Leveraging Translanguaging in GenAI-Enhanced Language Classes: Capturing Its Impact on Multilingual English Learners' Achievement Emotions and Academic Engagement through Latent Growth Curve Modeling (LGCM)

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Compliance with Ethical Standards

Ethical Approval: All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Abstract

The present research traced the growth trajectories of multilingual English learners' achievement emotions and academic engagement in generative artificial intelligence (GenAI)-enhanced classes and examined the effects of translanguaging pedagogy as an emotional scaffolding strategy in this context. Using purposive sampling, 342 multilingual English learners were selected and randomly assigned to either a control group or a treatment group. Data were collected at three time points using two validated questionnaires and analyzed via latent growth curve modeling (LGCM) and repeated measures multivariate analysis of variance (RM MANOVA). The analysis exhibited an upward trajectory in the development of learners' positive achievement emotions and academic engagement. The results further indicated that translanguaging significantly promoted learners' positive achievement emotions and reduced their negative achievement emotions, which, in turn, increased their academic engagement. These findings highlight the contributions of translanguaging pedagogy in GenAI-enhanced classrooms and call for more linguistically responsive instructional designs that recognize and build on learners' multilingual repertoires.

Keywords: Academic engagement, Achievement emotions, Generative artificial intelligence (GenAI), Latent growth curve modeling (LGCM), Multilingual English learners, Translanguaging

1. Introduction

The rapid advancement of artificial intelligence (AI) and generative artificial intelligence (GenAI) has profoundly reshaped the educational landscape (Chen et al., 2022), with language learning at the forefront of this transformation (Derakhshan & Taghizadeh, 2025). AI and GenAI tools such

as Gemini, Microsoft Copilot, and ChatGPT are increasingly integrated into classrooms to provide real-time feedback and scaffold learners' communicative tasks. While these tools promise enhanced personalization and efficiency (Chen et al., 2020), they also risk privileging monolingual norms of English use, thereby overlooking or suppressing the linguistic repertoires that learners bring to the classroom. For multilingual language learners, such limitations can inadvertently marginalize their diverse identities and diminish their sense of belonging (Lee et al., 2025).

Within this evolving context, translanguaging pedagogy, which encourages learners to use their full communicative repertoire (Li, 2018, 2023), has emerged as a powerful approach to support multilingual learners' identities and enhance their sense of belonging (García & Kleyn, 2016; Lei, 2014). It moves beyond rigid separations of languages, allowing learners to flexibly draw on their entire lsemiotic repertoires to accomplish their academic tasks (Zhu & Li, 2022). Research has demonstrated that translanguaging pedagogy not only facilitates learners' linguistic understanding (Wang et al., 2025) but also scaffolds their emotional well-being (Back et al., 2020; Charamba & Ndhlovana, 2025; Ghafouri & Esmaeilee, 2024; Song et al., 2022; Zhang, 2024). Such emotionally supportive practices are especially critical in GenAI-enhanced environments, where the impersonal nature of technology may adversely influence learners' achievement emotions and academic engagement.

Achievement emotions refer to learners' affective responses to their learning activities and outcomes (Chen et al., 2025; Pekrun, 2019). These emotions can be positive, such as enjoyment, hope, and pride, which foster learners' interest, persistence, and active participation in learning tasks (Derakhshan & Azari Noughabi, 2024; Derakhshan & Yin, 2024; Kirkpatrick et al., 2025); or negative, such as anxiety, shame, boredom, anger, and hopelessness, which can undermine learners' motivation and reduce their classroom participation (Shakki, 2023; Tsang & Dewaele,

2023). Closely tied to achievement emotions is academic engagement (Pekrun & Linnenbrink-Garcia, 2012), which encompasses learners' behavioral participation, cognitive investment, and emotional involvement in learning tasks (Hiver et al., 2021). High levels of academic engagement contribute to increased learning outcomes and sustained academic growth, whereas low engagement often results in reduced performance, academic failure, and withdrawal (Jiang & Peng, 2025).

Despite their critical importance, little is known about how achievement emotions and academic engagement are shaped in contemporary language education environments, notably AI- or GenAI-enhanced language classrooms (Guo & Wang, 2025). Most existing research has examined these constructs and their interactions within traditional language classrooms (e.g., Kirkpatrick et al., 2025; Shakki, 2023). While offering valuable insights, such studies have largely overlooked the complex interplay between learners' achievement emotions and academic engagement in modern or technology-mediated language classes, where the unique features of advanced technologies like AI and GenAI may influence learners' emotional, cognitive, and behavioral experiences (Derakhshan, 2025; Huang et al., 2023; Zhou & Hou, 2024). Furthermore, most studies in this domain have concentrated on monolingual or bilingual language learners, leaving the achievement emotions and academic engagement of multilingual learners underexplored. Additionally, the potential of translanguaging as an emotional scaffolding strategy in AI- or GenAI-enhanced multilingual language classrooms remains largely unexplored. This leaves a significant gap in understanding how linguistically responsive pedagogies can support multilingual learners' affective experiences and engagement in technologically enriched language classes.

Against this backdrop, the present study employs latent growth curve modeling (LGCM) to trace the developmental trajectories of multilingual English learners' achievement emotions and academic engagement over the course of a semester in GenAI-enhanced classrooms. Beyond documenting these longitudinal patterns, the study also examines the potential role of translanguaging pedagogy as an instructional intervention that may shape learners' achievement emotions and academic engagement. In doing so, this research addresses critical gaps in the pertinent literature and offers empirical insights into how linguistically responsive practices can foster learners' emotional well-being and sustained engagement in GenAI-enhanced language courses.

1.1. Translanguaging

Translanguaging, first developed in the context of bilingual education (García,2011), refers to the fluid and dynamic deployment of multilingual learners' entire linguistic repertoires for meaning-making, communication, and learning. Unlike code-switching, which assumes movement between distinct language systems, translanguaging views languages as integrated resources that can be strategically mobilized to enhance comprehension, scaffold complex content, and construct knowledge (García & Li, 2014). Pedagogically, it creates inclusive classroom spaces where learners' home and additional languages are valued, thereby legitimizing their linguistic identities and positioning them as competent language users (Li, 2014). Beyond cognitive benefits, translanguaging has been shown to foster affective gains by reducing anxiety, affirming cultural belonging, and supporting learners' motivation and engagement (Zhang, 2024). These qualities are particularly salient in multilingual educational contexts (Decristan et al., 2024), where the validation of diverse linguistic practices can counteract negative emotions often associated with monolingual ideologies in education (García & Kleyn, 2016). While a growing body of research

has documented these benefits in traditional language classrooms (Back et al., 2020; Charamba & Ndhlovana, 2025; Ghafouri & Esmaeilee, 2024; Song et al., 2022), little is known about how translanguaging might operate in technology-mediated or GenAI-enhanced environments.

1.2. Achievement Emotions: Positive and Negative Feelings

Achievement emotions, defined as affective experiences directly tied to achievement activities and outcomes (Pekrun, 2006), play a central role in shaping learners' motivation, engagement, and performance in language education (Pekrun et al., 2017; Pekrun & Linnenbrink-Garcia, 2012). These emotions are broadly categorized into positive (e.g., hope, enjoyment, pride) and negative (e.g., boredom, shame, anger, anxiety, and hopelessness) (Pekrun, 2006). Positive achievement emotions generally contribute to higher intrinsic motivation, greater persistence, and deeper engagement (Derakhshan & Yin, 2024), whereas negative emotions often constrain attention and hinder academic engagement (Shakki, 2023; Zhao et al., 2025; Zhao & Wang, 2025). Within multilingual language classes, the experience of achievement emotions becomes particularly complex, as learners navigate multiple linguistic repertoires, cultural frames of reference, and varying expectations for success (Kirkpatrick et al., 2025). The rise of AI- and GenAI-enhanced education further complicates these affective dynamics. While advanced technologies can foster learning enjoyment through personalized feedback and interactive tasks, they may also evoke anxiety and frustration due to increased cognitive demands (Guo & Wang, 2025).

1.3. Academic Engagement: Concept and Its Underlying Facets

Academic engagement refers to learners' active involvement and investment in learning, encompassing their emotional, behavioral, and cognitive contributions (Hiver et al., 2021). Emotional engagement captures learners' affective responses to learning activities, which influence their willingness to participate (Zhou et al., 2021). Behavioral engagement encompasses

observable actions such as attending class, completing tasks, persisting with challenges, and participating in classroom interactions (Zhou et al., 2021). Cognitive engagement involves the mental effort learners dedicate to understanding, processing, and mastering learning content (Zhou et al., 2021). Together, these dimensions highlight that engagement is a dynamic and multifaceted construct, shaped by both internal dispositions and external conditions (Hiver et al., 2021; Zhou et al., 2021). In multilingual and GenAI-enhanced language classrooms, understanding these dimensions is particularly important, as learners navigate diverse linguistic repertoires while interacting with advanced educational technologies that can either enhance or constrain their emotional, behavioral, and cognitive investment in learning tasks (Zhou & Hou, 2024).

1.4. The Interaction of Translanguaging, Achievement Emotions, and Academic Engagement in GenAI-Enhanced Language Classes

The role of translanguaging in shaping multilingual learners' achievement emotions in GenAI-enhanced language classes can be more effectively understood through the lens of its dual cognitive and affective functions (Back et al., 2020; Song et al., 2022). By enabling learners to mobilize their full linguistic repertoires, translanguaging not only facilitates deeper comprehension of complex subject matter but also acts as an emotional scaffold that supports their well-being (Charamba & Ndhlovana, 2025; Dovchin et al., 2025). In this sense, it helps alleviate the negative emotions associated with rigid monolingual instructional practices by affirming learners' diverse linguistic identities and granting them flexibility in processing and expressing meaning (Back et al., 2020; Song et al., 2022). This emotional scaffolding becomes especially critical in GenAI-enhanced language classes, where the novelty, complexity, and unpredictability of advanced technological tools may heighten learners' negative feelings, such as anger and anxiety.

By mitigating negative emotional experiences while simultaneously promoting positive feelings, translanguaging establishes the conditions necessary for learners' sustained engagement. As Pekrun and Linnenbrink-Garcia (2012) noted, the positive and negative emotions students experience in learning environments can directly influence their academic engagement across emotional, behavioral, and cognitive dimensions. According to them, positive emotions like enjoyment, pride, and hope enhance learners' motivation, persistence, and investment in classroom activities, thereby supporting both the quality and consistency of their participation (Pekrun et al., 2017). Conversely, negative emotions, including boredom, anxiety, shame, anger, and hopelessness, can disrupt learners' academic engagement by diminishing their interest, focus, and effort (Pekrun & Linnenbrink-Garcia, 2012).

Building upon these arguments, the present study intends to investigate the role of translanguaging as an emotional scaffolding strategy in shaping multilingual learners' achievement emotions and academic engagement within GenAI-enhanced language classrooms. Specifically, it seeks to examine how translanguaging-infused instruction influences multilingual learners' positive and negative achievement emotions and the extent to which these emotional experiences impact their overall engagement. To capture changes over time, the study also attempts to explore the trajectories of these emotional and behavioral dynamics throughout a full academic semester. These aims are directly addressed through the following research questions:

1. How do multilingual English learners' achievement emotions and academic engagement evolve over the course of a semester?
2. How does translanguaging-infused instruction influence multilingual English learners' achievement emotions and academic engagement?

2. Method

2.1. Research design

This experimental study adopted a quantitative "repeated measures design" (RMD) to investigate the effect of translanguaging-infused instruction on multilingual learners' achievement emotions and academic engagement in GenAI-enhanced English classes. The RMD entails collecting data from the same participants across multiple time points, thereby enabling the capture of both intra- and inter-individual variability with greater precision than cross-sectional approaches (Verma, 2015). This design was particularly well-suited to the study's aim of tracing the temporal trajectories of learners' emotions and engagement over the course of an academic semester. By assessing the same learners repeatedly, it was possible to track how translanguaging practices shaped fluctuations in both positive and negative emotions and how these fluctuations, in turn, influenced learners' academic engagement.

2.2. Setting and Participants

The present study took place at a public university in Golestan Province, Iran. This educational institution has recently integrated a range of GenAI tools, including ChatGPT, Gemini, and Microsoft Copilot, to support course objectives. These tools were seamlessly integrated into the curriculum as supplements to teachers' instructional practices, creating an educational environment where human–GenAI collaboration became a routine part of students' academic experience.

Using a purposive sampling strategy, participants were drawn from 10 undergraduate English classes where instruction was primarily delivered in the target language. The inclusion criterion required students to self-identify as multilingual, defined as individuals who regularly use three or more languages in academic, social, or daily contexts (Dewaele & Li, 2012). This

ensured that participants possessed the linguistic resources necessary to meaningfully engage with translanguaging-infused education.

In total, 342 students participated in the study, consisting of 149 males and 193 females, with an average age of 21. All were enrolled in English-related majors, including "English Language and Literature" (ELL; n = 213) and "Teaching English as a Foreign Language" (TEFL; n = 129). The participants had a hierarchical multilingual profile: Turkmen, Turkish, Baluchi, Arabic, and Kurdish as their first language (L1), Persian as their second language (L2), and English as their third language (L3). They regularly drew on these languages across diverse contexts, including everyday communication, social interactions, and academic tasks, providing a strong foundation for engaging effectively with translanguaging strategies in English language classes. As for the adequacy of the sample size, the sample of 342 participants was considered fairly adequate for running both LGCM (requiring a sample above 150, according to Kline, 2016) and repeated measures MANOVA (a power analysis with G*Power showed that the minimum required number of participants is 158 to achieve a medium effect size (f = .25) with a power of .8).

All ethical protocols were carefully followed to protect participants' rights and well-being throughout the study. In line with these protocols, each participant provided a written consent form and took part voluntarily, with the complete freedom to withdraw without any consequences.

2.3. Measures

2.3.1. Achievement Emotions Questionnaire (AEQ)

To assess learners' achievement-related emotions, the study employed the "Achievement Emotions Questionnaire" (AEQ) developed by Pekrun et al. (2011). The AEQ differentiates between positive emotions, namely "enjoyment", "hope", and "pride", and negative emotions,

including “anxiety”, “anger”, “shame”, “boredom”, and “hopelessness”. The instrument comprises 40 closed-ended items, with participants indicating the extent to which each statement reflects their feelings in English language classes. Responses were recorded on a Likert-type scale, ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). The AEQ demonstrated strong internal reliability in this study ($\alpha = 0.94$).

2.3.2. Academic Engagement Scale (AES)

To evaluate learners’ engagement levels, the study utilized the “Academic Engagement Scale” (AES) developed by Zhou et al. (2021). The AES captures learners’ “emotional”, “behavioral”, and “cognitive” engagement within language classes, providing a comprehensive assessment of how language learners invest themselves in learning activities. The scale comprises 24 closed-ended items, with responses recorded on a Likert scale, varying from 1 (“strongly disagree”) to 5 (“strongly agree”). The scale’s items include: “I kept trying my best even when it was hard” (item 3; behavioral facet), “I felt good while I was in the class” (item 12; emotional facet), and “I tried to connect new learning to the things I already learned before” (item 19; cognitive facet). Analysis of the scale’s reliability indicated excellent internal consistency ($\alpha = 0.97$).

2.4. Procedure

The study was carried out within the framework of a GenAI-enhanced English course that spanned a full academic semester (14 weeks), consisting of two 90-minute sessions per week. The course addressed all four language skills—reading, writing, listening, and speaking—while integrating ChatGPT as a GenAI tool already familiar to participants. Employing tools that learners had prior experience with was a deliberate pedagogical choice, as it reduced the cognitive load associated with learning new technologies and enabled learners to focus on applying the GenAI tools meaningfully to language learning tasks rather than struggling with unfamiliar platforms.

Prior to the experiment, participants were randomly allocated to the treatment and control groups. The treatment group received English language instruction that incorporated translanguaging strategies alongside the use of GenAI tools, enabling learners to strategically draw on their full linguistic repertoires while engaging with AI-enhanced learning tasks. In contrast, the control group followed an equivalent GenAI-enhanced curriculum without translanguaging integration. This group allocation allowed this research to specifically assess the influence of translanguaging on learners' achievement emotions and academic engagement within a technologically enriched language-learning environment.

During the 14-week intervention, both groups followed the same overall curriculum and completed comparable language learning tasks, ensuring that any observed differences could be attributed to the translanguaging integration rather than the task content. In the treatment group, instructors explicitly encouraged students to draw on their full linguistic repertoires—Turkmen Turkish, Baluchi, Arabic, and Kurdish (L1), Persian (L2), and English (L3)—to complete reading, writing, listening, and speaking tasks while interacting with GenAI tools. Translanguaging strategies included using students' L1 or L2 for comprehension checks, note-taking, brainstorming, peer discussions, and clarifying complex concepts before producing output in English. Instructors also modeled translanguaging practices during demonstrations and provided scaffolded support to help learners strategically integrate multiple languages. The control group received the same GenAI-supported tasks but was instructed to complete all activities exclusively in English, without structured opportunities to employ other languages.

To capture changes in learners' achievement emotions and engagement levels, both the treatment and control groups completed the validated scales (i.e., AEQ, AES) at three key points: "pre-intervention" (Week 1), "mid-intervention" (Week 7), and "post-intervention" (Week 14).

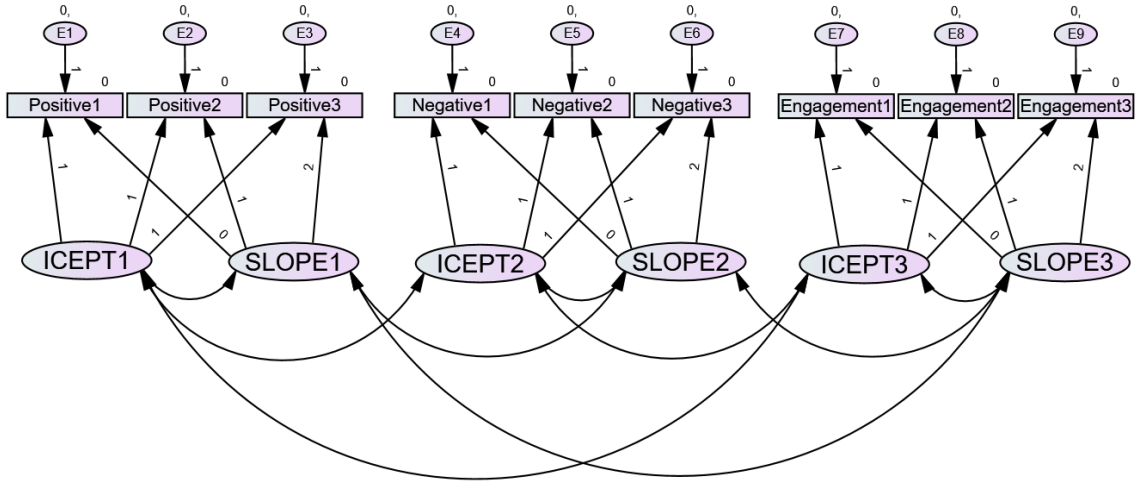
Administering the scales at multiple time points allowed the study to track both inter-individual and intra-individual variations in learners' emotional and behavioral experiences.

2.5. Data Analysis

The LGCM was used to answer the first research question. The LGCM approach provides researchers with a robust statistical framework for examining developmental trajectories over time. Rather than focusing solely on group-level averages, this technique captures individual differences by simultaneously estimating each participant's starting point, often referred to as the intercept, as well as their rate of change, or slope, over the course of the study (Duncan & Duncan, 2004). In doing so, LGCM not only highlights overall patterns of growth or decline but also reveals the extent to which individuals vary in their initial performance and in the pace and direction of their change (Duncan & Duncan, 2004). In the created LGCM model, three blocks aimed to measure the over-time changes in three variables (positive emotions, negative emotions, and engagement) (Figure 1). For instance, Positive1, Positive 2, and Positive 3 are the three scores obtained for positive emotions. The ICEPTs (intercepts) were set at 1 to set a baseline for the analyses, and the SLOPEs were given fixed values of 0, 1, and 2 to capture the growth. Accordingly, the covariances between ICEPTs and SLOPEs within each block represent the within-subjects changes for the given variable, and the covariances between the SLOPEs show the going togetherness among the three variables over time.

Figure 1

Proposed LGCM Model



Regarding the second research question, a "repeated measures multivariate analysis of variance" (RM MANOVA) was used to compare the changes between the treatment (TR) and control (CNT) groups. The assumptions of running this parametric test were checked to be in place. The LGCM analysis was run using IBM AMOS (version 26), and the RM MANOVA was run using IBM SPSS (version 29).

3. Results

Data were collected from control and treatment groups in three rounds of administrations to answer the two research questions of the study. The descriptive statistics of the collected data are presented in Table 1.

Table 1

Descriptive Statistics of Scores

			Minimum	Maximum	Mean	SD	Skewness
Control	Positive	Time1	15	75	57.913	10.681	-1.069
Group	emotions	Time2	15	75	58.681	11.001	-1.057

(N = 160)		Time3	15	75	56.781	11.304	-.953
	Negative emotions	Time1	27	117	60.150	17.909	.965
		Time2	26	108	53.419	16.168	1.095
		Time3	25	100	49.175	15.073	1.242
	Engagement	Time1	38	116	89.512	15.487	-.608
		Time2	35	114	93.219	15.977	-.924
		Time3	35	114	92.775	16.136	-.896
Treatment Group (N = 182)	Positive emotions	Time1	26	75	59.247	11.844	-.376
		Time2	27	75	61.643	11.657	-.700
		Time3	27	75	61.967	11.617	-.737
	Negative emotions	Time1	25	108	57.302	20.474	.389
		Time2	25	97	49.632	17.680	.588
		Time3	25	86	44.604	15.252	.723
	Engagement	Time1	51	120	88.978	14.672	-.171
		Time2	58	120	98.643	14.909	-.604
		Time3	50	120	100.901	16.177	-1.087

As reported in Table 1, the two groups had relatively different mean scores at the beginning. Both groups' mean scores of positive emotions and engagement grew over time, while their negative emotions declined. The inspection of the skewness values also suggested that all distributions were normal.

3.1. The Direction and Magnitude of Changes

To answer the first research question, an LGCM model (Figure 1, above) was created. The results of the analysis are presented in Table 2. The model with standardized estimates is also depicted in Figure 2.

Table 2

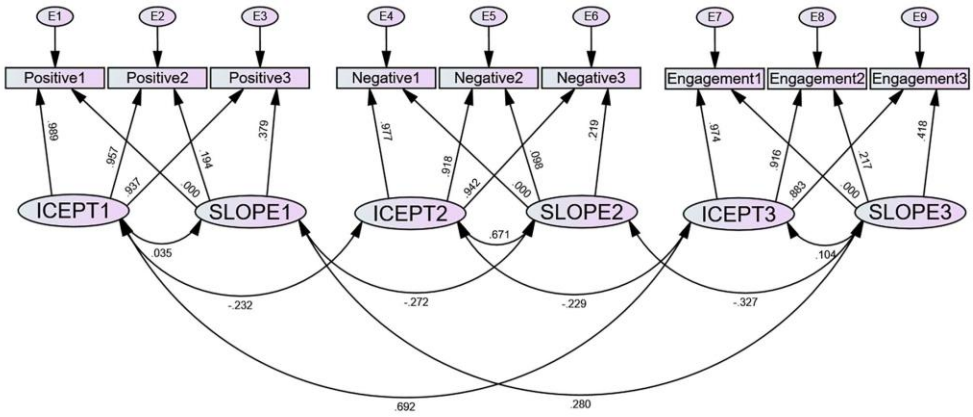
LGCM Results for Treatment and Control Groups

				Unstandardized				Standardized
				Estimate	S.E.	C.R.	P	Estimates
Covariances	ICEPT1	<-->	SLOPE1	.877	.738	1.189	.234	.035
	ICEPT2	<-->	SLOPE2	-30.773	3.220	-9.557	<.001	.671
	ICEPT3	<-->	SLOPE3	5.226	2.697	1.938	.053	.104
	ICEPT1	<-->	ICEPT2	-44.878	7.176	-6.254	<.001	-.232
	ICEPT2	<-->	ICEPT3	-57.863	9.445	-6.126	<.001	-.229
	SLOPE1	<-->	SLOPE2	-.935	.157	-5.964	<.001	-.272
	SLOPE2	<-->	SLOPE3	-1.718	.323	-5.318	<.001	-.327
	SLOPE1	<-->	SLOPE3	2.176	.315	6.912	<.001	.280
	ICEPT1	<-->	ICEPT3	112.127	10.909	10.278	<.001	.692
Variances	ICEPT1			124.027	9.729	12.749	<.001	
	SLOPE1			5.083	.954	5.329	<.001	
	ICEPT2			301.221	22.552	13.357	<.001	
	SLOPE2			2.330	1.715	1.359	.174	
	ICEPT3			211.983	17.379	12.198	<.001	
	SLOPE3			11.845	2.944	4.024	<.001	

		Unstandardized				Standardized
		Estimate	S.E.	C.R.	P	Estimates
Means	ICEPT1	59.087	.609	97.076	<.001	
	SLOPE1	.310	.087	3.562	<.001	
	ICEPT2	56.648	.945	59.949	<.001	
	SLOPE2	-5.484	.146	-37.625	<.001	
	ICEPT3	90.127	.807	111.734	<.001	
	SLOPE3	3.154	.182	17.359	<.001	

Figure 2

LGCM Model with Standardized Estimates



As reported in Table 2 and depicted in Figure 2, in the initial administration, there were significant correlations among the three variables: positive and negative emotions (r = -.232, p < .01); positive emotions and engagement (r = .692, p <.01); and negative emotions and engagement (r = -.229, p = <.001).

As for the changes over time, significant covariances were found between ICEPTs and SLOPEs of negative emotions, whereas non-significant results were found for positive emotions and engagement. This means that the extent of changes in the former significantly relates to their initial levels, while for the latter, the changes were heterogeneous among the participants. Moreover, the covariances among SLOPEs indicated that positive emotions, negative emotions, and engagement were significantly correlated in terms of their rate change. The highest correlation existed between the SLOPEs of negative emotions and engagement (r = -.327, p < .01), followed by the correlation between positive emotions and engagement (r = .28, p < .01). The lowest correlation existed between positive and negative emotions (r = -.272, p < .01).

Regarding the direction and extent of change, examining the changes in the means of SLOPEs revealed that the changes were significant and positive for positive emotions and engagement, while negative and significant changes were found for negative emotions. The change in negative emotions scores had the highest mean difference (MD = -5.48, SE = .146, p = <.001), while the lowest change was observed in positive emotions (MD = .31, SE = .087, p = <.001). The change in engagement scores was also significant (MD = 3.154, SE = .182, p = <.001).

Finally, the inspection of the variances showed significant values for the ICEPTS across all three variables, indicating heterogeneity of individuals at the outset of the study. However, the same heterogeneity in growth was only shown in positive emotions and engagement, whereas negative emotions showed homogeneity in growth.

3.2. The Difference in Two Groups

Next, to answer the second research question, the changes in the scores over time in treatment and control groups were compared using RM MANOVA. RM MANOVA assumptions were checked before running the test. Firstly, the assumption of independence of observation was met as

participants filled out the questionnaires individually. Regarding the normality, as reported above in Table 1, the skewness value for all distributions fell within the legitimate range of ±1.96. Moreover, the researcher visually inspected the relationships between pairs of variables and saw no sign of non-linearity. Regarding multicollinearity, the "variance inflation factor" (VIF) was calculated for all distributions, and the values ranged from 1.78 to 3.79, indicating no sign of multicollinearity (values above 10 are considered dangerous). As for the equality of error variances, no significant differences were found between the groups. The results are presented in Table 3.

Table 3

Equality of Error Variances and Multicollinearity Check

	Levene's Test Based on Median				
	Levene Statistic	df1	df2	Sig.	VIF
Positive1	2.655	1	340	.112	1.776
Positive2	2.220	1	340	.137	2.489
Positive3	1.106	1	340	.294	2.790
Negative1	2.905	1	340	.109	2.331
Negative2	3.249	1	340	.072	3.794
Negative3	1.009	1	340	.316	2.901
Engagement1	.159	1	340	.690	1.979
Engagement2	.147	1	340	.701	2.633
Engagement3	.203	1	340	.652	2.276

Finally, Box's test of equality of covariance matrices showed non-significant results, indicating that the assumption of homogeneity is met. Having all the assumptions in place, the test was run (Table 4).

Table 4

RM MANOVA: Test of Between-Subjects Effects

Source	Measure	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	Positive	3601722.231	1	3601722.231	9437.996	<.001	.965
	Negative	2803390.588	1	2803390.588	3203.094	<.001	.904
	Engagement	9029125.496	1	9029125.496	12837.773	<.001	.974
Group	Positive	2551.861	1	2551.861	6.687	.010	.019
	Negative	3563.609	1	3563.609	4.072	.044	.012
	Engagement	4808.182	1	4808.182	6.836	.009	.020
Error	Positive	129750.595	340	381.619			
	Negative	297572.575	340	875.213			
	Engagement	239130.469	340	703.325			

As reported in Table 4, the difference between the two groups for both positive ($F_{(1,340)} = 6.687$, $p = .01$, $\eta^2 = .019$, representing a small effect size) and negative ($F_{(1,340)} = 4.072$, $p = .044$, $\eta^2 = .012$, representing a small effect size) emotions was significant. Likewise, the engagement scores of the two groups ($F_{(1,340)} = 6.836$, $p = .009$, $\eta^2 = .02$, representing a small effect size) were significant. In all cases, the treatment group outperformed the control group, indicating the significant effect of the treatment.

4. Discussion

The present study aimed to track the developmental trajectories of multilingual English learners' achievement emotions and academic engagement in the context of GenAI-enhanced education. The study also sought to explore the contribution of translanguaging to multilingual learners' achievement emotions and academic engagement. The results indicated that both positive and negative achievement emotions of the multilingual learners significantly changed over the semester. Changes in these emotions also led to increased engagement. The outcomes are in line with previous studies that have reported the contribution of translanguaging pedagogy to the psycho-emotional states of language learners (e.g., Charamba & Ndhlovana, 2025; Ghafouri & Esmaeilee, 2024; Zhang, 2024). Similarly, the study concurs with a wealth of research that has demonstrated the link between GenAI adoption and emotionality in language education over recent years (Derakhshan, 2025; Huang et al., 2023; Zhou & Hou, 2024). The findings of this study, however, differ from the literature in that they are captured over a long period of time and through a complex analytical technique (i.e., LGCM) rather than one-shot studies on learners' emotions and GenAI technologies.

The study also underscores the theoretical conceptualization of translanguaging as a dynamic practice with dual functions of cognition and emotion (Back et al., 2020; Charamba & Ndhlovana, 2025; García, 2011; Song et al., 2022). The dynamism and contagious nature of emotions may explain these results, a claim supported by positive psychology perspectives and control value theory of emotions (Pekrun, 2006; Pekrun et al., 2017). The engaging essence of the translanguaging-infused course and the novelty of GenAI-powered education may have paved the way for experiencing positive achievement emotions more often and increased engagement, while also leading to fewer negative achievement emotions. The quality of the treatment and its content

can further justify the contribution of translanguaging to achievement emotions and engagement among multilingual learners. The need to strike a balance among the use of advanced technologies (e.g., GenAI), emotionality, and diverse linguistic repertoires by multilinguals may have contributed to this interplay and impact on the course. The potentiality of translanguaging pedagogy and GenAI technologies in regulating, boosting, and alleviating emotions may also explicate the outcomes obtained in this research (Charamba & Ndhlovana, 2025).

The study also revealed that multilingual students in the treatment group outperformed their peers in the control group in terms of scores for positive emotions, negative emotions, and academic engagement. Such a comparison evinces the efficacy of translanguaging-infused instruction, which empowered the treatment group to show higher scores in positive emotions and engagement and lower scores in negative emotions. Such changes in the emotional constructs, under the impact of translanguaging, theoretically align with the multidimensional nature of learner engagement (Hiver et al., 2021; Zhou et al., 2021) and achievement emotions (Derakhshan & Yin, 2024; Pekrun et al., 2017). Complexities in adopting GenAI technologies by multilingual learners may have required the participants to be emotionally engaged in the treatment, hence showcasing higher mean scores in terms of achievement emotions and classroom engagement (Huang et al., 2023; Zhou & Hou, 2024). This result is in agreement with Charamba and Ndhlovana (2025) and Song et al. (2022), who considered translanguaging as a practice that shapes and reshapes learners' social and emotional states. One justification could be the treatment group students' high emotional and GenAI literacy (Wang et al., 2025), which encouraged them to outperform their peers from pre-test to post-test.

The results can also be attributed to the participants' openness to diversity in receiving instruction and their acceptance of technology. An updated frame of reference and mentality may

have caused the treatment group learners to navigate achievement emotions and engagement despite the technical complexities of GenAI-mediated education and translanguaging pedagogy. They have probably perceived that success in language education is driven by multilingualism and emotionality (Kirkpatrick et al., 2025). What the study proves, in contrast to prior research, is the teachability of translanguaging using GenAI technologies to foster emotional experiences among multilingual individuals. All in all, the results of this study evince that the interplay of translanguaging pedagogy and GenAI can robustly generate and regulate learners' emotions in multilingual contexts.

5. Limitations and Future Directions

Although the study provided significant ideas about translanguaging, achievement emotions, and GenAI, it suffered from some limitations. First, the use of the purposive sampling technique poses a risk of selection bias in the interpretation and selection of the study sample. Second, the use of the treatment research design creates a possibility of human error, variable manipulation, and ethical implications. Future studies are recommended to use random sampling techniques and other designs that require no treatment. The impact and mediation of control and extraneous variables, such as GenAI literacy, demographics, and educational background of the students, on the results of this study have been ignored by the researchers. Future research is needed to control such intervening factors. Another limitation is that GenAI tools have been used in this study irrespective of their monomodality and multimodality. Future scholars can separately compare such tools and their influence on multilingual students' emotions and openness to translanguaging pedagogy. Diaries and reflective journals can be used in future longitudinal studies to better capture the dynamism and fluctuation of achievement emotions in light of translanguaging and GenAI technologies. Comparative studies are recommended to adopt a dual perspective, including both

multilingual teachers and students, regarding the topic examined in this research. Cross-cultural and cross-disciplinary studies are invited to investigate whether variations in the students' culture and majors play a role in their achievement emotions, engagement, translanguaging adoption, and GenAI acceptance. Validation studies can be done to develop scales that measure the interaction of translanguaging pedagogy, learner emotionality, multilingualism, and GenAI technologies.

6. Conclusions and Implications

The present study was an experimental endeavor to investigate the contribution of a translanguaging-oriented course on multilingual learners' achievement emotions and engagement in the context of GenAI–mediated education. The results indicated that translanguaging, as an emotional practice, could increase positive emotions, reduce negative emotions, and consequently enhance students' engagement in the classroom. It can then be concluded that translanguaging is by no means a simple instructional technique to encourage the use of the full linguistic repertoire of multilingual students in L2 classes. Instead, it is a socio-emotional practice that can bond with learners' emotionality and academic behaviors and practices in the classroom, even those mediated by AI tools. It is also asserted that translanguaging can be seen as a teachable and practically applicable practice in multilingual education to regulate achievement emotions and the degree of classroom engagement in the age of AI. The study also concludes that learners' achievement emotions (both positive and negative) are dynamic and subject to change due to translanguaging and GenAI technologies over extended periods of instruction. The successful integration of two innovative approaches to multilingual instruction, namely translanguaging and GenAI-mediated education, is also evident in the results.

The study, therefore, has implications for both theory and practice in different areas. It expands theoretical conceptualizations of translanguaging by demonstrating that it is an emotional

practice rather than a linguistically oriented activity in multilingual contexts. It also advances theories related to translanguaging by connecting it to GenAI technologies. In other words, the study updates the concept of translanguaging, making it more suitable for the age of AI. Another theoretical significance of this study is that it provides new insights into students' achievement emotions in the context of multilingualism, GenAI technologies, and translanguaging pedagogy rather than traditional language education. Positive psychology perspectives and control value theory of emotions may also evolve in light of the study's outcomes, as the dynamism of emotions is further highlighted through experimental evidence. The more controllability and positive appraisals multilinguals assign to translanguaging pedagogy and GenAI technologies, the more they may experience positive achievement emotions and classroom engagement.

On a practical level, the results are beneficial for multilingual teachers, as they understand the value and contribution of translanguaging pedagogy as an emotional practice in multilingual settings. They may replicate the practices and activities that were used during the treatment course in their actual classes to trigger positive achievement emotions and engagement in their learners in GenAI-mediated classes. The emotional literacy and GenAI literacy of teachers may also be enhanced in light of the results. Moreover, the study is significant for multilingual students in that it highlights the role of emotionality in translanguaging pedagogy and GenAI-mediated education. Their attitudes toward the adoption of innovative technologies may positively change when they see how GenAI tools can lead to positive emotional outcomes in learners and their learning. Multilingual teacher educators can use the results as motivators for designing and delivering professional development programs that are oriented and integrated by translanguaging pedagogy and GenAI technologies, to regulate learner emotions and behaviors in the classroom. Conceptual and practical workshops can be provided regarding learner emotions, translanguaging, and GenAI-

mediated education in the context of multilingualism. GenAI developers and AI bot designers can use the findings to update their products with a focus on catering to multilingual users and their emotions. Currently, most AI bots and chatbots lack emotionality and emotional understanding; hence, future releases can address these shortcomings.

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