factors), which interact with the academic environment (environmental factor) to produce learning outcomes. The integration of these frameworks supports the hypothesized mediation model in which growth mindset influences mathematics achievement both directly and indirectly through academic resilience.

2.2. Growth Mindset and Mathematics Achievement

The relationship between growth mindset and academic achievement, particularly in mathematics, has been the subject of considerable research and debate. Dweck (2006) originally proposed that growth mindset is a significant predictor of academic achievement, particularly in challenging academic domains. Blackwell et al. (2007) conducted a seminal longitudinal study of middle school students and demonstrated that an incremental theory of intelligence predicted increasing mathematics grades over two years, mediated through mastery-oriented goals and positive effort beliefs. Sisk et al. (2018) conducted a comprehensive meta-analysis of 273 studies and reported a small but significant overall effect of mindset on achievement (r = .10), with stronger effects observed among students facing academic difficulty, students from low-income backgrounds, and in mathematics specifically.

Importantly, recent research has emphasized that the relationship between growth mindset and achievement is not uniform across contexts and populations. Yeager et al. (2019) conducted a large-scale randomized trial involving over 12,000 ninth-grade students in the United States and found that a brief growth mindset intervention improved mathematics grades specifically among lower-achieving students in schools with supportive peer norms. In the Indian context, Rattan et al. (2012) investigated mindset beliefs among college students in Mumbai and found that growth mindset predicted greater persistence and performance on challenging mathematical tasks, though the study was limited to a single institution. Sharma and Singh (2018) examined growth mindset and academic achievement among secondary school students in Uttar Pradesh and reported moderate positive correlations, but the study lacked multivariate controls and relied on a small convenience sample.

2.3. Growth Mindset and Academic Resilience

Theoretical reasoning and emerging empirical evidence suggest a strong connection between growth mindset and academic resilience. Students who believe their abilities can be developed through effort are, by definition, more likely to view academic challenges as surmountable obstacles rather than insurmountable barriers, predisposing them toward resilient responses including persistence, strategic adjustment, and adaptive coping (Yeager & Dweck, 2012). Zeng et al. (2016) examined the relationship between mindset beliefs and resilience among Chinese university students and found that growth mindset significantly predicted resilience, mediated through self-efficacy. Kannangara et al. (2018) investigated growth mindset and resilience among university students in the United Kingdom and reported that growth mindset was positively associated with resilience and negatively associated with psychological distress.

In the educational context specifically, Martin and Marsh (2006) demonstrated that the belief that academic ability is developable was a significant predictor of academic resilience, as students who hold this belief are more likely to interpret academic setbacks as temporary and controllable rather than permanent and reflective of fixed deficiency. However, the specific relationship between growth mindset and academic resilience has not been examined among middle school students in India, where cultural attitudes toward intelligence, effort, and academic success may moderate the strength and nature of this association.

2.4. Academic Resilience as a Mediator

The hypothesis that academic resilience mediates the relationship between growth mindset and mathematics achievement is theoretically grounded in the idea that mindset beliefs influence achievement outcomes partly through their effects on the adaptive behavioral and emotional responses that constitute resilience. Growth mindset creates the cognitive foundation (belief that ability can grow), which enables resilient behavior (persistence, strategic effort, adaptive coping), which in turn produces improved academic outcomes (higher mathematics achievement). Zeng et al. (2016) provided partial support for this mediation pathway in the university context, and Claro et al. (2016) demonstrated using large-scale Chilean educational data that growth mindset predicted achievement partly through its association with students' adaptive responses to academic challenges. However, a direct test of the growth mindset to academic resilience to mathematics achievement mediation pathway among middle school students has not been conducted, representing a significant gap in the literature.

III. RESEARCH METHODOLOGY

3.1. Research Design

This study employed a quantitative, cross-sectional, correlational-predictive research design with mediation analysis. The design was chosen to examine the strength and direction of relationships among growth mindset, academic resilience, and mathematics achievement, and to test the hypothesized mediating role of academic resilience (Creswell & Creswell, 2018). Structural equation modeling (SEM) was employed to test the proposed path model, enabling simultaneous estimation of direct and indirect effects while accounting for measurement error (Kline, 2016).

3.2. Population and Sampling

The target population comprised students enrolled in grades 6 through 8 in government and private middle schools across four educational districts of Rajasthan, India (Jaipur, Jodhpur, Udaipur, and Kota). A multistage stratified random sampling procedure was employed. In the first stage, 28 schools (14 government, 14 private; balanced across urban and rural locations) were randomly selected from district education office registries, 7 per district. In the second stage, one section per grade in each school was randomly selected, and 15-20 students per section were randomly invited to participate.

Using G*Power 3.1 (Faul et al., 2009) with parameters for multiple regression (medium effect size f^2 = .15, α = .05, power = .95, 10 predictors), the minimum required sample was 172. To ensure adequate power for SEM analysis (N ≥ 200; Kline, 2016) and to accommodate the multilevel data structure, the target was 520 student responses. After distributing 520 questionnaires, 502 were returned (96.5% response rate). Following data cleaning (removal of incomplete responses and multivariate outliers), the final analytic sample comprised 486 students.

The sample included 258 (53.1%) male and 228 (46.9%) female students. By grade level, 168 (34.6%) were in Grade 6, 162 (33.3%) in Grade 7, and 156 (32.1%) in Grade 8. By school type, 246 (50.6%) were from government schools and 240 (49.4%) from private schools. By school location, 252 (51.9%) were in urban schools and 234 (48.1%) in rural schools. The mean age of participants was 12.4 years (SD = 1.18).

3.3. Instrumentation

3.3.1. Implicit Theories of Intelligence Scale (ITIS).

The ITIS was adapted from Dweck's (1999) original measure and expanded to 18 items across three subscales: Beliefs about Intelligence (6 items), Beliefs about Effort (6 items), and Response to Challenge (6 items). Items were rated on a 6-point Likert scale from 1 (Strongly Disagree) to 6 (Strongly Agree). Fixed mindset items were reverse-scored so that higher scores indicated stronger growth mindset orientation. The instrument was translated into Hindi using a rigorous forward-backward translation procedure with reconciliation by a bilingual committee. Content validity was established through expert review by nine specialists in educational psychology, motivation research, and psychometrics (CVI = .92). EFA on pilot data (n = 120) confirmed the three-factor structure with factor loadings ranging from .58 to .86. CFA on the main study data yielded good fit: χ^2/df = 2.18, CFI = .96, TLI = .95, RMSEA = .049, SRMR = .037. Cronbach's alpha was .89 (total), .85 (Intelligence Beliefs), .86 (Effort Beliefs), and .84 (Response to Challenge).

3.3.2. Academic Resilience Scale-30 (ARS-30).

The ARS-30 (Cassidy, 2016) is a 30-item measure assessing three subscales: Perseverance (10 items), Reflecting and Adaptive Help-Seeking (10 items), and Negative Affect and Emotional Response (10 items, reverse-scored). Items were rated on a 5-point Likert scale from 1 (Likely Would Not Do This) to 5 (Very Likely Would Do This). The ARS-30 has demonstrated robust psychometric properties across diverse educational contexts (Cassidy, 2016). CFA on the present data confirmed the three-factor structure: χ^2/df = 2.28, CFI = .94, TLI = .93, RMSEA = .052, SRMR = .042. Cronbach's alpha was .91 (total), .87 (Perseverance), .85 (Reflecting/Help-Seeking), and .86 (Negative Affect, reversed).

3.3.3. Mathematics Achievement.

Mathematics achievement was operationalized as students' scores on the most recent standardized term-end mathematics examination administered by respective school boards. To enable cross-school comparison, raw scores were converted to within-school z-scores (M = 0, SD = 1) using each school's grade-level mean and standard deviation as reference parameters. This standardization procedure accounts for differences in examination difficulty and grading practices across schools while preserving meaningful within-school variation (Marsh et al., 2008).

3.4. Data Collection Procedure

Ethical approval was obtained from the Institutional Human Research Ethics Committee (Approval No. IHREC/2024/EDU/112). Administrative permissions were secured from the Directorate of Elementary Education, Rajasthan, and from principals of all participating schools. Written parental consent and student assent were obtained. Data collection was conducted during January-March 2025. The ITIS and ARS-30 were administered during regular school hours by trained research assistants, with Hindi versions provided to government school students and English versions to English-medium private school students. Mathematics achievement scores were obtained from institutional records with administrative consent. To mitigate common method bias, predictor variables (self-report questionnaires) and the criterion variable (institutional achievement records) were measured through different sources (Podsakoff et al., 2003).

3.5. Data Analysis

Data analysis was conducted using IBM SPSS Statistics Version 28.0 and AMOS Version 26.0. Preliminary analyses included missing data screening (less than 2%, handled via Expectation Maximization), outlier detection (Mahalanobis distance, p < .001), normality assessment (skewness and kurtosis within ±2), linearity verification, and multicollinearity diagnostics (VIF < 3.0). Descriptive statistics were computed. Inferential analyses included:

- Pearson product-moment correlations;
- Hierarchical multiple regression predicting mathematics achievement and academic resilience;
- Independent samples t-tests for gender, school type, and location comparisons;
- One-way ANOVA with Tukey HSD post hoc tests for grade-level comparisons; and
- Structural equation modeling with bootstrapped mediation analysis (5,000 resamples).

Effect sizes (Cohen's d, η^2, R^2) were reported. Significance was set at α = .05.

IV. RESULTS AND DATA ANALYSIS

4.1. Descriptive Statistics

Table 1 presents descriptive statistics for all study variables. The overall growth mindset mean was 4.12 (SD = 0.82) on a 6-point scale, indicating a moderate growth orientation. Beliefs about Effort had the highest subscale mean (M = 4.36, SD = 0.78) while Beliefs about Intelligence had the lowest (M = 3.86, SD = 0.92). Overall academic resilience was moderate (M = 3.42, SD = 0.72) on a 5-point scale. Mathematics achievement z-scores had a mean of 0.00 (SD = 1.00) as expected. Skewness values ranged from -0.38 to 0.26 and kurtosis from -0.52 to 0.46, confirming approximate normality.

Table 1. Descriptive Statistics for Study Variables (N = 486)

Variable	M	SD	Skew	Kurt	α
Beliefs about Intelligence	3.86	0.92	-0.22	0.18	.85
Beliefs about Effort	4.36	0.78	-0.38	0.46	.86
Response to Challenge	4.14	0.84	-0.28	0.32	.84
Overall Growth Mindset	4.12	0.82	-0.30	0.28	.89
Perseverance	3.56	0.76	-0.18	0.24	.87
Reflecting/Help-Seeking	3.38	0.74	0.12	-0.36	.85
Negative Affect (reversed)	3.28	0.82	0.26	-0.52	.86
Overall Academic Resilience	3.42	0.72	0.06	-0.18	.91
Mathematics Achievement (z)	0.00	1.00	-0.14	0.16	-

Note. ITIS scored on 6-point scale; ARS-30 scored on 5-point scale; Mathematics Achievement expressed as within-school z-scores.

4.2. Correlation Analysis

Pearson correlation analysis (Table 2) revealed significant positive correlations among all primary study variables. Overall growth mindset was strongly correlated with academic resilience (r = .59, p < .001) and moderately correlated with mathematics achievement (r = .51, p < .001). Academic resilience was moderately correlated with mathematics achievement (r = .48, p < .001). Among mindset subscales, Beliefs about Effort showed the strongest correlation with achievement (r = .48, p < .001), followed by Response to Challenge (r = .46, p < .001) and Beliefs about Intelligence (r = .38, p < .001).

Table 2. Pearson Correlation Matrix for Primary Study Variables

Variable	1	2	3	4	5	6
1. Intelligence Beliefs	-					
2. Effort Beliefs	.56***	-				
3. Response to Challenge	.52***	.62***	-			
4. Academic Resilience	.48***	.56***	.54***	-		
5. Math Achievement	.38***	.48***	.46***	.48***	-	

Note. ***p < .001. Math = Mathematics.

4.3. Hierarchical Multiple Regression Analysis

Two hierarchical multiple regression analyses were conducted: one predicting mathematics achievement and one predicting academic resilience (Tables 3 and 4). In the first analysis, demographic variables (gender, grade level, school type, location) were entered in Step 1, accounting for 7.4% of the variance, $F_{(4, 481)} = 9.62$, p < .001. In Step 2, the three growth mindset dimensions were entered, contributing an additional 18.8% of variance, yielding a total R^2 of .262, $F_{(7, 478)} = 24.28$, p < .001. The change was significant: $\Delta R^2 = .188$, $\Delta F_{(3, 478)} = 40.62$, p < .001.

Beliefs about Effort was the strongest predictor of mathematics achievement (β = .24, p < .001), followed by Response to Challenge (β = .21, p < .001) and Beliefs about Intelligence (β = .12, p = .012). All VIF values ranged from 1.42 to 1.96, confirming the absence of problematic multicollinearity. Thus, H_1 and H_3 were supported.

Table 3. Hierarchical Multiple Regression Predicting Mathematics Achievement

Predictor	B	SE	β	t	p	VIF
Step 1 (R² = .074)						
Gender	0.14	0.08	.07	1.68	.094	1.02
Grade Level	-0.08	0.06	-.06	-1.38	.168	1.04
School Type	0.28	0.08	.14	3.28	.001	1.10
School Location	0.22	0.08	.12	2.62	.009	1.08
Step 2 (ΔR² = .188)						
Intelligence Beliefs	0.13	0.05	.12	2.52	.012	1.62
Effort Beliefs	0.31	0.06	.24	4.92	<.001	1.96
Response to Challenge	0.25	0.06	.21	4.28	<.001	1.84

Note. Total R² = .262. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

In the second regression predicting academic resilience, demographic variables in Step 1 explained 4.6% of the variance, $F_{(4, 481)} = 5.82$, p < .001. The growth mindset dimensions in Step 2 contributed an additional 31.2%, for a total R^2 of .358, $F_{(7, 478)} = 38.06$, p < .001. Effort Beliefs (β = .28, p < .001), Response to Challenge (β = .26, p < .001), and Intelligence Beliefs (β = .16, p = .002) were all significant predictors. Thus, H_2 was supported.

Table 4. Hierarchical Multiple Regression Predicting Academic Resilience

Predictor	B	SE	β	t	p	VIF
Step 1 (R² = .046)						
Gender	0.12	0.06	.08	1.86	.064	1.02
Grade Level	0.10	0.04	.10	2.28	.023	1.04
School Type	0.08	0.06	.06	1.28	.202	1.10
School Location	0.14	0.06	.10	2.18	.030	1.08
Step 2 (ΔR² = .312)						
Intelligence Beliefs	0.12	0.04	.16	3.18	.002	1.62
Effort Beliefs	0.26	0.04	.28	5.94	<.001	1.96
Response to Challenge	0.22	0.04	.26	5.36	<.001	1.84
Predictor	B	SE	β	t	p	VIF

Note. Total R^2 = .358. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

4.4. Group Comparison Analyses

An independent samples t-test comparing students in the top tertile (strong growth mindset, n = 160) and bottom tertile (fixed mindset, n = 160) revealed that growth-mindset students had significantly higher mathematics achievement (M = 0.62, SD = 0.74) than fixed-mindset students (M = -0.48, SD = 0.82), t(318) = 8.86, p < .001, d = 1.00, a large effect. Growth-mindset students also demonstrated significantly higher academic resilience (M = 3.92, SD = 0.62) compared to fixed-mindset students (M = 2.84, SD = 0.74), t(318) = 9.96, p < .001, d = 1.12.

Private school students reported significantly stronger growth mindsets (M = 4.32, SD = 0.76) than government school students (M = 3.92, SD = 0.86), t(484) = 5.24, p < .001, d = 0.49. Urban students reported higher academic resilience than rural students, t(484) = 3.46, p < .001, d = 0.32. No significant gender differences were found in growth mindset, t(484) = 1.42, p = .156, d = 0.13, or mathematics achievement, t(484) = 0.96, p = .338, d = 0.09.

One-way ANOVA revealed significant grade-level differences in academic resilience, F(2, 483) = 5.86, p = .003, η² = .024. Tukey HSD post hoc tests indicated that Grade 8 students (M = 3.58, SD = 0.68) demonstrated significantly higher resilience than Grade 6 students (M = 3.26, SD = 0.76), p = .002, but did not differ significantly from Grade 7 students (M = 3.42, SD = 0.72), p = .172. Thus, H₅ was partially supported.

4.5. Structural Equation Modeling and Mediation Analysis

The hypothesized path model was tested using SEM with maximum likelihood estimation. The model demonstrated good overall fit: χ²/df = 2.16, CFI = .96, TLI = .95, RMSEA = .049 (90% CI [.040, .058]), SRMR = .036. Results confirmed that growth mindset had a significant direct effect on academic resilience (β = .56, p < .001) and academic resilience had a significant direct effect on mathematics achievement (β = .32, p < .001). The direct effect of growth mindset on mathematics achievement, controlling for resilience, was reduced but remained significant (β = .26, p < .001), indicating partial mediation.

Bootstrapped mediation analysis (5,000 resamples) confirmed a significant indirect effect of growth mindset on mathematics achievement through academic resilience (βindirect = .18, 95% CI [.12, .25], p < .001). The total effect of growth mindset on mathematics achievement was .44 (p < .001), of which approximately 40.9% was mediated through academic resilience. The model explained 35.8% of the variance in academic resilience and 34.6% of the variance in mathematics achievement. Thus, H₄ was fully supported.

Table 5. Path Coefficients and Mediation Effects from Structural Equation Model

Path / Effect	B	SE	95% CI	p	R²	Result
GM -> AR (direct)	.56	.04	[.48, .64]	<.001	.358	Supported
AR -> MA (direct)	.32	.05	[.23, .41]	<.001	.346	Supported
GM -> MA (direct)	.26	.05	[.16, .36]	<.001	-	-
GM -> AR -> MA (indirect)	.18	.03	[.12, .25]	<.001	-	Mediation
Total effect (GM -> MA)	.44	.04	[.36, .52]	<.001	-	-

Note. GM = Growth Mindset; AR = Academic Resilience; MA = Mathematics Achievement. Bootstrapped 95% CIs based on 5,000 resamples.

V. DISCUSSION

The present study provides robust quantitative evidence that growth mindset is a significant predictor of both mathematics achievement and academic resilience among middle school students in Rajasthan, India. The finding that growth mindset accounted for 26.2% of the variance in mathematics achievement is substantially larger than the overall meta-analytic effect reported by Sisk et al. (2018), potentially reflecting the heightened relevance of mindset beliefs in the Indian educational context, where mathematics is both culturally valued and a major source of academic anxiety. The large effect size (d = 1.00) separating growth-mindset and fixed-mindset students on mathematics achievement underscores the practical significance of mindset orientations for mathematical learning outcomes.

The emergence of Beliefs about Effort as the strongest predictor of both mathematics achievement and academic resilience is a theoretically significant finding with important practical implications. The belief that effort leads to mastery is the operational core of growth mindset, transforming challenges from threats to be avoided into opportunities for learning and development (Dweck, 2006). Students who believe that effort in mathematics will produce improvement are more likely to persist through difficult problems, seek help when stuck, and maintain engagement when progress is slow. This finding aligns

with Blackwell et al. (2007), who demonstrated that effort beliefs were the primary mechanism through which growth mindset predicted mathematics grade trajectories. In the Indian context, where cultural narratives around intelligence and academic achievement can be paradoxically fatalistic (attributing success to innate talent) and effort-oriented (emphasizing hard work), strengthening the specific belief that effort produces growth appears to be a particularly potent intervention target.

The strong predictive relationship between growth mindset and academic resilience ($R^2 = .358$) corroborates the theoretical propositions of Yeager and Dweck (2012) and extends the empirical evidence of Zeng et al. (2016) to the Indian middle school context. Growth mindset appears to provide the cognitive foundation upon which resilient academic behavior is built: by framing intelligence as malleable, students develop the psychological resources to persevere through difficulty, regulate negative emotions in the face of setbacks, and seek adaptive strategies for improvement rather than withdrawing from challenge.

The mediation analysis constitutes a central contribution, demonstrating that approximately 41% of the total effect of growth mindset on mathematics achievement was channeled through academic resilience. This finding illuminates the psychological pathway through which mindset beliefs translate into tangible academic outcomes: growth mindset fosters resilience (persistence, adaptive coping, strategic adjustment), which in turn enhances mathematics performance. The remaining direct effect of growth mindset on achievement may operate through additional mechanisms, including self-efficacy beliefs, goal orientation, and the quality and quantity of cognitive engagement with mathematical content (Blackwell et al., 2007).

5.1. Limitations

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inferences; the direction of effects may be reciprocal, with mathematics achievement also influencing mindset beliefs and resilience. Longitudinal and experimental designs are needed to establish causality. Second, growth mindset was measured via self-report, which may be subject to social desirability bias, particularly given increasing public awareness of growth mindset concepts. Behavioral measures of mindset, such as challenge-seeking and persistence on difficult tasks, would strengthen future research. Third, the study was conducted in Rajasthan, and findings may not generalize to other Indian states with different educational systems, cultural norms, and socioeconomic profiles. Fourth, mathematics achievement was based on school-administered examinations that may vary in quality and rigor across schools, despite the z-score standardization procedure. Fifth, the study did not examine classroom-level factors such as teacher mindset, instructional quality, or classroom climate that may moderate the mindset-achievement relationship (Yeager et al., 2019).

5.2. Implications for Practice and Policy

The findings carry several important implications for educational practice and policy. First, schools should implement evidence-based growth mindset interventions at the middle school level, focusing specifically on strengthening students' beliefs about the value of effort and their constructive responses to challenge. Brief, scalable mindset interventions such as those developed by Yeager et al. (2019) have demonstrated efficacy in improving mathematics outcomes and could be adapted for the Indian educational context. Second, mathematics pedagogy should be redesigned to emphasize process over product, rewarding effort, strategy use, and improvement rather than exclusively rewarding correct answers and speed. Third, teacher professional development programs should incorporate mindset-informed instructional practices, equipping teachers with strategies for providing growth-oriented feedback, creating challenge-embracing classroom cultures, and modeling resilient responses to mathematical difficulty. Fourth, the significant school-type and location-based disparities in growth mindset call for targeted interventions in government and rural schools where fixed mindset beliefs appear more prevalent, potentially reflecting resource constraints and limited exposure to efficacy-building academic experiences. Fifth, academic resilience-building programs should be integrated into school counseling and social-emotional learning curricula, recognizing that resilience is a learnable capacity that can be systematically developed through structured interventions involving cognitive reframing, coping skill instruction, and peer support mechanisms.

VI. CONCLUSION

This study provides compelling quantitative evidence that growth mindset and academic resilience are significant predictors of mathematics achievement among middle school students in the Indian educational context. Through rigorous correlational-predictive methodology, validated instrumentation, and comprehensive statistical analyses including structural equation modeling with bootstrapped mediation, the study demonstrates that beliefs about effort and responses to challenge are the most potent mindset dimensions, and that academic resilience serves as a significant mediating mechanism through which growth mindset translates into mathematical achievement. The substantial explanatory power of the proposed models, the confirmed mediation pathway, and the identified school-type and location-based disparities collectively provide an empirically grounded framework for designing targeted interventions to improve mathematics learning outcomes. As India confronts the urgent challenge of strengthening mathematical competencies among its vast student population, fostering growth mindsets and academic resilience represents a psychologically powerful, educationally sound, and practically scalable strategy for unlocking the mathematical potential of every learner.

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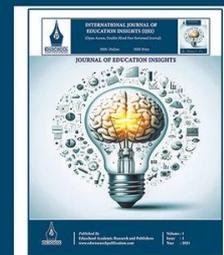
The Impact of School Climate on Student Well-Being and Academic Motivation Among High School Students: A Quantitative Investigation

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Abstract

This study investigated the impact of school climate on student well-being and academic motivation among high school students. Employing a quantitative, correlational-predictive research design with mediation analysis, data were collected from 468 students enrolled in grades 11 and 12 across 32 higher secondary schools in Maharashtra, India. Three validated instruments were used: the School Climate Assessment Instrument (SCAI, $\alpha = .93$), the WHO-5 Well-Being Index adapted for adolescents (WHO-5A, $\alpha = .87$), and the Academic Motivation Scale-High School Version (AMS-HS, $\alpha = .91$). Hierarchical multiple regression analysis revealed that school climate significantly predicted student well-being ($\beta = .54$, $p < .001$), accounting for 33.6% of the variance after controlling for demographic variables. School climate also significantly predicted academic motivation ($\beta = .49$, $p < .001$), explaining 28.8% of the variance. Among the four dimensions, teacher-student relationships ($\beta = .28$) and sense of safety and belonging ($\beta = .24$) were the strongest predictors. Structural equation modeling confirmed that student well-being partially mediated the relationship between school climate and academic motivation (βindirect = .21, 95% CI [.14, .29]). Students in schools with positive climates reported significantly higher well-being ($M = 4.02$) than those in schools with poor climates ($M = 2.86$), $t(302) = 8.14$, $p < .001$, $d = 0.94$. These findings underscore the critical importance of cultivating positive school climates for promoting holistic student development.

Keywords: - School Climate, Student Well-Being, Academic Motivation, Higher Secondary Education, Structural Equation Modeling, Quantitative Research

I. INTRODUCTION

School climate, broadly defined as the quality and character of school life encompassing norms, values, interpersonal relationships, teaching and learning practices, and organizational structures (Thapa et al., 2013), has increasingly been recognized as a foundational determinant of student educational experiences and developmental outcomes. Schools are not merely settings for academic instruction but are complex social ecosystems in which students spend a substantial portion of their formative years, developing cognitive, social, emotional, and identity-related competencies (Cohen et al., 2009). The quality of this social ecosystem, as reflected in the prevailing school climate, profoundly shapes how students think, feel, and behave within the educational context and beyond.

Student well-being, conceptualized as a multidimensional construct encompassing positive affect, life satisfaction, psychological functioning, and the absence of mental health difficulties (Diener et al., 1999), has emerged as a central concern in contemporary education. The World Health Organization (2018) has emphasized that promoting well-being among school-age children is not only an end in itself but also a prerequisite for effective learning and healthy development. Declining mental health indicators among adolescents globally, including rising rates of anxiety, depression, and stress-related disorders, have heightened the urgency of understanding the school-level factors that either protect or undermine student well-being (Gutman & Vorhaus, 2012).

Academic motivation, defined as the internal and external forces that initiate, guide, and sustain learning-related behaviors (Ryan & Deci, 2020), is a critical determinant of student engagement, persistence, and achievement. Self-Determination Theory (Deci & Ryan, 1985) posits that the satisfaction of three basic psychological needs, namely autonomy,

competence, and relatedness, is essential for the development and maintenance of intrinsic motivation. School environments that fulfill these needs through supportive relationships, meaningful choices, and optimal challenges are theorized to foster autonomous forms of academic motivation that are associated with deeper learning and greater academic success (Reeve, 2012).

India's higher secondary education system serves approximately 25 million students in grades 11 and 12, a critical transitional phase characterized by heightened academic pressure, competitive examination preparation, and significant developmental changes (UDISE+, 2023). The National Education Policy 2020 explicitly acknowledges the importance of creating safe, supportive, and inclusive school environments that promote both academic excellence and holistic student development (Ministry of Education, 2020). However, empirical research examining the relationship between school climate, student well-being, and academic motivation in the Indian higher secondary context remains remarkably sparse, with most existing studies being descriptive in nature and lacking the multivariate statistical rigor necessary to establish predictive relationships and test mediating mechanisms.

1.1. Statement of the Problem

Despite growing recognition of the importance of school climate for student outcomes, rigorous quantitative research examining how specific dimensions of school climate differentially predict student well-being and academic motivation in the Indian educational context is lacking. The mediating pathways through which school climate influences academic motivation, potentially through its effects on student well-being, remain empirically untested in the Indian higher secondary school context. This gap constrains the development of evidence-based school improvement strategies that simultaneously address academic motivation and psychological well-being.

1.2. Research Objectives

The objectives of this study were:

- To examine the relationship between school climate, student well-being, and academic motivation among high school students;
- To determine which specific dimensions of school climate (teacher-student relationships, sense of safety and belonging, academic support structures, and peer relationships) most significantly predict student well-being and academic motivation;
- To investigate the mediating role of student well-being in the relationship between school climate and academic motivation; and
- To assess whether significant differences exist in school climate perceptions, student well-being, and academic motivation based on gender, school type (government vs. private), stream of study, and school location (urban vs. rural).

1.3. Research Hypotheses

- H_1: School climate significantly predicts student well-being among high school students.
- H_2: School climate significantly predicts academic motivation among high school students.
- H_3: Teacher-student relationships and sense of safety and belonging are the strongest predictors of student well-being and academic motivation among the dimensions of school climate.
- H_4: Student well-being mediates the relationship between school climate and academic motivation.
- H_5: Significant differences exist in school climate perceptions, student well-being, and academic motivation based on gender, school type, stream of study, and school location.

II. REVIEW OF LITERATURE

2.1. Theoretical Framework

This study is anchored in three complementary theoretical frameworks. First, the Bioecological Model of Human Development (Bronfenbrenner & Morris, 2006) conceptualizes the school as a microsystem that directly influences student development through proximal processes occurring in everyday interactions between students, teachers, and peers. Within this framework, school climate represents the aggregate quality of these proximal processes, shaping developmental trajectories in domains of cognitive, social, and emotional functioning. The mesosystem interactions between school and home contexts, and the exosystem influences of community and policy environments, further moderate the impact of school climate on individual student outcomes.

Second, Self-Determination Theory (Deci & Ryan, 1985; Ryan & Deci, 2020) provides the motivational framework for understanding how school climate influences academic motivation. SDT posits that social contexts that satisfy the three basic psychological needs of autonomy (sense of volition and choice), competence (sense of mastery and effectiveness), and relatedness (sense of belonging and connection) promote autonomous, intrinsic forms of motivation, whereas need-thwarting contexts lead to controlled motivation or amotivation. School climate dimensions such as teacher-student relationships and peer connectedness directly map onto the need for relatedness, while academic support structures address competence needs, and opportunities for student voice address autonomy needs.

Third, Keyes' (2005) Complete State Model of Mental Health provides the conceptual basis for understanding student well-being not merely as the absence of psychopathology but as the presence of positive emotional, psychological, and social functioning. This model aligns with the World Health Organization's definition of health as a state of complete physical, mental, and social well-being, and supports the investigation of school climate as an environmental determinant of positive psychological functioning among students.

2.2. School Climate and Student Well-Being

A growing body of research has documented the association between school climate and student well-being. Thapa et al. (2013) conducted a comprehensive review of school climate research and concluded that positive school climates characterized by supportive relationships, safety, and engagement were associated with improved psychological adjustment and reduced mental health problems among students. Suldo et al. (2012) examined the relationship between school climate dimensions and subjective well-being among middle school students in the United States and found that teacher social support and school satisfaction were the strongest predictors of well-being, accounting for approximately 25% of the variance.

Kidger et al. (2012) investigated the association between school-level factors and adolescent emotional health across 24 secondary schools in England and reported that school connectedness and positive teacher-student relationships were protective factors against emotional distress. In a cross-national study spanning 30 countries, Due et al. (2009) found that school-level social support was significantly associated with student well-being, with the strength of the association varying by cultural context. In the Indian context, Sharma and Khanna (2021) examined school climate perceptions among secondary school students in Himachal Pradesh and found that students perceiving positive school climates reported lower levels of stress and anxiety, though the study was limited by its descriptive design and small sample size.

2.3. School Climate and Academic Motivation

The relationship between school climate and academic motivation is well-supported by both theoretical reasoning and empirical evidence. Reeve (2012) provided a comprehensive framework linking autonomy-supportive school environments to enhanced intrinsic motivation, demonstrating that teachers and schools that offer choices, acknowledge student perspectives, and provide meaningful rationales for tasks promote greater autonomous motivation. Wang and Eccles (2013) conducted a longitudinal study of over 1,000 American adolescents and found that perceptions of school climate, particularly teacher emotional support and classroom structure, predicted trajectories of behavioral, emotional, and cognitive engagement across the middle and high school years.

Ryzin et al. (2009) utilized latent growth curve modeling to examine the longitudinal relationship between school climate and motivation among high school students and found that improvements in perceived school climate over time were associated with corresponding increases in academic motivation and engagement. In the Indian context, Kapur (2018) investigated the relationship between school environment and academic motivation among senior secondary students in Delhi and reported moderate positive correlations, though the study employed a convenience sample and univariate analytical techniques. Verma and Gupta (2020) examined the motivational climate of government and private secondary schools in Uttarakhand and found that private schools with more structured academic support systems reported higher student motivation levels.

2.4. Student Well-Being as a Mediator

The hypothesis that student well-being mediates the relationship between school climate and academic motivation is theoretically grounded in the broaden-and-build theory of positive emotions (Fredrickson, 2001), which posits that positive emotional experiences broaden individuals' thought-action repertoires and build enduring personal resources including intellectual, social, and psychological resources. Within this framework, positive school climates generate well-being (positive emotions, satisfaction, psychological security), which in turn broadens students' cognitive and motivational capacities, facilitating greater academic engagement and intrinsic motivation. Empirical support for this mediation pathway is emerging but limited. Tian et al. (2016) examined school climate, well-being, and academic engagement among Chinese adolescents and found that subjective well-being partially mediated the climate-engagement relationship. However, this mediation model has not been tested in the Indian educational context.

III. RESEARCH METHODOLOGY

3.1. Research Design

This study employed a quantitative, cross-sectional, correlational-predictive research design with mediation analysis. The design was selected to examine the strength and direction of relationships among school climate, student well-being, and academic motivation, and to test the hypothesized mediating role of well-being (Creswell & Creswell, 2018). Structural equation modeling (SEM) was used to test the proposed path model, enabling simultaneous estimation of direct and indirect effects while controlling for measurement error (Kline, 2016).

3.2. Population and Sampling

The target population comprised students enrolled in grades 11 and 12 in government and private higher secondary schools across four educational districts of Maharashtra, India (Pune, Nagpur, Nashik, and Aurangabad). A multistage stratified random sampling procedure was employed. In the first stage, 32 schools (16 government, 16 private; 16 urban, 16 rural) were randomly selected from the district education office registries, 8 per district. In the second stage, one class section per school was randomly selected, and all students in the selected section were invited to participate.

Using G*Power 3.1 (Faul et al., 2009) with parameters for multiple regression (medium effect size $f^2 = .15$, $\alpha = .05$, power = .95, 10 predictors), the minimum required sample was 172. To ensure adequate power for SEM ($N \geq 200$; Kline, 2016) and to account for the nested data structure, the target was 500 students. After distributing 500 questionnaires, 482 were returned (96.4% response rate), and after excluding incomplete responses, the final analytic sample comprised 468 students.

The sample included 252 (53.8%) female and 216 (46.2%) male students. By school type, 232 (49.6%) were from government schools and 236 (50.4%) from private schools. By stream of study, 164 (35.0%) were in Science, 156 (33.3%) in

Commerce, and 148 (31.6%) in Arts/Humanities. By school location, 238 (50.9%) were in urban schools and 230 (49.1%) in rural schools. By grade, 242 (51.7%) were in Grade 11 and 226 (48.3%) in Grade 12.

3.3. Instrumentation

3.3.1. School Climate Assessment Instrument (SCAI).

The SCAI is a researcher-developed instrument comprising 32 items across four subscales: Teacher-Student Relationships (8 items), Sense of Safety and Belonging (8 items), Academic Support Structures (8 items), and Peer Relationships (8 items). Items were rated on a 5-point Likert scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Content validity was established through expert review by ten specialists in educational psychology, school counseling, and psychometrics (CVI = .94). Exploratory Factor Analysis on pilot data (*n* = 140) confirmed the four-factor structure with factor loadings ranging from .54 to .91. CFA on the main study data yielded good fit: χ^2/df = 2.14, CFI = .96, TLI = .95, RMSEA = .049, SRMR = .036. Cronbach's alpha was .93 (total), .89 (Teacher-Student Relationships), .87 (Safety and Belonging), .86 (Academic Support), and .85 (Peer Relationships).

3.3.2. WHO-5 Well-Being Index - Adolescent Version (WHO-5A).

The WHO-5A is an adapted version of the WHO-5 Well-Being Index (World Health Organization, 1998) supplemented with 10 additional items specifically relevant to adolescent school contexts, yielding a total of 15 items across three subscales: Emotional Well-Being (5 items), Psychological Well-Being (5 items), and Social Well-Being (5 items). Items were rated on a 6-point Likert scale from 0 (*At No Time*) to 5 (*All of the Time*). The original WHO-5 has demonstrated excellent psychometric properties worldwide (Topp et al., 2015). CFA on the present data confirmed the three-factor structure: χ^2/df = 2.28, CFI = .95, TLI = .94, RMSEA = .052, SRMR = .040. Cronbach's alpha coefficients were .87 (total), .84 (Emotional), .83 (Psychological), and .82 (Social).

3.3.3. Academic Motivation Scale - High School Version (AMS-HS).

The AMS-HS was adapted from the Academic Motivation Scale (Vallerand et al., 1992) for the Indian higher secondary context. The instrument comprises 21 items across three subscales aligned with Self-Determination Theory: Intrinsic Motivation (7 items), Extrinsic Motivation (7 items), and Amotivation (7 items, reverse-scored). Items were rated on a 7-point Likert scale from 1 (*Does Not Correspond at All*) to 7 (*Corresponds Exactly*). CFA confirmed the three-factor structure: χ^2/df = 2.36, CFI = .94, TLI = .93, RMSEA = .054, SRMR = .044. Cronbach's alpha was .91 (total), .88 (Intrinsic Motivation), .85 (Extrinsic Motivation), and .86 (Amotivation).

3.4. Data Collection Procedure

Ethical clearance was obtained from the Institutional Ethics Committee for Human Research (Approval No. IECHR/2024/EDU/104). Administrative permissions were secured from the Maharashtra State Board of Secondary and Higher Secondary Education and from principals of all participating schools. Written parental consent and student assent were obtained prior to data collection. Data were collected during February-April 2025 through paper-based questionnaire administration during designated class periods under the supervision of trained research assistants. To minimize response bias, students were assured of anonymity and confidentiality, and teachers were absent during administration. To mitigate common method variance, procedural remedies including randomized item ordering, scale format variation across instruments, and temporal separation between school climate and motivation measures were implemented (Podsakoff et al., 2003).

3.5. Data Analysis

Data analysis was conducted using IBM SPSS Statistics Version 28.0 and AMOS Version 26.0. Preliminary analyses included screening for missing data (less than 1.8%, handled via Expectation Maximization), outlier detection (Mahalanobis distance), normality assessment (skewness and kurtosis within ±2), linearity checks, and multicollinearity diagnostics (VIF < 3.0, Tolerance > .30). Descriptive statistics were computed for all variables. Inferential analyses included:

- Pearson product-moment correlations;
- Hierarchical multiple regression predicting well-being and academic motivation;
- Independent samples *t*-tests for gender, school type, and location comparisons;
- One-way ANOVA with Tukey HSD post hoc tests for stream-based comparisons; and
- Structural equation modeling with bootstrapped mediation analysis (5,000 resamples).

Effect sizes (Cohen's *d*, η^2, R^2) were reported. Significance was set at α = .05.

IV. RESULTS AND DATA ANALYSIS

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics for all study variables. The overall school climate mean was 3.56 (*SD* = 0.72) on a 5-point scale, indicating a moderate perception of school climate quality. Teacher-Student Relationships had the highest subscale mean (*M* = 3.74, *SD* = 0.76) while Academic Support Structures had the lowest (*M* = 3.38, *SD* = 0.82). Overall student well-being was moderate (*M* = 3.42, *SD* = 0.84) on a 5-point scale, and academic motivation was moderate (*M* = 4.64, *SD* = 0.96) on a 7-point scale. Skewness values ranged from -0.41 to 0.28 and kurtosis from -0.56 to 0.44, confirming approximate normality.

Table 1. Descriptive Statistics for Study Variables (N = 468)

Variable	M	SD	Skew	Kurt	A
Teacher-Student Relationships	3.74	0.76	-0.32	0.22	.89
Safety and Belonging	3.62	0.78	-0.24	0.18	.87
Academic Support Structures	3.38	0.82	0.14	-0.38	.86
Peer Relationships	3.52	0.74	-0.12	0.28	.85
Overall School Climate	3.56	0.72	-0.14	0.08	.93
Emotional Well-Being	3.56	0.88	-0.28	0.16	.84
Psychological Well-Being	3.34	0.86	0.16	-0.42	.83
Social Well-Being	3.38	0.82	0.22	-0.56	.82
Overall Student Well-Being	3.42	0.84	0.04	-0.26	.87
Intrinsic Motivation	4.86	1.04	-0.41	0.44	.88
Extrinsic Motivation	4.72	0.98	-0.18	0.12	.85
Amotivation (reversed)	4.32	1.12	0.28	-0.34	.86
Overall Academic Motivation	4.64	0.96	-0.08	0.06	.91

Note. SCAI and WHO-5A scored on 5-point scales (WHO-5A rescaled to 0-5); AMS-HS scored on 7-point scale. Amotivation items are reverse-scored.

4.2. Correlation Analysis

Pearson correlation analysis (Table 2) revealed significant positive correlations among all primary study variables. Overall school climate was strongly correlated with student well-being ($r = .58$, $p < .001$) and academic motivation ($r = .54$, $p < .001$). Student well-being was strongly correlated with academic motivation ($r = .52$, $p < .001$). Among school climate subscales, Teacher-Student Relationships demonstrated the strongest correlations with both well-being ($r = .54$, $p < .001$) and academic motivation ($r = .51$, $p < .001$), followed by Safety and Belonging ($r = .50$ and .47, respectively, both $p < .001$).

Table 2. Pearson Correlation Matrix for Primary Study Variables

Variable	1	2	3	4	5	6
1. Teacher-Student Rel.	-					
2. Safety & Belonging	.64***	-				
3. Academic Support	.52***	.56***	-			
4. Peer Relationships	.48***	.54***	.46***	-		
5. Student Well-Being	.54***	.50***	.42***	.46***	-	
6. Academic Motivation	.51***	.47***	.44***	.40***	.52***	-

Note. Rel. = Relationships. ***$p < .001$.

4.3. Hierarchical Multiple Regression Analysis

Two hierarchical multiple regression analyses were conducted: one predicting student well-being and one predicting academic motivation (Tables 3 and 4). In the first analysis predicting well-being, demographic variables (gender, school type, stream, location) were entered in Step 1, accounting for 6.8% of the variance, $F(4, 463) = 8.46$, $p < .001$. In Step 2, the four school climate dimensions were entered, contributing an additional 26.8% of variance, yielding a total R^2 of .336, $F(8, 459) = 29.08$, $p < .001$. The ΔR^2 was significant: $\Delta F(4, 459) = 46.32$, $p < .001$.

Teacher-Student Relationships was the strongest predictor of well-being ($\beta = .28$, $p < .001$), followed by Safety and Belonging ($\beta = .24$, $p < .001$), Peer Relationships ($\beta = .16$, $p = .001$), and Academic Support ($\beta = .11$, $p = .024$). All VIF values ranged from 1.34 to 2.22, confirming no multicollinearity concerns.

Table 3. Hierarchical Multiple Regression Predicting Student Well-Being

Predictor	B	SE	β	t	p	VIF
Step 1 (R^2 = .068)						
Gender	0.16	0.07	.10	2.22	.027	1.04
School Type	0.14	0.08	.08	1.72	.086	1.12
Stream of Study	0.06	0.05	.05	1.12	.264	1.08
School Location	0.20	0.08	.12	2.56	.011	1.10
Step 2 (ΔR^2 = .268)						
Teacher-Student Rel.	0.31	0.06	.28	5.42	<.001	2.22
Safety and Belonging	0.26	0.06	.24	4.56	<.001	2.08
Academic Support	0.11	0.05	.11	2.26	.024	1.74
Peer Relationships	0.18	0.05	.16	3.28	.001	1.68

Note. Total R^2 = .336. B = unstandardized coefficient; SE = standard error; β = standardized coefficient; Rel. = Relationships.

In the second regression predicting academic motivation, demographic variables in Step 1 explained 5.4% of the variance, $F(4, 463) = 6.62$, $p < .001$. The school climate dimensions in Step 2 contributed an additional 23.4%, for a total R^2 of .288, $F(8, 459) = 23.26$, $p < .001$. Teacher-Student Relationships ($\beta = .26$, $p < .001$) and Safety and Belonging ($\beta = .21$, $p < .001$) were again the strongest predictors, followed by Academic Support ($\beta = .16$, $p = .002$) and Peer Relationships ($\beta = .12$, $p = .014$). Thus, H_1, H_2, and H_3 were supported.

Table 4. Hierarchical Multiple Regression Predicting Academic Motivation

Predictor	B	SE	β	t	p	VIF
Step 1 (R² = .054)						
Gender	0.10	0.09	.05	1.08	.281	1.04
School Type	0.18	0.09	.09	1.94	.053	1.12
Stream of Study	0.22	0.06	.16	3.46	<.001	1.08
School Location	0.08	0.09	.04	0.86	.390	1.10
Step 2 (ΔR² = .234)						
Teacher-Student Rel.	0.33	0.07	.26	4.86	<.001	2.22
Safety and Belonging	0.26	0.07	.21	3.94	<.001	2.08
Academic Support	0.19	0.06	.16	3.14	.002	1.74
Peer Relationships	0.14	0.06	.12	2.46	.014	1.68

Note. Total R² = .288. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

4.4. Group Comparison Analyses

An independent samples t-test comparing students in the top tertile (positive climate, $n = 152$) and bottom tertile (poor climate, $n = 152$) of school climate scores revealed that students in positive-climate schools reported significantly higher well-being ($M = 4.02$, $SD = 0.68$) than those in poor-climate schools ($M = 2.86$, $SD = 0.82$), $t(302) = 8.14$, $p < .001$, $d = 0.94$, a large effect. Similarly, academic motivation was significantly higher in the positive-climate group ($M = 5.24$, $SD = 0.86$) than in the poor-climate group ($M = 4.08$, $SD = 1.02$), $t(302) = 6.92$, $p < .001$, $d = 0.82$.

Female students reported significantly higher well-being ($M = 3.54$, $SD = 0.82$) than male students ($M = 3.28$, $SD = 0.84$), $t(466) = 3.28$, $p = .001$, $d = 0.31$. Private school students perceived significantly more positive school climates ($M = 3.72$, $SD = 0.68$) than government school students ($M = 3.40$, $SD = 0.74$), $t(466) = 4.62$, $p < .001$, $d = 0.45$. Urban school students reported significantly higher well-being than rural school students, $t(466) = 3.06$, $p = .002$, $d = 0.28$.

One-way ANOVA revealed significant stream-based differences in academic motivation, $F(2, 465) = 6.28$, $p = .002$, $\eta^2 = .026$. Tukey HSD post hoc tests indicated that Science students ($M = 4.92$, $SD = 0.88$) reported significantly higher academic motivation than Arts/Humanities students ($M = 4.36$, $SD = 1.04$), $p = .001$, but did not differ significantly from Commerce students ($M = 4.68$, $SD = 0.94$), $p = .124$. Thus, H_5 was largely supported.

4.5. Structural Equation Modeling and Mediation Analysis

The hypothesized path model was tested using SEM with maximum likelihood estimation. The model demonstrated good fit: $\chi^2/df = 2.22$, CFI = .96, TLI = .95, RMSEA = .051 (90% CI [.042, .060]), SRMR = .037. Results confirmed that school climate had a significant direct effect on student well-being ($\beta = .54$, $p < .001$) and student well-being had a significant direct effect on academic motivation ($\beta = .39$, $p < .001$). The direct effect of school climate on academic motivation, controlling for well-being, was reduced but remained significant ($\beta = .28$, $p < .001$), indicating partial mediation.

Bootstrapped mediation analysis (5,000 resamples) confirmed a significant indirect effect of school climate on academic motivation through student well-being ($\beta_{indirect} = .21$, 95% CI [.14, .29], $p < .001$). The total effect of school climate on academic motivation was .49 ($p < .001$), of which approximately 42.9% was mediated through student well-being. The model accounted for 33.6% of the variance in student well-being and 39.2% of the variance in academic motivation. Thus, H_4 was fully supported.

Table 5. Path Coefficients and Mediation Effects from Structural Equation Model

Path / Effect	β	SE	95% CI	p	R²	Result
SC -> WB (direct)	.54	.04	[.46, .62]	<.001	.336	Supported
WB -> AM (direct)	.39	.05	[.30, .48]	<.001	.392	Supported
SC -> AM (direct)	.28	.05	[.18, .38]	<.001	-	-
SC -> WB -> AM (indirect)	.21	.04	[.14, .29]	<.001	-	Mediation
Total effect (SC -> AM)	.49	.04	[.41, .57]	<.001	-	-

Note. SC = School Climate; WB = Student Well-Being; AM = Academic Motivation. Bootstrapped 95% CIs based on 5,000 resamples.

V. DISCUSSION

The present study provides robust quantitative evidence that school climate is a significant predictor of both student well-being and academic motivation among high school students in Maharashtra, India. The finding that school climate accounted for 33.6% of the variance in student well-being extends the international evidence base established by Thapa et al. (2013) and Suldo et al. (2012) to the Indian higher secondary context. The large effect size observed in the group comparison between positive and poor climate schools ($d = 0.94$ for well-being, $d = 0.82$ for motivation) underscores that school climate is not a peripheral educational concern but a fundamental determinant of student psychological functioning and academic engagement.

The emergence of Teacher-Student Relationships as the strongest predictor of both well-being and academic motivation is consistent with Self-Determination Theory's emphasis on relatedness as a basic psychological need (Ryan & Deci, 2020) and with the empirical evidence of Kidger et al. (2012) and Wang and Eccles (2013). Teachers who demonstrate warmth, respect, empathy, and genuine interest in students' lives create relational contexts that fulfill students' need for belonging, enhance their sense of being valued, and provide the psychological security necessary for risk-taking in learning. In the Indian

educational context, where teacher-student hierarchies are traditionally pronounced and emotional expression may be culturally constrained, the strong predictive role of teacher-student relationships suggests that even within hierarchical structures, the quality of interpersonal warmth and support significantly matters for student outcomes.

The significant predictive role of Safety and Belonging as the second strongest climate dimension aligns with Maslow's (1943) hierarchical theory, which posits that safety and belonging needs must be satisfied before higher-order needs such as self-actualization (analogous to intrinsic academic motivation) can be pursued. Students who feel physically safe, emotionally secure, and socially included in their school environment are freed from the cognitive and emotional burden of managing threats and exclusion, enabling them to direct their psychological resources toward learning and growth. This finding has particular relevance in the Indian context, where issues of bullying, caste-based discrimination, and academic pressure-related anxiety have been documented as threats to student safety and belonging (Rao, 2019).

The mediation analysis represents a central contribution of this study, demonstrating that approximately 43% of the total effect of school climate on academic motivation was channeled through student well-being. This finding provides empirical support for the broaden-and-build theory (Fredrickson, 2001), suggesting that positive school climates generate well-being (positive emotions, life satisfaction, psychological flourishing), which in turn broadens students' cognitive and motivational repertoires, fostering greater engagement with and enthusiasm for academic pursuits. The remaining direct effect of school climate on motivation may operate through additional mechanisms not captured in the present model, such as the direct influence of academic support structures on competence beliefs, or the role of peer relationships in creating social norms that value academic effort (Tian et al., 2016).

5.1. Limitations

Several limitations warrant acknowledgment. First, the cross-sectional design precludes causal inferences; longitudinal studies are needed to establish temporal precedence and examine reciprocal effects between school climate, well-being, and motivation. Second, all data were collected through student self-report, introducing potential common method variance. Future research should incorporate multi-informant perspectives (teachers, parents, administrators) and observational measures of school climate such as the Classroom Assessment Scoring System (Pianta et al., 2012). Third, the study treated school climate as a student-level perception; multilevel modeling approaches that simultaneously account for within-school and between-school variability would provide a more nuanced understanding of climate effects. Fourth, the sample was drawn from Maharashtra and may not generalize to other Indian states with different educational systems, cultural norms, and resource contexts. Fifth, the well-being measure, while psychometrically sound, assessed general subjective well-being rather than school-specific well-being, which may have attenuated the observed relationships.

5.2. Implications for Practice and Policy

The findings carry several important implications for educational practice and policy. First, school improvement initiatives should prioritize the cultivation of positive teacher-student relationships through targeted professional development programs that train teachers in relational pedagogy, empathetic communication, and emotionally responsive teaching practices. Given that teacher-student relationships emerged as the most powerful climate predictor, investing in teachers' relational competencies is likely to yield the greatest returns for student well-being and motivation. Second, schools should implement systematic strategies to enhance students' sense of safety and belonging, including anti-bullying programs, inclusive school policies, restorative justice practices, and structured opportunities for peer connection and community building. Third, educational policymakers should develop standardized school climate assessment frameworks that enable regular monitoring and evidence-based improvement of school environments, moving beyond purely academic performance metrics to encompass indicators of student well-being and school quality. Fourth, the significant disparities in school climate between government and private schools, and between urban and rural schools, call for targeted resource allocation and capacity building to ensure that all students, regardless of institutional or geographic context, have access to supportive school environments. Fifth, given the confirmed mediating role of well-being, schools should integrate social-emotional learning (SEL) programs and mental health support services into their regular programming, recognizing that student well-being is not a competing priority with academic achievement but rather a pathway toward it.

VI. CONCLUSION

This study provides compelling quantitative evidence that school climate is a powerful predictor of both student well-being and academic motivation among high school students in the Indian educational context. Through rigorous methodology, validated instrumentation, and comprehensive statistical analyses including structural equation modeling with bootstrapped mediation, the study demonstrates that teacher-student relationships and sense of safety and belonging are the most potent climate dimensions, and that student well-being serves as a significant mediating mechanism through which school climate translates into academic motivation. The substantial explanatory power of the proposed models, the confirmed mediation pathway, and the identified institutional and geographic disparities collectively offer an empirically grounded framework for designing holistic school improvement strategies that simultaneously promote academic motivation and psychological well-being. As India continues to pursue the transformative educational vision of NEP 2020, cultivating positive school climates that nurture the whole student, cognitively, emotionally, and socially, must be recognized as a foundational priority for achieving the dual goals of educational excellence and student flourishing across the nation's vast and diverse higher secondary school system.

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The Effect of Parental Involvement on Academic Motivation and Achievement Among Elementary School Students: A Quantitative Study

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Abstract

This study investigated the effect of parental involvement on academic motivation and achievement among elementary school students. A quantitative, correlational-predictive research design with mediation analysis was employed. Data were collected from 512 parents and 512 matched students (grades 3-5) across 28 elementary schools in Tamil Nadu, India. The Parental Involvement in Education Scale (PIES, $\alpha = .92$), the Academic Motivation Inventory for Children (AMIC, $\alpha = .88$), and standardized academic achievement scores were utilized. Hierarchical multiple regression analysis revealed that parental involvement significantly predicted academic achievement ($\beta = .44$, $p < .001$), accounting for 31.7% of the variance. Structural equation modeling confirmed that academic motivation partially mediated this relationship (indirect effect $\beta = .22$, 95% CI [.16, .29], $p < .001$). Home-based involvement ($\beta = .31$) and academic socialization ($\beta = .27$) emerged as the strongest predictors. Independent samples t-test revealed significant differences in parental involvement between urban and rural settings, $t(510) = 5.62$, $p < .001$, $d = 0.78$. One-way ANOVA indicated significant differences across socioeconomic groups, $F(2, 509) = 12.34$, $p < .001$, $\eta^2 = .046$. These findings highlight the pivotal role of parental involvement in fostering academic motivation and achievement and offer actionable recommendations for school-family partnership programs.

Keywords: - Parental Involvement, Academic Motivation, Academic Achievement, Elementary Education, School-Family Partnerships, Quantitative Research

I. INTRODUCTION

Parental involvement in education has long been recognized as a cornerstone of children's academic success. Defined as the participation of parents in regular, bidirectional, and meaningful communication involving student academic learning and other school activities (Epstein, 2011), parental involvement encompasses a broad range of behaviors and practices that connect the home and school environments. Decades of research have consistently demonstrated that children whose parents are actively engaged in their education exhibit higher levels of academic achievement, stronger motivation, better attendance, and more positive attitudes toward school (Fan & Chen, 2001; Hill & Tyson, 2009; Jeynes, 2007).

The theoretical underpinnings of parental involvement research draw from multiple frameworks that collectively explain why and how parent engagement influences child outcomes. Epstein's (2011) overlapping spheres of influence model posits that children learn and develop most effectively when the three major contexts of their lives, namely family, school, and community, work together with shared goals and mutual support. Hoover-Dempsey and Sandler (1997) proposed a process model explaining parental involvement decisions through parents' role construction, self-efficacy for helping their children succeed, and invitations from children, teachers, and schools. Together, these frameworks establish that parental involvement operates through multiple pathways to shape children's academic trajectories.

Academic motivation, broadly defined as the internal processes that instigate, sustain, and direct learning behaviors (Schunk et al., 2014), represents a critical mechanism through which parental involvement may influence academic achievement. Self-determination theory (Deci & Ryan, 2000) suggests that parental behaviors supporting children's autonomy, competence, and relatedness foster intrinsic motivation and self-regulated learning. When parents create supportive home learning environments, communicate high yet realistic academic expectations, and model positive attitudes toward education,

they cultivate the motivational orientations that drive children's active engagement with academic tasks (Grolnick & Slowiaczek, 1994).

In the Indian context, parental involvement in education assumes particular significance given the country's socioeconomic diversity, linguistic heterogeneity, and ongoing educational reforms. The Right to Education Act (2009) formally recognized parental participation as essential for school governance through School Management Committees (SMCs). The National Education Policy (NEP) 2020 further emphasized the role of parents as active partners in children's learning, advocating for stronger school-family-community linkages (Ministry of Education, 2020). However, empirical research examining the specific pathways through which parental involvement influences academic outcomes among Indian elementary school children remains remarkably limited. Much of the existing evidence is derived from Western, English-speaking contexts with markedly different cultural norms regarding parenting, schooling, and the parent-teacher relationship (Boonk et al., 2018). The transferability of these findings to the Indian educational context, characterized by distinct cultural values of familial obligation, respect for education, and collectivistic orientations, cannot be assumed and requires systematic empirical investigation.

1.1. Statement of the Problem

Despite policy emphasis on parental engagement in Indian education, there is a dearth of rigorous quantitative research examining the mechanisms through which parental involvement influences academic outcomes at the elementary school level. Existing Indian studies are predominantly qualitative or descriptive, lacking the statistical sophistication necessary to identify specific dimensions of involvement that most effectively predict achievement and to test motivational mediating pathways. This gap is especially concerning for elementary education, a critical developmental period when parental influence on academic habits and motivational orientations is particularly potent (Hill & Tyson, 2009).

1.2. Research Objectives

The objectives of this study were:

- To examine the relationship between parental involvement, academic motivation, and academic achievement among elementary school students;
- To identify which specific dimensions of parental involvement (home-based involvement, school-based involvement, academic socialization, and parent-teacher communication) most significantly predict academic achievement;
- To investigate the mediating role of academic motivation in the relationship between parental involvement and academic achievement; and
- To determine whether significant differences in parental involvement exist based on school location (urban vs. Rural), socioeconomic status, and parent education level.

1.3. Research Hypotheses

- H_1: Parental involvement significantly predicts academic achievement among elementary school students.
- H_2: Parental involvement significantly predicts academic motivation among elementary school students.
- H_3: Academic motivation mediates the relationship between parental involvement and academic achievement.
- H_4: Home-based involvement and academic socialization are the strongest predictors of academic achievement among the dimensions of parental involvement.
- H_5: Significant differences exist in parental involvement based on school location, socioeconomic status, and parent education level.

II. REVIEW OF LITERATURE

2.1. Theoretical Framework

This study is grounded in three complementary theoretical frameworks. First, Epstein's (2011) Theory of Overlapping Spheres of Influence conceptualizes family, school, and community as interconnected systems that collectively shape children's learning and development. Epstein identified six types of parental involvement: parenting, communicating, volunteering, learning at home, decision-making, and collaborating with the community. This typology provides a comprehensive lens for operationalizing the multidimensal nature of parental involvement. Second, the Hoover-Dempsey and Sandler (1997, 2005) model of the parental involvement process explains how parents' motivational beliefs (role construction and self-efficacy) and contextual invitations shape involvement decisions, which in turn influence student outcomes through modeling, reinforcement, and instruction mechanisms.

Third, Self-Determination Theory (Deci & Ryan, 2000) provides the motivational framework for understanding how parental involvement translates into children's academic motivation. SDT posits that the satisfaction of three basic psychological needs, namely autonomy, competence, and relatedness, is essential for the development of intrinsic motivation and autonomous forms of extrinsic motivation. Parental involvement behaviors that support children's autonomy (e.g., providing choice in homework approaches), enhance competence (e.g., scaffolding academic tasks), and foster relatedness (e.g., expressing interest in school experiences) are theorized to promote adaptive motivational orientations that drive academic engagement and achievement (Grolnick, 2009).

2.2. Parental Involvement and Academic Achievement

A substantial body of research has examined the relationship between parental involvement and academic achievement. Jeynes (2007) conducted a meta-analysis of 52 studies and reported an overall effect size of 0.74 for the relationship between

parental involvement and academic achievement among elementary school students, with parental expectations and reading with children yielding the largest effects. Fan and Chen (2001) similarly found a moderate positive effect (r = .25-.30) in their meta-analysis, noting that the strength of the relationship varied by the type of involvement and the measure of achievement used.

More recently, Boonk et al. (2018) conducted a systematic review of 75 studies published between 2003 and 2017 and concluded that home-based involvement, particularly reading at home and maintaining high parental expectations, was more consistently associated with achievement than school-based involvement such as volunteering and attending events. This distinction between home-based and school-based involvement has important implications for understanding which parental behaviors are most impactful and for designing targeted intervention programs.

Hill and Tyson (2009) introduced the concept of academic socialization, defined as parental communication of expectations, values, and aspirations related to education, and found it to be the most strongly associated with achievement among middle school students. Academic socialization encompasses behaviors such as discussing the importance of education, linking current schoolwork to future goals, and fostering educational aspirations. Whether academic socialization is equally potent at the elementary level, where children's cognitive capacity for abstract future-oriented thinking is still developing, remains an empirical question addressed by the present study.

2.3. Parental Involvement and Academic Motivation

A growing body of literature has examined the motivational pathways through which parental involvement influences academic outcomes. Gonzalez-DeHass et al. (2005) conducted a comprehensive review and found that parental involvement was positively associated with children's intrinsic motivation, perceived competence, and mastery goal orientation. Grolnick and Slowiaczek (1994) identified three dimensions of parental involvement (behavioral, cognitive-intellectual, and personal) and demonstrated that each uniquely predicted children's self-regulation and motivation in school. More recently, Froiland and Davison (2014) reported that parental involvement predicted intrinsic motivation for schoolwork, which in turn predicted GPA among elementary students, supporting the mediating role of motivation.

In the Indian context, empirical research on parental involvement and academic motivation is limited. Singh and Shakir (2019) examined parental involvement among secondary students in Delhi and found positive correlations with self-concept and achievement motivation. Kaur and Singh (2021) investigated home learning environments among primary school children in Punjab and reported that parental educational support was a significant predictor of children's academic interest and persistence. However, no Indian study to date has comprehensively tested the mediating role of academic motivation in the parental involvement-achievement relationship using structural equation modeling among elementary school children.

2.4. Contextual Factors Influencing Parental Involvement

Research consistently demonstrates that parental involvement patterns are influenced by sociodemographic factors. Green et al. (2007) found that parents' role construction and self-efficacy, which shape involvement decisions, varied significantly by socioeconomic status (SES) and education level. Lower-SES parents often reported equivalent desire for involvement but faced structural barriers including inflexible work schedules, transportation limitations, and feelings of inadequacy in academic matters (Lareau, 2011). Urban-rural disparities in parental involvement have also been documented, with rural parents reporting lower levels of school-based involvement due to geographic distance and limited communication infrastructure, though home-based involvement levels were often comparable (Semke & Sheridan, 2012). In the Indian context, Kaul (2018) reported significant SES-based and caste-based disparities in parental school engagement in government elementary schools, highlighting the need for inclusive and culturally responsive approaches to promoting parental involvement.

III. RESEARCH METHODOLOGY

3.1. Research Design

This study employed a quantitative, cross-sectional, correlational-predictive research design with mediation analysis. The correlational-predictive design was selected to examine the relationships among parental involvement, academic motivation, and academic achievement, and to identify predictive patterns among these variables (Creswell & Creswell, 2018). Structural equation modeling (SEM) was used to test the hypothesized mediation model, allowing for simultaneous estimation of direct and indirect effects while controlling for measurement error (Kline, 2016).

3.2. Population and Sampling

The target population comprised parents and students in grades 3 through 5 enrolled in government and government-aided elementary schools in two districts of Tamil Nadu, India (Chennai and Madurai). These grades were selected because children at this stage (ages 8-11) are developing foundational academic skills and motivational orientations, and parental involvement remains highly influential during this developmental period (Hill & Tyson, 2009). A multistage stratified random sampling procedure was employed. In the first stage, 28 schools (14 per district, stratified by urban/rural location) were randomly selected. In the second stage, one classroom per grade level per school was randomly selected. In the third stage, all students in selected classrooms and their parents were invited to participate.

Using Cochran's (1977) formula for sample size determination with a 95% confidence level and 4.5% margin of error, and further considering the requirements for SEM analysis (minimum N = 200; Kline, 2016), the target sample was set at 550 parent-student dyads. After excluding incomplete responses and unmatched dyads, the final analytic sample comprised 512 parent-student dyads. The parent sample included 341 (66.6%) mothers and 171 (33.4%) fathers. By school location, 274 (53.5%) were from urban schools and 238 (46.5%) from rural schools. Socioeconomic status was categorized as low (n = 178,

34.8%), middle (n = 214, 41.8%), and high (n = 120, 23.4%) based on a composite index of household income, parental occupation, and housing type. Regarding parent education: 142 (27.7%) had primary education or less, 198 (38.7%) had secondary education, and 172 (33.6%) had higher education (degree or above).

3.3. Instrumentation

3.3.1. Parental Involvement in Education Scale (PIES).

The PIES is a researcher-developed instrument comprising 32 items across four subscales: Home-Based Involvement (8 items), School-Based Involvement (8 items), Academic Socialization (8 items), and Parent-Teacher Communication (8 items). Items were rated on a 5-point Likert scale from 1 (Never) to 5 (Always). Content validity was established through expert review by eight specialists in educational psychology and family studies (CVI = .93). Exploratory Factor Analysis on pilot data (n = 140) confirmed the four-factor structure, with factor loadings ranging from .51 to .86. Confirmatory Factor Analysis on the main study data yielded good fit: χ^2/df = 2.21, CFI = .95, TLI = .94, RMSEA = .049, SRMR = .038. Cronbach's alpha was .92 (total), .87 (Home-Based), .84 (School-Based), .89 (Academic Socialization), and .86 (Parent-Teacher Communication).

3.3.2. Academic Motivation Inventory for Children (AMIC).

The AMIC comprised 20 items across three subscales: Intrinsic Motivation (7 items), Extrinsic Motivation (7 items), and Academic Self-Regulation (6 items). Items were developmentally appropriate for elementary-aged children. Responses were recorded on a 4-point pictorial Likert scale. The instrument was adapted from the Young Children's Academic Intrinsic Motivation Inventory (Gottfried, 1990) and the Self-Regulation Questionnaire-Academic (Ryan & Connell, 1989). CFA confirmed the three-factor structure: χ^2/df = 2.36, CFI = .93, TLI = .92, RMSEA = .058, SRMR = .044. Cronbach's alpha was .88 (total), .84 (Intrinsic Motivation), .81 (Extrinsic Motivation), and .83 (Self-Regulation).

3.3.3. Academic Achievement.

Academic achievement was operationalized as a composite standardized score derived from school-administered end-of-term examinations in three core subjects: Tamil/English (language), Mathematics, and Environmental Science. Raw scores were standardized within each school and grade level to a mean of 100 and standard deviation of 15 to account for between-school and between-grade variations in assessment difficulty.

3.4. Data Collection Procedure

Ethical approval was obtained from the Institutional Ethics Review Board (Approval No. IERB/2024/EDU/076). Permission was obtained from the Tamil Nadu Directorate of Elementary Education and respective school headmasters. Written informed consent was obtained from all participating parents, and verbal assent was obtained from student participants. Data were collected during January through March 2025. Parent questionnaires were distributed during scheduled parent-teacher meetings and collected within one week. Student motivation inventories were administered in small groups of 8-10 during regular school hours by trained research assistants who read each item aloud. Academic achievement data were obtained from school records for the most recently completed term. To minimize common method bias, procedural remedies including temporal separation of predictor and criterion measures and the use of multiple data sources (parent self-report, student self-report, and school records) were implemented (Podsakoff et al., 2003).

3.5. Data Analysis

Data were analyzed using IBM SPSS Statistics Version 28.0 and AMOS Version 26.0. Preliminary analyses included screening for missing data, outlier detection (Mahalanobis distance), normality assessment, and multicollinearity diagnostics. Descriptive statistics were computed for all study variables. Inferential analyses included:

- Pearson product-moment correlations;
- Hierarchical multiple regression analysis;
- Independent samples t-test for urban-rural comparisons;
- One-way ANOVA with post hoc Tukey HSD tests; and
- Structural equation modeling with bootstrapped mediation analysis (5,000 resamples).

Effect sizes (Cohen's d, η^2, and R^2) were reported alongside significance tests. The significance level was set at α = .05.

IV. RESULTS AND DATA ANALYSIS

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics for all study variables. Parents reported moderate levels of overall involvement (M = 3.52, SD = 0.71), with the highest scores on Home-Based Involvement (M = 3.78, SD = 0.68) and the lowest on School-Based Involvement (M = 3.14, SD = 0.82). Student academic motivation was moderate (M = 3.18, SD = 0.54 on a 4-point scale). The mean standardized achievement score was 101.24 (SD = 14.82). Skewness values ranged from -0.38 to 0.24 and kurtosis from -0.56 to 0.41, confirming approximate normality.

Table 1. Descriptive Statistics for Study Variables (N = 512)

Variable	M	SD	Skew	Kurt	α
Home-Based Involvement	3.78	0.68	-0.28	0.16	.87
School-Based Involvement	3.14	0.82	0.24	-0.42	.84
Academic Socialization	3.61	0.73	-0.18	0.22	.89
Parent-Teacher Comm.	3.54	0.76	0.11	-0.31	.86
Overall Parental Involve.	3.52	0.71	-0.06	0.09	.92
Intrinsic Motivation	3.28	0.58	-0.21	0.34	.84
Extrinsic Motivation	3.04	0.62	0.14	-0.56	.81
Academic Self-Regulation	3.22	0.56	-0.12	0.18	.83
Overall Academic Motivation	3.18	0.54	-0.07	0.04	.88
Academic Achievement	101.24	14.82	-0.38	0.41	-

Note. M = Mean; SD = Standard Deviation; α = Cronbach's Alpha. PIES scored on 5-point scale; AMIC scored on 4-point scale; Achievement standardized (M = 100, SD = 15).

4.2. Correlation Analysis

Pearson correlation analysis (Table 2) revealed significant positive correlations among all primary study variables. Overall parental involvement was strongly correlated with academic achievement ($r = .53$, $p < .001$) and academic motivation ($r = .49$, $p < .001$). Academic motivation was moderately-to-strongly correlated with academic achievement ($r = .51$, $p < .001$). Among parental involvement subscales, Home-Based Involvement ($r = .50$, $p < .001$) and Academic Socialization ($r = .48$, $p < .001$) showed the strongest correlations with achievement.

Table 2. Pearson Correlation Matrix for Primary Study Variables

Variable	1	2	3	4	5	6	7
1. Home-Based	-						
2. School-Based	.46***	-					
3. Acad. Social.	.58***	.42***	-				
4. Parent-Teacher	.51***	.53***	.49***	-			
5. Overall PI	.83***	.74***	.81***	.78***	-		
6. Motivation	.47***	.31***	.46***	.38***	.49***	-	
7. Achievement	.50***	.29***	.48***	.39***	.53***	.51***	-

Note. PI = Parental Involvement. ***$p < .001$.

4.3. Group Comparison: Urban Versus Rural

An independent samples t-test was conducted to compare parental involvement between urban and rural settings (Table 3). Results revealed a statistically significant difference, with urban parents (M = 3.72, SD = 0.66) reporting significantly higher involvement than rural parents (M = 3.28, SD = 0.72), $t(510) = 5.62$, $p < .001$, $d = 0.78$.

Table 3. Independent Samples t-Test: Parental Involvement by School Location

Variable	M (Urb)	SD (Urb)	M (Rur)	SD (Rur)	T	p	d	95% CI
Home-Based	3.91	0.64	3.63	0.71	3.02	<.001	0.41	[.14, .68]
School-Based	3.42	0.78	2.82	0.79	6.12	<.001	0.84	[.58, 1.10]
Acad. Social.	3.76	0.70	3.44	0.74	3.78	<.001	0.54	[.28, .80]
Parent-Teach.	3.72	0.72	3.33	0.77	4.24	<.001	0.62	[.36, .88]
Overall PI	3.72	0.66	3.28	0.72	5.62	<.001	0.78	[.52, 1.04]

Note. Urb = Urban (n = 274); Rur = Rural (n = 238); PI = Parental Involvement; df = 510.

4.4. One-Way ANOVA: Socioeconomic Status Differences

One-way ANOVA revealed significant differences in overall parental involvement across socioeconomic groups, $F(2, 509) = 12.34$, $p < .001$, $\eta^2 = .046$. Post hoc Tukey HSD comparisons indicated that high-SES parents (M = 3.86, SD = 0.58) reported significantly higher involvement than both middle-SES parents (M = 3.52, SD = 0.68), $p = .001$, and low-SES parents (M = 3.24, SD = 0.78), $p < .001$. Similarly, significant SES-based differences were found for academic motivation, $F(2, 509) = 8.67$, $p < .001$, $\eta^2 = .033$, and academic achievement, $F(2, 509) = 10.92$, $p < .001$, $\eta^2 = .041$. Significant differences were also observed based on parent education level, $F(2, 509) = 14.18$, $p < .001$, $\eta^2 = .053$. Thus, H_5 was fully supported.

4.5. Hierarchical Multiple Regression Analysis

A two-step hierarchical multiple regression was conducted (Table 4). In Step 1, demographic controls explained 11.3% of variance, $F(5, 506) = 12.89$, $p < .001$. In Step 2, parental involvement dimensions contributed an additional 20.4%, total $R^2 = .317$, $F(9, 502) = 25.88$, $p < .001$. Home-Based Involvement was the strongest predictor ($\beta = .31$, $p < .001$), followed by Academic Socialization ($\beta = .27$, $p < .001$). School-Based Involvement was non-significant ($\beta = .08$, $p = .142$). All VIF values were below 2.8. Thus, H_1 and H_4 were supported.

Table 4. Hierarchical Multiple Regression Predicting Academic Achievement

Predictor	B	SE	β	t	p	VIF
Step 1 (R² = .113)						
School Location	3.42	1.18	.13	2.90	.004	1.14
SES	2.86	0.92	.14	3.11	.002	1.28
Parent Education	1.94	0.84	.11	2.31	.021	1.22
Child Gender	0.68	1.02	.03	0.67	.506	1.02
Grade Level	1.12	0.78	.06	1.44	.151	1.06
Step 2 (ΔR² = .204)						
Home-Based Involve.	6.74	1.12	.31	6.02	<.001	2.16
School-Based Involve.	1.44	0.98	.08	1.47	.142	1.84
Academic Socialization	5.48	1.08	.27	5.07	<.001	2.62
Parent-Teacher Comm.	2.34	0.89	.12	2.63	.009	1.78

Note. Total R^2 = .317. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

4.6. Structural Equation Modeling and Mediation Analysis

The hypothesized mediation model was tested using SEM. The structural model showed good fit: χ^2/df = 2.44, CFI = .94, TLI = .93, RMSEA = .054, SRMR = .045. Parental involvement had a significant direct effect on academic motivation (β = .52, p < .001) and motivation had a significant direct effect on achievement (β = .42, p < .001). The direct effect of involvement on achievement remained significant after controlling for motivation (β = .22, p < .001), indicating partial mediation. Bootstrapped mediation analysis confirmed a significant indirect effect (indirect β = .22, 95% CI [.16, .29], p < .001). The model explained 28.4% of variance in motivation and 38.6% in achievement. Thus, H_2 and H_3 were supported.

Table 5. Path Coefficients and Mediation Effects from Structural Equation Model

Path / Effect	B	SE	95% CI	p	R²	Result
PI → Motivation (direct)	.52	.04	[.44, .60]	<.001	.284	Supported
Motivation → Achiev.	.42	.05	[.33, .51]	<.001	.386	Supported
PI → Achievement (direct)	.22	.05	[.13, .31]	<.001	-	-
PI → Motiv. → Achiev.	.22	.03	[.16, .29]	<.001	-	Mediation
Total effect (PI → Ach.)	.44	.04	[.36, .52]	<.001	-	-

Note. PI = Parental Involvement; Motiv. = Motivation; Achiev. = Achievement. Bootstrapped 95% CIs based on 5,000 resamples.

V. DISCUSSION

The present study provides rigorous quantitative evidence that parental involvement is a significant predictor of both academic motivation and academic achievement among elementary school students in India. The finding that parental involvement explained 31.7% of the variance in academic achievement, after controlling for demographic variables, represents a substantial and practically meaningful effect that aligns with the meta-analytic conclusions of Jeynes (2007) and Fan and Chen (2001). The magnitude of the overall relationship (r = .53) is notably higher than average effect sizes reported in Western meta-analyses, suggesting that in the Indian cultural context, where education is deeply valued and family involvement in children's academic lives is a cultural expectation, parental engagement may have a particularly potent influence on academic outcomes.

The identification of Home-Based Involvement and Academic Socialization as the strongest predictors of academic achievement corroborates and extends the findings of Boonk et al. (2018) and Hill and Tyson (2009). Home-based involvement creates direct learning opportunities that supplement formal instruction. Academic socialization shapes children's internalized beliefs about the importance and personal relevance of education. The relatively weak predictive power of School-Based Involvement is consistent with Boonk et al.'s (2018) conclusion that visible forms of school participation are less consistently associated with achievement than more substantive home-based and communicative involvement behaviors.

The mediation analysis represents a central contribution of this study, demonstrating that academic motivation serves as a significant mediating pathway through which parental involvement influences academic achievement. The finding that 50% of the total effect was mediated through motivation provides strong empirical support for Self-Determination Theory (Deci & Ryan, 2000) and the process models of Hoover-Dempsey and Sandler (1997, 2005). When parents engage in supportive involvement behaviors, they foster children's intrinsic motivation, academic self-regulation, and positive orientations toward learning, which in turn drive the academic behaviors that produce higher achievement.

The significant urban-rural disparity in parental involvement (d = 0.78) is a concerning finding with important equity implications. The largest gap was observed in School-Based Involvement, likely reflecting geographic, transportation, and scheduling barriers that rural parents face. The socioeconomic gradient in parental involvement further underscores the structural inequities that shape educational opportunities. These findings resonate with Lareau's (2011) conceptualization of concerted cultivation as a class-based parenting strategy and with Kaul's (2018) documentation of SES-based participation disparities in Indian government schools.

5.1. Limitations

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inferences; parental involvement may be both a cause and a consequence of children's academic success. Longitudinal and intervention-based designs are needed to establish directionality. Second, parental involvement was measured through parent self-report, which

may be subject to social desirability bias. Future studies should incorporate multi-informant assessments including teacher and child reports of involvement. Third, academic achievement was measured through school-administered examinations, which may vary in quality across schools despite standardization. Fourth, the study was limited to government and government-aided schools in Tamil Nadu; findings may differ in private schools, other states, and for different age groups. Fifth, the study did not assess the quality of parental involvement, as two parents may report similar frequency of homework help but differ dramatically in the quality of support provided.

5.2. Implications for Practice and Policy

The findings offer several actionable implications. First, school-family partnership programs should prioritize home-based involvement and academic socialization strategies rather than focusing primarily on school-event attendance, which was the least effective predictor of achievement. Second, schools serving rural and low-SES communities should implement targeted outreach strategies that address structural barriers to involvement, including flexible meeting schedules, technology-mediated communication channels, and community-based liaison programs. Third, teacher education programs should include training on building effective parent partnerships, as Parent-Teacher Communication was a significant predictor of achievement. Fourth, policymakers implementing NEP 2020's family engagement provisions should support the types of parental involvement, particularly home-based involvement and academic socialization, that are most strongly linked to student outcomes.

VI. CONCLUSION

This study provides robust quantitative evidence that parental involvement is a powerful predictor of academic achievement among elementary school students in India, operating in part through its positive influence on children's academic motivation. Through validated instrumentation, a substantial multi-district sample, comprehensive inferential analyses including structural equation modeling with bootstrapped mediation, and attention to contextual variations, the study demonstrates that home-based involvement and academic socialization are the most potent forms of parental engagement for promoting student success. The significant urban-rural and socioeconomic disparities in involvement levels underscore the need for equitable, culturally responsive family engagement policies. As India advances the inclusive and holistic vision of education articulated in NEP 2020, strengthening the home-school connection through evidence-based parental involvement programs will be essential for ensuring that every child, regardless of geographic location or socioeconomic background, has the family support needed to achieve their full academic potential.

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Integration of Digital Tools and Methods for Improving Students Performance: Innovative Digital Education

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Abstract

This study investigates the integration of digital tools to enhance student's academic performance in senior high schools within Zorzor District of Lofa County, Liberia. Education is recognized as a fundamental human right, particularly during global emergencies such as the COVID-19 pandemic, which exposed critical gaps in access to quality learning. Using quantitative research design, data were collected from Grade 11 and 12 students and teachers in two high schools through structures questionnaires and interviews. The findings reveal limited access to digital learning resources, inadequate research and collaboration platforms, and insufficient technological infrastructure, all of which negatively affected classroom performance and national examination outcomes. To address these challenges, the study proposes an innovative digital education framework incorporating learning management system, collaborative platforms, and adaptive technologies to support diverse learning needs. The findings contribute practical insights for educators, school administrators, and policymakers seeking to strengthen digital education and ensure continuity of learning during crises.

I. INTRODUCTION

In the era of digital advancements, the study "Innovative Digital Education" addresses the imperative need to investigate the integration of digital tools in educational settings. As COVID-19 has underscored the importance of continuous learning, ensuring access to innovative technology tools becomes crucial in upholding students' right to education during global emergencies (COVID-19 response, n.d.). The high schools in the district face a challenge of poor academic performance due to the inadequate use of recommended technologies. Students lack technology tools to improve their learning process, impacting their engagement and performance. This study aims to identify and address these challenges by exploring the integration of digital tools. The purpose is to assess the current state of digital technology integration in high schools, focusing on its impact on students' academic performance and learning experiences. By identifying challenges and opportunities, the research aims to contribute insights that will guide the development of an innovative education.

1.1 Research Questions:

- What is the current academic performance of students in various high schools in the district, as evidenced by classroom assessments and national exams?
- How did the recent high school quizzing competition highlight the lack of proper digital technology innovation, and what were the observed challenges faced by students and teachers?
- To what extent are digital technologies currently integrated into the education system of high schools in the district?
- What were the challenges experienced by students and teachers in conducting research during the COVID-19 period, particularly in the absence of proper digital tools?

1.2 Research Objectives:

- Evaluate the academic performance of students in various high schools in the district.
- Examine the impact of recent quizzing competitions, highlighting challenges in the absence of proper digital technology.
- Explore the extent of digital technology integration in high schools.
- Investigate challenges faced during COVID-19 without adequate digital tools.

1.3 Significance of the Study:

The integration of digital tools in Zorzor district's high schools enhances learning with interactive content, global connectivity, and personalized paths. It equips students with 21st-century skills, offers diverse resources, facilitates efficient assessment, and prepares them for the evolving technological landscape. Cost-effective and forward-looking, this approach transforms education, improving academic performance and ensuring students' readiness for the digital age.

II. METHODOLOGY

2.1. Research Design

A quantitative research design was adopted to examine the role of digital tools in improving students' academic performance. The study followed a systematic process involving problem identification, sample determination, ethical approval, informed consent, data collection, and statistical analysis.

2.2. Study Population and Sample

The study was conducted in Zorzor District, Lofa County, Liberia. The target population consisted of Grade 11 and 12 students and teachers from Zorzor Central High School and Zorzor Lutheran Mission High School. The total student population was 635. A sample of 100 participants (90 students and 10 teachers) was selected using purposive sampling.

2.3. Intervention Description

The intervention focused on integrating digital tools such as Learning Management Systems (LMS), collaborative online platforms, gamified learning modules, and AI-supported tutoring systems. These tools were selected to enhance engagement, personalization, and collaborative learning.

2.4. Components of the Intervention and methods:

Learning Management Systems (LMS): Implement cutting-edge Learning Management Systems for personalized learning with interactive content, real-time feedback, and data analytics to customize materials based on individual students' progress and learning styles.
Virtual Reality (VR) and Augmented Reality (AR): Utilizing VR/AR for immersive education, simulations, and virtual labs enhance understanding in science, engineering, and medicine.
Collaborative Online Platforms: Online platforms enhance collaborative learning with forums, project tools, and virtual groups. They promote teamwork and communication, crucial skills for the modern workplace, by facilitating joint assignments and projects.
Gamified Learning Modules: Creating educational games and quizzes to enhance learning, incorporating rewards for motivation, fostering an enjoyable learning environment through gamified modules that reinforce educational goals for students.
Artificial Intelligence (AI) Tutoring Systems :AI Tutoring Systems provide personalized, adaptive tutoring, assessing student progress, offering instant help, and tailoring sessions based on analysis of responses, enhancing learning experiences.

2.5. Expected Outcomes:

The anticipated outcomes include improved academic performance, increased engagement and motivation, and the development of 21st-century skills among students. The intervention plan outlines a comprehensive approach involving innovative teaching methodologies, advanced technologies, and continuous assessment strategies. It aims to enhance the learning experience, promote critical thinking, and prepare students for the challenges of the 21st century.

2.6. Instrumentation:

Primary data were collected using structured questionnaires, interviews, and classroom observations. Questionnaires were selected for their ability to capture quantitative data efficiently from a large sample.

2.7. Research Procedure

The research procedure involves a literature review on new digital technology tools and their impact, followed by the design of a methodology for effective investigation and analysis. Data collection methods, including interviews, surveys, observations, and document analysis, was employed.

2.8. Ethical Considerations

Ethical principles, including informed consent, confidentiality, and voluntary participation, were strictly observed

throughout the study (Laustsen et al., 2021).

2.9. Considerations during Data Collection/ Researcher Bias:

Measures are implemented to prioritize participants' safety and well-being, including informed consent, confidentiality, and ensuring physical and emotional safety during data collection. To mitigate researcher bias, a diverse research team is formed, training on bias recognition and addressing biases is provided, unbiased analytical tools are employed, and transparency and accountability are maintained.

2.10. Data Collection/Analysis:

Primary data were collected using structured questionnaires, interviews, and classroom observations. Questionnaires were selected for their ability to capture quantitative data efficiently from a large sample.

2.11. Validity and Reliability:

To enhance research validity and reliability, a collaborative partnership approach with educational institutions, teachers, and students was employed, ensuring diverse perspectives. Prejudice control measures minimized biases, and standardized methods were used for consistent data collection and analysis.

III. RESULTS

3.1. Descriptive Findings:

This chapter thoroughly analyzes the outcomes of implementing an innovative education with diverse digital tools in the various high schools in Zorzor district. Table 1: Students engagement with digital tools.

Table 1. Students' Academic Performance by Grade and Gender

Grades	1	2	3	Total
11th grade	56%	20%	24%	100%
Female	63%	17%	21%	100%
Male	49%	23%	28%	100%
12th grade	29%	16%	55%	100%
Female	29%	16%	55%	100%
Male	29%	16%	56%	100%
Grand Total	42%	18%	40%	100%

Table 1 illustrates clear grade-level differences in digital tool engagement. Among 11th-grade students, engagement is predominantly low, particularly among females, with 63% classified at Level 1 compared to 48% of males. By contrast, 12th-grade students exhibit substantially higher engagement, as more than half of both females (55%) and males (56%) fall within Level 3. While minor gender differences are observed in 11th grade where males demonstrate slightly higher engagement these differences are minimal in 12th grade, indicating a convergence of digital engagement levels across genders at the higher grade level.

Table 2. Challenges Associated with the Absence of Digital Technology

Grades	1	2	3	Total
11th grade	15%	31%	53%	100%
Female	3%	33%	64%	100%
Male	27%	30%	43%	100%
12th grade	15%	31%	54%	100%
Female	15%	31%	55%	100%
Male	15%	31%	54%	100%
Grand Total	15%	31%	54%	100%

Table 2 indicates that limited access to digital technology presents substantial challenges for students across all groups, with more than half reporting high levels of difficulty. Eleventh-grade students, particularly females, are the most affected: 64% of 11th-grade females report high levels of challenge, compared with 43% of their male counterparts. In contrast, 12th-grade students exhibit relatively consistent patterns across genders, with similar proportions of males and females reporting high levels of difficulty. Overall, the findings suggest that inadequate digital technology significantly hinders learning, with the greatest impact observed among 11th-grade female students.

Table 3. Perceived Impact of Digital Tool Integration on Learning Outcomes

Grades	1	2	3	Total
11th grade	25%	11%	64%	100%
Female	21%	7%	71%	100%
Male	29%	14%	57%	100%
12th grade	23%	21%	56%	100%
Female	25%	25%	50%	100%
Male	21%	18%	62%	100%
Teacher	30%	20%	50%	100%
Female	40%	40%	20%	100%
Male	20%	0%	80%	100%

|	Grand Total	24%	18%	58%	100%

Table 3 indicates that the integration of digital tools is widely perceived as enhancing learning outcomes, with a majority of respondents (58%) reporting a high level of improvement. Both 11th- and 12th-grade students generally rate the impact positively, although 11th-grade students report slightly greater benefits than their 12th-grade counterparts. Gender-based patterns differ by grade level: among 11th graders, females report stronger perceived improvements than males, whereas the opposite pattern is observed among 12th graders. Teachers express more varied perceptions; however, male teachers report the highest level of improvement overall, with 80% selecting the highest response category. Despite these variations, the overall trend suggests that digital tools substantially enhance perceived learning outcomes.

Table 4. Challenges Experienced During COVID-19 Due to Limited Digital Tools

Grade	No	Yes	Total
11th grade	0.00%	100.00%	100.00%
Female	0.00%	100.00%	100.00%
Male	0.00%	100.00%	100.00%
12th grade	1.61%	98.39%	100.00%
Female	0.00%	100.00%	100.00%
Male	2.94%	97.06%	100.00%
Teacher	0.00%	100.00%	100.00%
Female	0.00%	100.00%	100.00%
Male	0.00%	100.00%	100.00%
Grand Total	1.00%	99.00%	100.00%

Table 4 indicates that nearly all respondents, across grades and genders, experienced challenges during the COVID-19 period due to inadequate access to digital tools. All 11th-grade students and all teachers reported facing such difficulties, with no respondents in these groups indicating otherwise. Among 12th-grade students, a very small proportion predominantly male reported not experiencing challenges; however, the vast majority still indicated significant difficulties. Overall, 99% of respondents were negatively affected, underscoring that insufficient digital tools constituted a widespread and near-universal problem during the pandemic.

Fig 1 : Types of Challenges Encountered During the COVID-19 Period
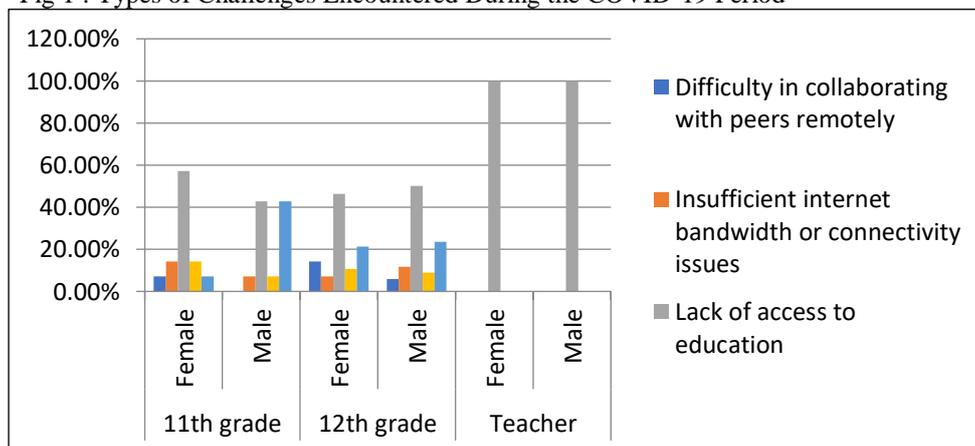
Across all respondent groups, the most significant challenge during the COVID-19 period was limited access to education, affecting more than half of the participants and consistently ranking as the most frequently reported issue among 11th-grade students, 12th-grade students, and teachers. Limited access to online databases and academic journals emerged as the second most common challenge, particularly among male students in both grade levels. Other difficulties including inadequate internet bandwidth, lack of required software or digital tools, and constraints on remote collaboration were reported less frequently; however, female students generally indicated slightly higher prevalence rates than their male counterparts. Notably, teachers identified limited access to education as their sole primary challenge, underscoring the extensive disruption to teaching and learning continuity during the pandemic.

IV. DISCUSSION

This study, conducted at Zorzor Central High School and Zorzor Lutheran Mission High School in Zorzor District, Lofa County, Liberia, examines the influence of digital tools on students' academic performance and engagement. The findings indicate a positive relationship between the use of digital technologies and improved academic outcomes, while also revealing notable gender disparities in digital engagement. The predominance of smartphones and the widespread use of platforms such as Google Classroom highlight the need for targeted interventions that promote equitable access and participation.

Despite the observed benefits, several challenges constrain effective digital integration, including limited access to devices and internet connectivity, high data costs, and insufficient digital skills among some students. These barriers underscore the urgency of investing in technological infrastructure and comprehensive digital literacy programs to foster inclusive learning environments. Teacher involvement emerged as a critical determinant of successful integration, with evidence of gender gaps in digital tool usage among educators. This finding reinforces the importance of sustained professional development and institutional support to enhance teachers' digital competencies and address gender-based disparities.

Overall, the results align with existing literature emphasizing the need to bridge the digital divide, adopt student-centered pedagogical approaches, and address gender inequalities in technology use. The study offers practical insights for navigating digital transformation in secondary education, particularly in resource-constrained contexts. Its recommendations such as the development of mobile-friendly learning materials, the use of diverse assessment strategies, and continuous pedagogical adaptation provide a strategic framework for fostering an inclusive and adaptive digital learning environment. By implementing these measures, schools in Zorzor District can advance toward a more technologically enriched educational experience that better prepares students for the demands of an evolving digital society.

V. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This study examined academic performance patterns, the role of digital technology in quizzing competitions, the extent of digital integration in high schools, and the challenges experienced during the COVID-19 period. The findings provide a coherent overview of how digital readiness influences both learning outcomes and academic activities.

First, the analysis revealed clear differences in academic performance across grade levels. Eleventh-grade students generally performed above average, whereas twelfth-grade students demonstrated noticeably lower performance. Gender differences were minimal, indicating that academic variation is more strongly associated with grade level than gender. These results suggest the need for targeted instructional support for final-year students to improve academic outcomes.

Second, the study found that the absence of adequate digital technology significantly affected the effectiveness of quizzing competitions. Most respondents across both grade levels reported a high negative impact, with female students indicating slightly greater challenges. This finding highlights the importance of digital tools in supporting competitive academic activities and aligns with prior research emphasizing technology-enabled learning environments.

Third, perceptions of digital technology integration were largely positive. Most respondents reported moderate to high improvements in learning outcomes, with over half indicating a high level of impact. However, variations across demographic groups suggest the need for focused interventions, including teacher training and student support, to ensure equitable benefits from digital integration.

Finally, the study underscores the widespread challenges faced during the COVID-19 pandemic due to limited access to digital tools. Students and teachers alike reported significant barriers to effective teaching and learning, reinforcing the necessity of sustainable digital infrastructure and preparedness strategies for future disruptions.

Overall, the findings emphasize the critical role of digital technology in enhancing academic performance, supporting extracurricular academic activities, and ensuring continuity of education during crises. Clear presentation of results through well-structured tables and figures, alongside consistent APA-style referencing, strengthens the interpretability and academic quality of the study. These insights offer practical implications for policymakers, school administrators, and educators seeking to improve digital integration and educational resilience.

5.2. Recommendations

Enhance Support for 12th-Grade Students: Given the documented decline in academic performance among 12th-grade students, the implementation of targeted academic interventions is imperative. Schools should establish structured support systems, such as personalized tutoring, academic counseling, and remedial programs specifically designed to address identified learning gaps. These measures can enhance academic achievement and better prepare students for post-secondary education or workforce entry.

Invest in Digital Technology Infrastructure: The findings underscore the critical importance of digital technology in supporting learning activities, including online assessments, quizzing competitions, and remote instruction, particularly during the COVID-19 pandemic. Educational authorities and school administrators should prioritize strategic investments in reliable internet connectivity, up-to-date hardware and software, and interactive digital learning platforms. Strengthening digital infrastructure can enhance student engagement, promote collaborative learning, and support the continuity of education during periods of disruption.

Strengthening Teacher Professional Development: Variations in teachers' perceptions of digital integration suggest the need for ongoing and sustained professional development. Training programs should focus on improving digital literacy, integrating technology effectively into pedagogy, and using digital tools to support differentiated and inclusive instruction. Strengthening teachers' competencies in educational technology will enhance instructional quality and maximize learning outcomes.

Address Equity in Access to Education: The study highlights persistent inequities in access to education, particularly during emergency situations such as the COVID-19 pandemic. Policymakers and education stakeholders should implement strategies to narrow the digital divide, including device provision, subsidized internet access, and targeted support for students from disadvantaged backgrounds. Ensuring equitable access is essential for fostering inclusive, sustainable, and resilient learning environments.

Promote Collaborative and Multi-Stakeholder Approaches: Addressing academic performance gaps and digital integration challenges requires coordinated and collaborative efforts among educators, policymakers, parents, and community stakeholders. Multi-stakeholder partnerships can facilitate resource sharing, evidence-informed decision-making, and the development of contextually responsive and sustainable educational solutions. Such collective approaches are vital for strengthening educational systems and improving student outcomes in both routine and crisis contexts.

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