Article

Check for updates

Journal of International Students
Volume 16, Issue 18 (2026), pp. 127-142
ISSN: 2162-3104 (Print), 2166-3750 (Online)
jistudents.org
https://doi.org/10.32674/ctxwbc05

AI-Supported Classroom Planning, Student Engagement, and EFL Achievement: Evidence from a Pretest–Posttest Study in India

Palash Majumder
School of Education, Lovely Professional University, Punjab, India

Nimisha Beri
Department of Teacher Education, National Council of Educational Research and Training, New Delhi, India

Narendra Kumar
Department of Education, Central University of Rajasthan, Rajasthan, India

Corresponding author: Palash Majumder, School of Education, Lovely Professional University, Phagwara, Punjab 144411, India. Email: rajumajumder56@gmail.com

ORCID: Palash Majumder https://orcid.org/0000-0001-9115-0490 | Nimisha Beri https://orcid.org/0000-0003-0242-087X | Narendra Kumar, https://orcid.org/0000-0003-1855-6413

ABSTRACT: *This study examines the association between AI-based classroom planning and classroom climate and English as a foreign language (EFL) achievement among 240 secondary school students in West Bengal, India, with student engagement as a mediating variable. A single-group pretest–posttest design was employed across a three-week AI-supported intervention. Using SPSS 26 and AMOS 26, paired-sample t tests revealed statistically significant pre to-post improvements in classroom climate ($t(239) = -76.90$, $p < .001$, $d = -4.96$), student engagement ($t(239) = -64.46$, $p < .001$, $d = -4.16$), and EFL achievement ($t(239) = -61.77$, $p < .001$, $d = -3.99$). These effect sizes are unusually large and should be interpreted cautiously given the single-group design, short intervention duration, and potential testing and novelty effects. Structural equation modeling (SEM) confirmed partial mediation via student engagement ($\beta = .479$, $p = .001$, 95% CI [.320, .641]), explaining 63.3% of the variance in EFL achievement. These findings offer a scalable, evidence-based model for AI-supported language pedagogy in underresourced, multilingual EFL*

contexts in the Global South.

Keywords: AI-based classroom planning, classroom climate, EFL achievement, Global South, mediation analysis, multilingual education, student engagement

Received: April 20, 2026 | **Revised**: June 29, 2026 | **Accepted:** July 10, 2026

How to Cite (APA): Majumder, P., Beri, N., & Kumar, N. (2026). Evaluating the impact of AI-based classroom planning on classroom climate and EFL achievement: An experimental study with student engagement as a mediating variable. *Journal of International Students, 16*(18), 127–142. https://doi.org/10.32674/ctxwbc05

INTRODUCTION

Artificial intelligence (AI) is reshaping education globally, offering scalable solutions for personalized instruction, adaptive feedback, and learner engagement across linguistically diverse contexts (Holmes et al., 2019; Luckin et al., 2016; Zawacki-Richter et al., 2019). Duke (2026), in a critical conceptual review, argues that AI holds transformative potential for advancing diversity, equity, and inclusion in international education—provided that deployment is grounded in ethically coherent, pedagogically informed frameworks. As AI tools proliferate in global classrooms, their capacity to support multilingual instruction and language development in underresourced settings has attracted growing scholarly attention.

Despite this momentum, global south English as a foreign language (EFL) remains significantly underrepresented in the empirical literature. Infrastructural constraints, socioeconomic disparities, and linguistic heterogeneity continue to restrict access to high-quality language instruction. India's National Education Policy (NEP) 2020 advocates for AI-based learning environments, yet evidence-based evaluations of the impact of classroom-level AI remain scarce—particularly for multilingual learners in resource-constrained contexts where English functions as a foreign rather than a societal language.

The participants in this study were class IX students in government-sponsored Bengali-medium secondary schools in West Bengal, India. English is learned exclusively as a curricular subject; Bengali is the dominant language of home, community, and schooling. This constitutes an EFL context by definition, as English does not function as a medium of wider social communication outside the classroom (Cummins, 2000). While structurally distinct from international student populations, these learners encounter challenges—navigating instruction in an additional language, operating within limited-resource environments, and developing proficiency essential for future academic and professional mobility—that resonate broadly with research on multilingual learners in globally comparable contexts. The present study contributes to this broader conversation by examining how AI-based classroom planning is associated with EFL

achievement and classroom climate, with student engagement as the mediating construct.

As illustrated in Figure 1, AI-based classroom planning functions as an instructional intervention that is hypothesized to improve all three measured variables. Within this framework, the structural mediation model tests classroom climate as the predictor, student engagement as the mediator, and EFL achievement as the outcome. Both direct and engagement-mediated pathways are hypothesized. The study is guided by five hypotheses (H1–H5) detailed in Section 5.

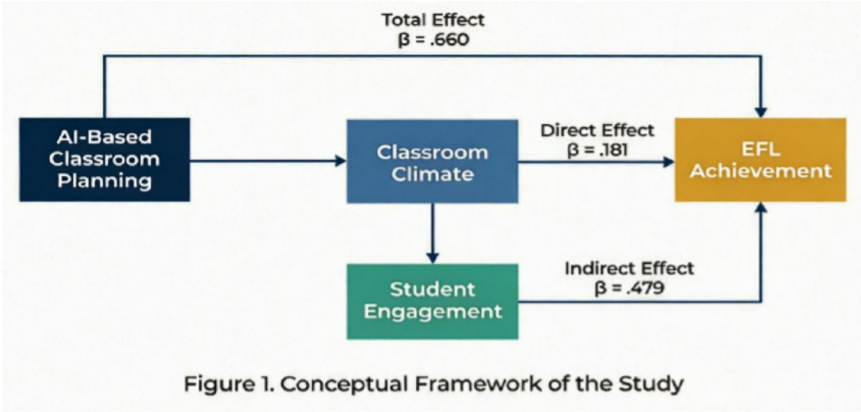

Figure 1: Conceptual Framework of the Study Showing Direct, Indirect, and Total Effects

Note. The structural mediation model depicts classroom climate as the predictor, student engagement as the mediator, and EFL achievement as the outcome. AI-based classroom planning serves as the overarching instructional intervention hypothesized to improve all three variables. Empirical path coefficients are reported in Section 7.

REVIEW OF RELATED LITERATURE

Artificial Intelligence in Education and Classroom Planning

AI in education has introduced transformative methodologies for personalized instruction, automated feedback, and data-driven planning. AI-based classroom planning tools enable teachers to design responsive lessons grounded in learner analytics and adaptive content delivery, reducing cognitive load while improving instructional alignment (Luckin et al., 2016; Zawacki-Richter et al., 2019). Chiu et al. (2024) demonstrated that AI-based chatbots increase teacher support and student motivation in language learning contexts, whereas Xu and Li (2024) reported that AI affordances significantly predict student engagement in EFL classrooms. Duke (2026) further emphasizes that realizing AI's potential for educational equity requires intentional design that centers the needs of

underserved, multilingual populations—a principle operationalized in the present study's teacher-mediated intervention model.

AI, Multilingualism, and EFL Language Learning

AI serves as a critical linguistic scaffolding mechanism with substantial implications for multilingual EFL learners. By providing low-stakes practice environments and immediate nonjudgmental feedback, AI reduces foreign language anxiety—a well-documented barrier to EFL participation (Duffy & Binghang, 2026). In a qualitative case study of Chinese EFL undergraduates in a transnational university context, Duffy and Binghang (2026) reported that while learners valued AI tools' diagnostic feedback and low-anxiety speaking practices, voluntary engagement was constrained by privacy concerns and facility design—highlighting that the contextual and motivational conditions surrounding AI use are as important as the technology itself. AI further supports learning through culturally contextualized prompts, enabling equitable access to quality instruction for learners from diverse linguistic backgrounds (Duke, 2026; Guo & Wang, 2025). Recent research underscores both the promise and the complexity of this integration: Ittefaq et al. (2025) reported that AI literacy, perceived usefulness, and positive attitudes jointly predict students' intention to adopt generative AI, whereas Bannister et al. (2024) caution that institutional policies frequently overlook the needs of linguistically diverse learners—highlighting the importance of equitable, context-sensitive AI deployment.

Classroom Climate and Its Role in EFL Learning

The classroom climate encompasses interpersonal relationships, rule clarity, student–teacher interactions, and emotional tone, which define the classroom atmosphere (Fraser, 2015). Supportive climates promote motivation, reduce anxiety, and facilitate engagement—outcomes that are particularly salient in EFL contexts where climate governs students' willingness to speak and take linguistic risks (Thapa et al., 2013; Wang et al., 2020). These dynamics are especially critical for language-minority and multilingual learners, who rely on inclusive environments to navigate new academic and linguistic demands (Derakhshan et al., 2022; Reyes et al., 2012). A comprehensive meta-analysis by Wang et al. (2020) confirmed that classroom climate is positively associated with academic achievement and psychological well-being across educational levels, with effects moderated by student and study characteristics.

Student Engagement as a Mediating Construct

Student engagement—conceptualized across behavioral, emotional, and cognitive dimensions (Fredricks et al., 2004)—is a central mediating construct that links instructional quality to academic outcomes. AI tools stimulate engagement through personalized feedback and interactive tasks (Kukulska-Hulme, 2009; Xu & Li, 2024), while engagement itself facilitates linguistic acquisition among multilingual EFL learners (Yılmaz Bodur et al., 2023). The mediating role of engagement between instructional interventions and achievement is empirically supported (Reschly & Christenson, 2012) but remains underexamined in AI-

enhanced EFL contexts in the Global South. From a self-determination theory perspective, engagement is sustained when learning environments support learners' needs for autonomy, competence, and relatedness (Ryan & Deci, 2020)—conditions that well-designed AI scaffolding may help cultivate.

EFL Achievement in AI-Enhanced Contexts

EFL performance in multilingual settings is shaped by emotional safety, the classroom atmosphere, and learner motivation as much as by explicit instruction (Cummins, 2000). AI-based instruction—through personalized content delivery and real-time corrective feedback—is positively associated with improvements in reading, writing, and comprehension skills among EFL learners (Guo & Wang, 2025; Holmes et al., 2019). Wei (2023) demonstrated that AI language instruction is associated with improvements in L2 motivation and self-regulated learning, with direct implications for learners in EFL settings globally. Similarly, Zhang et al. (2025), in a study of 510 school-age EFL learners, reported that informal digital learning of English predicted achievement gains, partially mediated by reduced anxiety and heightened enjoyment—mirroring the engagement-mediated pathway examined in the present study.

The reviewed literature establishes the potential of AI-based classroom planning to improve process variables (climate and engagement) and outcome variables (EFL achievement) while validating student engagement as a theoretically grounded mediator. However, studies examining these variables jointly through a quantitative design in Global South multilingual EFL contexts—particularly with SEM-based mediation analysis—remain limited. The present study addresses this gap directly.

The objectives of the study are as follows:

1) To examine the association between AI-based classroom planning and the classroom climate among secondary school students.
2) To examine the association between AI-based classroom planning and student engagement.
3) To examine the association between AI-based classroom planning and EFL achievement.
4) To explore the relationships among classroom climate, student engagement, and EFL achievement within an AI-based instructional context.
5) To assess the mediating role of student engagement between classroom climate and EFL achievement.

HYPOTHESES OF THE STUDY

Based on the objectives and conceptual framework, the following associational hypotheses were formulated. Given the single-group design, the following hypotheses are framed in terms of expected associations and pre-to-post changes rather than causal effects:

H1: There is a statistically significant positive change in the classroom climate following the AI-based classroom planning intervention.

H2: There is a statistically significant positive change in student engagement following the intervention.

H3: There is a statistically significant positive change in EFL achievement following the intervention.

H4: There is a statistically significant positive relationship between changes in classroom climate and changes in EFL achievement.

H5: Changes in student engagement significantly mediate the relationship between changes in classroom climate and changes in EFL achievement.

METHODOLOGY

Research Design

This study adopted a single-group pretest–posttest design over a three-week AI-supported intervention aligned with the WBBSE Class IX EFL curriculum. This design is appropriate for exploratory AI intervention research in resource-constrained settings where randomized controlled trials pose logistical and ethical challenges; it serves as a pilot investigation to establish a preliminary evidence base for future controlled designs. However, the absence of a random control group constitutes a significant threat to internal validity. Without a counterfactual condition, observed preto-post improvements cannot be causally attributed to the AI intervention; confounds, including history effects, maturation, testing effects, demand characteristics, and teacher enthusiasm, cannot be ruled out. Future research employing randomized controlled designs with an active control condition is necessary to establish causal directionality.

The AI-based classroom planning intervention employed six structured components: (1) AI-generated lesson outlines providing curriculum-aligned instructional frameworks; (2) contextual vocabulary prompts supporting lexical acquisition; (3) adaptive grammar activities tailored to proficiency level; (4) automated real-time feedback mechanisms following written and comprehension tasks; (5) adaptive content delivery adjusting difficulty in response to learner performance; and (6) AI-assisted digital resource curation organizing supplementary materials. Together, these constituted a coherent, scalable AI-supported instructional framework implemented consistently across the three-week period.

Participants

A total of 240 class IX students from six government-sponsored Bengali-medium secondary schools in West Bengal participated. Stratified random sampling ensured demographic diversity across gender and socioeconomic background. Informed consent was obtained from all the students, parents, and school authorities. Students were nested within six schools, introducing clustering

effects. Standard errors were computed at the individual level and may be slightly underestimated; therefore, the results should be interpreted with caution. Future research should employ multilevel modeling to properly account for this nested data structure.

Tools and Instruments

Three validated instruments were employed: (a) the 36-item Classroom Climate Inventory (Muthee, 2009; 17 negatively keyed items reverse-scored; 5-point Likert; α = .88–.89); (b) the 30-item Student Engagement Scale (Sharma & Chowdhry, 2022; Cognitive, Emotional, and Behavioral subscales; 5-point Likert; α = .91–.92; composite score used for SEM); and (c) a 50-item EFL achievement test developed by the researchers, validated through expert panel review (five EFL specialists) and pilot testing (N = 30), with acceptable item difficulty (0.40–0.75), discrimination indices (0.30–0.65), and split-half reliability (Spearman-Brown = .85). All the instruments were translated into Bengali and back-translated; equivalence was verified prior to administration.

Data collection procedure

Pretest data were collected one week before the intervention. During the three-week AI-driven instructional phase, the teachers implemented AI-generated lesson plans and scaffolds following a standardized protocol. Posttest data were collected immediately after the intervention by trained research assistants under standardized conditions.

Statistical Analysis

Change scores were computed as follows: Climate_Change = Climate_Post – Climate_Pre; Engage_Change = Engage_Post – Engage_Pre; EFL_Change = EFL_Post – EFL_Pre. Analyses were conducted in SPSS 26 and AMOS 26 using descriptive statistics, paired-sample t tests, Pearson correlations, multiple regression, and SEM-based mediation with 2,000-resample bootstrap confidence intervals. Effect sizes (Cohen's d) were calculated using paired-sample standardized mean differences based on change-score variability; such estimates may appear inflated when variability in difference scores is relatively low.

Ethical Considerations

The study adhered to the ICSSR ethical guidelines. Ethical clearance (equivalent to IRB approval) was granted by the institutional ethics committee prior to implementation. Informed consent was obtained from all participants and their guardians. Participation was voluntary, with the right to withdraw at any time. Data confidentiality was maintained throughout.

Use of Artificial Intelligence in Manuscript Preparation

In accordance with COPE guidelines as endorsed by the Journal of International Students, the authors report that AI tools—including Claude (Anthropic) and ChatGPT (OpenAI)—were used in the preparation of this manuscript for literature searching, grammar and style refinement, and reference formatting. AI was not

used for data collection, statistical analysis, or interpretation of findings. All AI-assisted content was critically reviewed, edited, and verified by the authors, who take full responsibility for the accuracy, integrity, and originality of the final manuscript.

RESULTS

An interpretive caution applies throughout: Cohen's d values observed (−4.96 to −3.99) are unusually large by conventional benchmarks (Cohen, 1988). These likely reflect the methodological characteristics of single-group change-score designs, including the absence of a control condition, short intervention duration, sample homogeneity, and low variability in difference scores. These effect sizes should not be assumed to generalize beyond settings with similar implementation conditions and cannot be interpreted as evidence of causal treatment effects.

Descriptive Statistics and Pre-Post Comparisons

Table 1

Pretest and posttest descriptive statistics, paired t test results, and effect sizes (N = 240)

Variable	Pretest M (SD)	Posttest M (SD)	Mean diff.	t(239)	p	Cohen's d
Classroom Climate	93.91 (7.66)	103.75 (7.76)	−9.84	−76.90	< .001	−4.96
Student Engagement	91.72 (9.83)	101.41 (10.13)	−9.69	−64.46	< .001	−4.16
EFL Achievement	24.88 (4.91)	33.75 (5.45)	−8.87	−61.77	< .001	−3.99

Note. Pretest score ranges: Classroom Climate 70–113; Student Engagement 63–117; EFL Achievement 11–38. Posttest ranges: Classroom Climate 80–122; Student Engagement 71–125; EFL Achievement 19–49. All t tests are significant at $p < .001$. Effect sizes are based on change-score standardized mean differences and should be interpreted with caution; they likely reflect the methodological characteristics of the single-group design rather than the true intervention magnitude. Substantial posttest mean increases were observed across all three variables. The pre–post improvements are visually depicted in Figure 2.

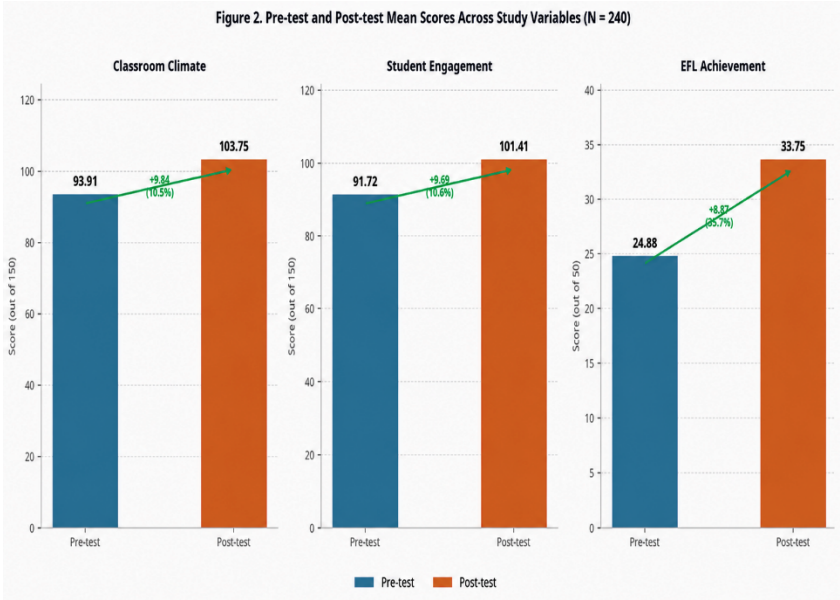

Figure 2: Pretest and Posttest Mean Scores across Classroom Climate, Student Engagement, and EFL Achievement (N = 240)

Note. Blue bars = pretest means; orange bars = posttest means. The green annotations indicate the absolute gain and percentage improvement for each variable. Classroom climate: scored out of 180; student engagement: out of 150; EFL achievement: out of 50.

Correlation, Regression, and Mediation Results

Pearson correlation revealed a strong positive association between Climate_Change and EFL_Change ($r = .660$, $p < .01$). Multiple regression demonstrated that Climate_Change was associated with Engage_Change ($\beta = .733$, $t = 16.601$, $p < .001$, $R^2 = .537$), and Engage_Change was associated with EFL_Change ($\beta = .786$, $t = 19.638$, $p < .001$, $R^2 = .618$). In the combined model, both predictors remained significant ($R^2 = .633$, $F(2, 237) = 204.81$, $p < .001$).

Table 2

Summary of correlation, regression, and SEM mediation results

Analysis	Path/variable	β (std.)	p	95% CI/R^2
Pearson correlation	Climate_Change → EFL_Change	.660	< .01	—
Regression — Step 1	Climate_Change → Engage_Change	.733	< .001	$R^2 = .537$
Regression — Step 2	Engage_Change → EFL_Change	.786	< .001	$R^2 = .618$

Analysis	Path/variable	β (std.)	p	95% CI/R^2
Multiple regression	Climate_Change → EFL_Change	.181	.002	R^2 = .633
Multiple regression	Engage_Change → EFL_Change	.654	< .001	R^2 = .633
SEM — direct effect	Climate → EFL (direct)	.181	.003	—
SEM — indirect	Climate → Engage → EFL	.479	.001	[.320, .641]
SEM — total effect	Climate → EFL (total)	.660	< .001	—

Note. SEM was conducted in AMOS 26 with 2,000-resample bootstrapping. Because the model is just identified (df = 0), global fit indices (CFI = 1.000, TLI = 1.000, RMSEA = .000) are mathematically constrained and not substantively interpretable. Interpretive emphasis rests on standardized path coefficients and bootstrap-estimated indirect effects. Partial mediation is indicated by a significant direct effect alongside a significant indirect effect.

AI-based classroom planning was associated with statistically significant pre–post improvements across all three domains. Student engagement was confirmed as a significant partial mediator of the climate–EFL achievement relationship (β = .479, 95% CI [.320, .641]), accounting for the dominant share of the total association. These findings should be interpreted as preliminary associational evidence rather than causal evidence.

DISCUSSION

This study examined the associations of AI-based classroom planning with classroom climate, student engagement, and EFL achievement in West Bengal, India. All five hypotheses were supported, and the findings are discussed below.

Hypothesis Testing

H1–H3: Supported. Statistically significant pre–post improvements were observed across classroom climate (d = −4.96), student engagement (d = −4.16), and EFL achievement (d = −3.99), which is consistent with evidence linking AI-mediated instruction to language and engagement gains (Guo & Wang, 2025; Wei, 2023; Xu & Li, 2024). The unusually large effect sizes are interpreted as context-specific and methodologically influenced (see Section 7 preamble) and should not be taken as evidence of strong causal treatment effects. The absence of a control group means that testing effects, maturation, history effects, demand characteristics, and novelty cannot be ruled out as contributing factors.

H4: Supported. The strong climate–EFL correlation (r = .660, p < .01) confirms that improvements in the classroom environment are associated with

greater EFL gains, which is consistent with socioemotional models of language learning (Derakhshan et al., 2022; Reyes et al., 2012).

H5: Confirmed via SEM. Partial mediation was established: the indirect effect (β = .479, 95% CI [.320, .641]) substantially exceeded the direct effect (β = .181), with the model explaining 53.7% of the variance in engagement and 63.3% of the variance in EFL achievement. Student engagement emerges as the central mechanism linking classroom climate improvements to EFL achievement gains.

Student Engagement as a Mediating Mechanism

The dominance of the indirect pathway positions student engagement as the primary conduit through which instructional quality is associated with language achievement gains. Sustained behavioral, emotional, and cognitive engagement is critical for overcoming linguistic barriers in EFL contexts (Fredricks et al., 2004; Yılmaz Bodur et al., 2023). Similarly, Duffy and Binghang (2026) reported that while EFL learners value the low-anxiety practice opportunities afforded by AI tools, motivational and contextual factors—including privacy concerns and facility design—shape whether engagement is actually sustained, underscoring that AI effectiveness is mediated by the quality of the surrounding learning environment.

Classroom Climate and EFL Learning

The association between AI-based planning and improved classroom climate supports research on emotional safety and inclusion in EFL environments. Positive climates—orderly, supportive, and predictable—are prerequisites for language risk-taking, particularly for learners whose instructional language is not their primary medium (Fraser, 2015; Wang et al., 2020).

AI as a Co-Planner: Toward a Hybrid Pedagogical Model

These findings reinforce the conceptualization of AI as a pedagogical coplanner rather than a teacher replacement. The intervention positioned AI as a teacher-capacity enhancer—enabling responsive lesson design while preserving the relational dimensions of teaching (Chiu et al., 2024; Holmes et al., 2019). Duke (2026) argues that AI's potential to advance equity in education depends on this kind of human-centered, ethically grounded deployment—precisely the model adopted in the present study.

ETHICAL IMPLICATIONS OF AI IN MULTILINGUAL EFL EDUCATION

Responsible AI integration in multilingual EFL education requires attention to three principal concerns. First, algorithmic bias: AI systems trained predominantly on high-resource, English-dominant data may embed assumptions poorly calibrated to Global South or multilingual populations (Duke, 2026). Second, the digital divide: Equitable access to AI tools depends on reliable infrastructure and digital literacy—resources unevenly distributed globally

(Duke, 2026). Third, overreliance risk: excessive AI dependence may diminish teachers' pedagogical judgment. Responsible implementation requires ongoing professional development and institutional frameworks supporting reflective adoption, which is consistent with international guidance on the ethics of AI in education (UNESCO, 2021).

LIMITATIONS

Several limitations must be acknowledged when interpreting these findings. Most fundamentally, the absence of a random control group constitutes a significant threat to internal validity. Without a counterfactual condition, the observed improvements cannot be causally attributed to the AI intervention, and confounds, including history effects, maturation, testing effects, and demand characteristics, cannot be ruled out; the findings must therefore be interpreted as associational rather than causal. Relatedly, the three-week intervention period is insufficient to assess sustained outcomes or meaningful long-term language development, and any observed preto-post changes may reflect short-term novelty or reactivity rather than durable learning gains.

A further consideration concerns the magnitude of the observed effects. Unusually large Cohen's d values likely reflect the methodological characteristics of single-group change-score designs, sample homogeneity, and low variability in difference scores and should not be assumed to represent true intervention efficacy. In addition, treating the 240 students as independent observations, when they were in fact nested within six schools, may result in an underestimation of the standard errors; future research should employ multilevel modeling to properly account for this clustered data structure.

The study's generalizability is also constrained. The sample's restriction to government-sponsored Bengali-medium schools in West Bengal limits direct transferability to other EFL or ESL settings. Two analytical limitations further temper the conclusions: the mediation analysis was conducted on concurrently measured change scores, which weakens the ability to establish temporal precedence among the variables, and the structural equation mediation model is just-identified ($df = 0$), meaning that its global fit indices are mathematically constrained and uninformative. Because a just-identified model cannot be falsified through fit assessment, the results rest on the standardized path coefficients and the bootstrap-estimated indirect effects and should be interpreted with appropriate caution.

CONCLUSION

This study provides preliminary evidence that AI-based classroom planning is linked to significant preto-post improvements in classroom climate, student engagement, and EFL achievement in a multilingual Global South context. These findings should be interpreted as preliminary evidence of association rather than causal proof; the single-group design precludes definitive causal attribution. SEM confirmed that student engagement partially mediated the climate–EFL

achievement relationship (β = .479, 95% CI [.320, .641] vs. direct β = .181)—establishing engagement as the central mechanism through which instructional quality is associated with language outcomes. These findings position AI as a potentially scalable pedagogical coplanner that enhances teacher capacity and fosters emotionally secure, engaging EFL learning environments without supplanting culturally responsive teaching. As Duke (2026) argues, such ethically grounded, equity-centered AI deployment is essential for realizing AI's potential in international and multilingual education contexts. Future research should employ randomized controlled designs, extend intervention periods, and replicate findings across diverse national and linguistic EFL contexts.

Acknowledgment

In the preparation of this manuscript, we utilized artificial intelligence (AI) tools for content creation with the following capacity:

☐ None
☐ Some sections, with minimal or no editing
☐ Some sections, with extensive editing ✓
☐ Entire work, with minimal or no editing
☐ Entire work, with extensive editing

AI tools (Claude, Anthropic; ChatGPT, OpenAI) were used in a limited, supporting capacity for literature searching, language and style refinement, and reference formatting, as disclosed in Section 6.7. AI was not used for data collection, statistical analysis, or the interpretation of findings, all of which were carried out by the authors. Every AI-assisted suggestion, including all references, was independently verified by the authors against original publisher records. The use of AI tools complied with ethical standards and guidelines for academic integrity, and the final content has been thoroughly reviewed and edited by the authors, who take full responsibility for its accuracy, relevance, and originality.

REFERENCES

Bannister, P., Alcalde Peñalver, E., & Santamaría Urbieta, A. (2024). International students and generative artificial intelligence: A cross-cultural exploration of higher education academic integrity policy. *Journal of International Students, 14*(3), 149–170. https://doi.org/10.32674/jis.v14i3.6277

Chiu, T. K. F., Moorhouse, B. L., Chai, C. S., & Ismailov, M. (2024). Teacher support and student motivation to learn with artificial intelligence (AI) based chatbot. *Interactive Learning Environments, 32*(7), 3240–3256. https://doi.org/10.1080/10494820.2023.2172044

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.

Cummins, J. (2000). Language, power and pedagogy: Bilingual children in the crossfire. Multilingual Matters.

Derakhshan, A., Fathi, J., Pawlak, M., & Kruk, M. (2022). Classroom social climate, growth language mindset, and student engagement: The mediating role of boredom in learning English as a foreign language. Journal of

Multilingual and Multicultural Development, 45(8), 3415–3433. https://doi.org/10.1080/01434632.2022.2099407

Duffy, L., & Binghang, L. (2026). "It's easier talking to a machine": Privacy, motivation, and the underuse of English language labs in a Sino-foreign university in China. Journal of International Students, 16(10), 89–104. https://doi.org/10.32674/g5wkva87

Duke, B. (2026). Artificial intelligence for inclusive and sustainable international education: A critical conceptual review. Journal of International Students, 16(10), 167–198. https://doi.org/10.32674/96t36095

Fraser, B. J. (2015). Classroom learning environments. In R. Gunstone (Ed.), Encyclopedia of science education (pp. 154–157). Springer. https://doi.org/10.1007/978-94-007-2150-0_186

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. Review of Educational Research, 74(1), 59–109. https://doi.org/10.3102/00346543074001059

Guo, Y., & Wang, Y. (2025). Exploring the effects of artificial intelligence application on EFL students' academic engagement and emotional experiences: A mixed-methods study. European Journal of Education, 60(1), Article e12812. https://doi.org/10.1111/ejed.12812

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign.

Ittefaq, M., Zain, A., Arif, R., Ahmad, T., Khan, L., & Seo, H. (2025). Factors influencing international students' adoption of generative artificial intelligence: The mediating role of perceived values and attitudes. Journal of International Students, 15(7), 127–156. https://doi.org/10.32674/fnwdpn48

Kukulska-Hulme, A. (2009). Will mobile learning change language learning? ReCALL, 21(2), 157–165. https://doi.org/10.1017/S0958344009000202

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence unleashed: An argument for AI in education. Pearson.

Muthee, J. M. (2009). Classroom climate inventory [Measurement instrument]. Department of Psychology, University of Kerala.

Reschly, A. L., & Christenson, S. L. (2012). Jingle, jangle, and conceptual haziness: Evolution and future directions of the engagement construct. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), Handbook of research on student engagement (pp. 3–19). Springer. https://doi.org/10.1007/978-1-4614-2018-7_1

Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. Journal of Educational Psychology, 104(3), 700–712. https://doi.org/10.1037/a0027268

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. Contemporary Educational Psychology, 61, Article 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Sharma, H., & Chowdhry, M. (2022). Student engagement scale [Measurement instrument]. National Psychological Corporation.

Thapa, A., Cohen, J., Guffey, S., & Higgins-D'Alessandro, A. (2013). A review of school climate research. Review of Educational Research, 83(3), 357–385. https://doi.org/10.3102/0034654313483907

UNESCO. (2021). Recommendation on the ethics of artificial intelligence. United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000381137

Wang, M.-T., Degol, J. L., Amemiya, J., Parr, A., & Guo, J. (2020). Classroom climate and children's academic and psychological wellbeing: A systematic review and meta-analysis. Developmental Review, 57, Article 100912. https://doi.org/10.1016/j.dr.2020.100912

Wei, L. (2023). Artificial intelligence in language instruction: Impact on English learning achievement, L2 motivation, and self-regulated learning. Frontiers in Psychology, 14, Article 1261955. https://doi.org/10.3389/fpsyg.2023.1261955

Xu, J., & Li, J. (2024). Effects of AI affordances on student engagement in EFL classrooms: A structural equation modeling and latent profile analysis. European Journal of Education, 59(4), Article e12808. https://doi.org/10.1111/ejed.12808

Yılmaz Bodur, Z., Kılıç, A. F., & Aktan, S. (2023). Perceived instructional environment and English achievement: The mediating role of student engagement. The Journal of Educational Research, 116(2), 100–112. https://doi.org/10.1080/00220671.2023.2203093

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – Where are the educators? International Journal of Educational Technology in Higher Education, 16(1), Article 39. https://doi.org/10.1186/s41239-019-0171-0

Zhang, H., Du, L., Luo, S., Xun, H., Yang, A., & Tang, Y. (2025). Unlocking EFL achievement through informal digital learning: The mediating roles of anxiety and enjoyment among school-age students in the Chinese mainland. Asian-Pacific Journal of Second and Foreign Language Education, 10(1), Article 45. https://doi.org/10.1186/s40862-025-00352-x

Author bios

PALASH MAJUMDER is a Research Scholar in the School of Education at Lovely Professional University, Phagwara, Punjab, India. His major research interests lie in the areas of educational technology, psychometrics, English language teaching, student engagement and parental involvement in educational research. Email: rajumajumder56@gmail.com

NIMISHA BERI, PhD, is an Associate Professor in the Department of Teacher Education at the National Council of Educational Research and Training

(NCERT), New Delhi, India. Her major research interests lie in the areas of teacher education, educational psychology, and language pedagogy.

NARENDRA KUMAR, PhD, is an Assistant Professor in the Department of Education at the Central University of Rajasthan, India. His major research interests lie in the areas of educational assessment, curriculum studies, and technology-enhanced learning.