



Digital selves in the Nigerian second language classroom: Modelling the structural relationship between AI-enhanced identity expression, growth mindset, language self-efficacy, and second language grit

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ABSTRACT

As artificial intelligence increasingly mediates second language learning, understanding its psychological implications has become vital. This study models how AI-enhanced identity expression influences learners' motivational dynamics by examining its direct and indirect impacts on growth mindset, language self-efficacy, and second language grit among Nigerian undergraduate students of a second language. Drawing on self-based and sociocultural motivation theories, the study suggests that projecting one's digital self through AI-mediated interaction cultivates adaptive beliefs that support perseverance in language learning. Data from 721 students were analysed using structural equation modelling with bootstrapped mediation. Results showed that AI-enhanced identity expression significantly predicted growth mindset, language self-efficacy, and second language grit, and that growth mindset and self-efficacy sequentially mediated the relationship between identity expression and grit. The final model explained a substantial proportion of variance across all motivational constructs. These findings advance the understanding of AI-mediated selfhood in second language learning by identifying identity expression as a psychological mechanism that transforms technological interaction into motivational resilience. Pedagogically, the study affirms the importance of identity-centred AI integration in strengthening learners' self-beliefs and perseverance in technology-enhanced second language classrooms.

Keywords: Artificial Intelligence; identity expression; second language; higher education; structural equation modelling

1. Introduction

The rapid development of artificial intelligence (AI) technologies is significantly transforming language instruction (Satvati et al., 2025). In higher education settings, AI-powered platforms offer adaptive content, personalised feedback, and interactive dialogue systems, creating more opportunities for

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language practice and learner independence (He et al., 2025). Beyond their teaching capabilities, these AI tools are also changing how learners interact with language, how they develop their identities as second language (L2) users, and how they view their roles in language learning (Li et al., 2025; Zhu & Wang, 2025). For example, emerging research on AI-mediated language learning suggests that such tools support skill development while also influencing learners' self-reflection, creativity, and subjectivity during mediated language tasks (Du & Daniel, 2024; Ekizer, 2025; He et al., 2025). Despite these changes, much of the existing literature remains focused on performance metrics (e.g., proficiency improvements, error correction) (Alshehri, 2025; Wu et al., 2025), and has given limited attention to the psychosocial aspects of AI use in language classrooms, including how learners present, negotiate, and perform their digital identities through AI-mediated interactions.

Recent scholarship has begun to recognise that language learning in digital contexts involves more than acquiring linguistic competence (Zhang & Yang, 2025). It also entails expressing and negotiating one's sense of self (Ramadan et al., 2024; Wang et al., 2021). Digital environments offer learners unique, semi-autonomous spaces in which they can experiment with stylistic choices, cultural voice, and identity enactment (Chan, 2022). In the domain of L2 learning, the concept of identity has been expanded by researchers to encompass how learners present, revise, and perform their target-language selves (Dörnyei, 2009; Papi, 2010). In this vein, the concept of AI-enhanced identity expression is introduced here to assess how learners project and refine their linguistic and cultural selves through interaction with AI systems. The concept is drawn from recent and past scholarship that clarified digital identity as digital identification, self-presentation, and the datafied self, each corresponding to specific facets of users' online experiences (Rowland & Estevens, 2024).

Empirical evidence from related fields suggests that more genuine or self-congruent expression in digital environments is associated with higher motivation and psychological well-being (Almayez et al., 2025; Laffier & Westley, 2025; Peters et al., 2018). For instance, in a large-scale study of social media users, Bailey et al. (2020) found that individuals whose online self-presentation closely matched their self-reported personality exhibited greater life satisfaction. Similarly, research on online self-presentation among adolescents indicates that authentic self-disclosure is associated with more explicit self-concept and better psychological outcomes (Yang et al., 2025). Meanwhile, in language learning, motivational beliefs such as growth mindset and self-efficacy have been shown to significantly influence persistence, strategy application, and achievement (Bai & Wang, 2020). A recent path analysis among Korean EFL students confirmed that a growth mindset predicted language self-efficacy, which in turn affected engagement and perceived proficiency (Kim, 2024). These findings suggest that identity-focused digital self-expression may strengthen motivational beliefs (mindset, self-efficacy) and, consequently, foster long-term learning traits, such as grit.

However, empirical models linking digital identity expression through AI tools with motivational constructs such as growth mindset, language self-efficacy, and L2 grit remain limited. Although recent research has begun to examine motivation, self-efficacy, and anxiety in AI-mediated language learning (Shao, 2024), the identity aspect remains under-theorised. As AI tools become increasingly embedded in educational practice, particularly in language classrooms, understanding these relationships becomes crucial for designing psychologically supportive learning environments—ones that promote skill development while also considering learners' evolving digital selves and motivational pathways.

In particular, the Nigerian higher education context offers a particularly relevant setting for this exploration. In the Nigerian education system, English serves as an L2 and an institutional language, facilitating academic mobility, socioeconomic advancement, and digital participation (Njoku, 2017). However, Nigerian university students often encounter tensions between globalised English norms and local linguistic identities (Ugwuanyi & McKenzie, 2025), making the negotiation of L2 self especially visible and significant. Within this context, we suggest that AI tools can act as sociocultural mediators that either enhance or limit learners' expression of identity and agency. Consequently, studying AI-supported identity expression among Nigerian L2 learners provides an opportunity to examine the linkages between identity and motivation within a multilingual and postcolonial environment.

2. Literature review: Conceptual clarification of variables

2.1. Identity Expression

Classic sociocultural accounts frame identity as emerging through talk (reflected in stance, style, and linguistic resources) rather than as a stable, internal essence, positioning language use as a form of identity work (Bucholtz & Hall, 2005). Building on this, Norton's investment model connects identity with learners' changing relationships to the target language and the social worlds it opens up. Identity is continually (re)negotiated as learners seek legitimacy, capital, and participation (Darvin, 2025). Motivation research further places identity within future-oriented self-guides that link who learners aspire to become with their persistence in language practices (Sun & Mu, 2023; Ushioda, 2011). Meta-analytic and comparative studies on the L2 Motivational Self System (L2MSS) emphasise both its explanatory power and the importance of differentiating "own" versus "other" standpoints in self-guides, cautioning against overly monolithic views of identity (Al-Hoorie, 2018; Dörnyei, 2009).

While the L2MSS concentrates on the internal visualisation of the ideal and ought-to selves as motivational resources (Dörnyei, 2009; Al-Hoorie, 2018), it tends to underrepresent how such selves are performed, contested, and reconstructed through AI-mediated interaction (Joseph, 2025). In contrast, AI-enhanced identity expression operationalises these self-guides in observable communicative acts, making the negotiation of the imagined L2 self a self-dialogic and co-constructed process with digital environments. As noted in previous studies, identity expression involves curating voice, negotiating audience, and calibrating authenticity (Laffier & Westley, 2025). Thus, AI-enhanced identity expression extends the traditional concepts of identity by emphasising human-AI co-authoring as a new domain of identity work. Recent research on AI chatbots in EFL has shown gains in confidence and increased participatory opportunities, although it also highlights under-theorised socio-psychological mechanisms and potential tensions surrounding authorship and voice (Du & Daniel, 2024; He et al., 2025). Emerging classroom studies similarly report that students balance AI and authenticity as they incorporate chatbot suggestions into their academic writing, raising questions about how identity is projected and negotiated in real-time (Werdiningsih et al., 2024).

However, within the broader CALL identity scholarship, AI tools can be seen as amplifiers of both opportunity and risk (Klimanova, 2021). Building on these ideas, the present study conceptualises AI-enhanced identity expression as a two-part process: (a) projecting a desired or imagined L2 self through AI-mediated text and dialogue, and (b) negotiating that self via selective acceptance or rejection of AI suggestions. This approach maintains the interactional core of identity (Bucholtz & Hall, 2005), the socio-political insight of investment (Darvin & Norton, 2015), and the future-self framework of L2MSS (Dörnyei, 2009), while identifying AI mediation as the mechanism through which identity expression becomes instructionally meaningful.

2.2. Language Growth Mindset

The concept of a growth mindset originates from Carol Dweck's research on implicit theories of intelligence, which compares a fixed mindset (the belief that ability is unchanging) with a growth mindset (the belief that ability can be developed) (Dweck, 2006). According to Dweck, learners with a growth mindset believe that intelligence and skills can improve through effort, practical strategies, and support; therefore, they welcome challenges instead of avoiding them (Dweck, 2006). In educational psychology, this belief system has been linked to motivated behaviour, resilience following setbacks, and a focus on learning rather than showcasing one's ability (Limeri et al., 2020). However, the idea of the growth mindset has faced some criticism. Some scholars argue that the original distinction is too broad and does not specify what can grow (for example, domain-specific skills, personality traits, language ability) and under what conditions (Yeager & Dweck, 2020). Others warn about the risk of a shallow "effort = growth" story that ignores strategy, context, and resources (Yeager & Dweck, 2019).

In the L2 context, the construct has been adapted as a language growth mindset, reflecting learners' belief that their language ability can improve through consistent effort, strategy, and interaction (Lou & Noels, 2019). Recent research has shown that a growth mindset in L2 contexts is often linked with self-efficacy and engagement and may not directly predict proficiency without these mediators (Kim, 2024). Building on these insights and addressing calls for more situational definitions (Yan & Schuetze, 2023), the present study conceptualises language growth mindset in the AI context as learners' belief that their language ability can specifically improve through AI-mediated effort, strategy use, and feedback.

2.3 Language Self-Efficacy

Rooted in social cognitive theory, self-efficacy refers to people's context- and task-specific judgments of ability, distinct from broader constructs such as self-concept or trait confidence (Bandura, 1977). Bandura's framework identifies four experiential sources of efficacy beliefs (i.e., mastery experiences, vicarious modelling, social persuasion, and physiological or affective states), which shape how learners assess and regulate their perceived competence. In applied linguistics, researchers emphasise that language self-efficacy (LSE) must be domain-specific, linked to specific L2 skills and task demands rather than general academic confidence (Graham, 2022). This realisation has led to the development of skill-level instruments (listening, reading, speaking, and writing) and multidimensional models of writing efficacy that distinguish ideation, linguistic conventions, and self-regulation as separate subcomponents. In technology-mediated learning, studies increasingly associate LSE with self-regulated learning strategies and demonstrate that language-specific effectiveness is reinforced through iterative feedback and adaptive tools (An et al., 2021). However, conceptual precision remains essential as recent proposals recommend mapping learners' confidence to their linguistic performance within digital platforms (Barkati et al., 2024; Wu, 2023). Accordingly, drawing from a recent definition (Wang et al., 2024), the present study defines LSE as learners' belief that they can successfully perform specific L2 tasks with AI acting as a scaffold.

2.4 L2 Grit

Originally defined as perseverance and passion for long-term goals, grit comprises perseverance of effort (PoE) and consistency of interest (CoI) (Duckworth et al., 2007). In language acquisition, the construct has been adapted as L2 grit, referring to learners' sustained effort and interest towards language learning goals (Demir, 2024). This conceptual position is supported by evidence that L2 grit relates to language motivation and achievement beyond general grit (Teimouri et al., 2022). Across empirical studies, a typical pattern is that PoE shows more consistent positive links to L2 outcomes than CoI. For example, Alamer (2021) validated L2 grit against vocabulary knowledge and reported stronger, more reliable associations for PoE, with CoI comparatively weaker. Similarly, Mikami's (2024) conceptual replication of the L2-Grit scale demonstrated discriminant validity and generalisability concerns, noting that perseverance aligns more robustly with achievement indices than consistency. In light of these debates, the present study adopts a context-anchored stance, viewing L2 grit as learners' enduring commitment (i.e., PoE) and a relatively stable alignment of interest (i.e., CoI) towards L2 mastery within AI-enhanced learning ecosystems. We assume grit's predictive utility increases when referenced to language- and task-specific timescales. Additionally, we treat L2 grit as analytically distinct from related constructs (e.g., self-regulation, conscientiousness), mindful of evidence that grit can overlap with these dispositions. Accordingly, we model L2 grit as correlates of AI-enhanced identity expression, growth mindset, and LSE, while recognising its dependence on situated beliefs and supports in AI-mediated classrooms.

3. Hypotheses Development

3.1. Direct Relationships

Recent research in applied linguistics positions AI-enhanced identity expression as a psychological mechanism through which learners project and negotiate their linguistic self-concepts in mediated

interaction (Hu et al., 2025). In these environments, identity work occurs as learners use generative tools to author, revise, and re-voice their texts, thereby performing their digital selves in iterative feedback loops (Hu et al., 2025). This self-expressive process parallels the construction of the ideal L2 self in motivation theory (Dörnyei, 2009). Consequently, it is theoretically consistent to expect that AI-enhanced identity expression fosters a growth mindset since self-projection through AI feedback normalises incremental progress and reframes errors as opportunities for development (Bai & Wang, 2020; Furey et al., 2025). Prior studies show that when feedback environments emphasise self-expression and autonomy, learners exhibit more growth-oriented beliefs about linguistic ability (Zhang, 2024).

At the same time, identity expression through AI feedback loops enhances LSE, as learners observe tangible improvements in the clarity, coherence, and sophistication of their language performance (Wu, 2023). Previous research on computer-assisted language learning (CALL) and AI-mediated writing suggests that such scaffolded authorship boosts confidence in performing linguistic tasks (An et al., 2021). Since sustained efficacy and adaptive belief systems are both close motivators of perseverance (Teimouri et al., 2022), we extend these ideas to L2 grit and suggest that learners who create digital selves using AI tools and adopt a growth-oriented mindset are likely to demonstrate higher LSE and, consequently, greater perseverance and consistent interest in AI-mediated learning contexts. Overall, these hypotheses examine whether identity-based motivational beliefs form a clear structural pathway linking AI-enhanced identity expression to growth mindset, LSE, and L2 grit. Therefore, we hypothesise that:

- H1.** AI-enhanced identity expression positively predicts growth mindset.
- H2.** AI-enhanced identity expression positively predicts language self-efficacy.
- H3.** AI-enhanced identity expression positively predicts L2 grit.
- H4.** Growth mindset positively predicts language self-efficacy.
- H5.** Growth mindset positively predicts L2 Grit.
- H6.** Language self-efficacy positively predicts L2 grit.

3.2. Mediation Effects

Emerging evidence suggests that identity-based engagement rarely directly influences persistence but rather operates through adaptive belief systems, such as growth mindset and self-efficacy, which convert experience into motivation (Bai & Wang, 2020). When learners articulate and refine their digital selves via AI feedback, they internalise incremental views of ability and interpret errors as opportunities for growth (Zeng et al., 2024). Within this recursive cycle, a growth mindset acts as a cognitive filter that reframes identity expression into enhanced self-efficacy, while LSE functions as a proximal motivational engine, transforming belief into sustained effort and persistence (Derakhshan & Fathi, 2024; Kim, 2024). Such layered interdependencies align with social cognitive and socio-affective models of L2 motivation, which see self-efficacy as a mediator between adaptive cognition and long-term perseverance (Al-Khresheh, 2025; Sun, 2023). Recent studies in AI-supported learning environments similarly reveal that confidence supports continued interaction with feedback systems (Bognár & Khine, 2025; Xu et al., 2025). Based on these converging insights, the present study hypothesises that:

- H7.** Growth mindset mediates the relationship between AI-enhanced identity expression and language self-efficacy.
- H8.** Language self-efficacy mediates the relationship between growth mindset and L2 Grit.
- H9.** The effect of AI-enhanced identity expression on L2 grit is serially mediated by growth mindset and language self-efficacy.

Figure 1 illustrates these hypotheses.

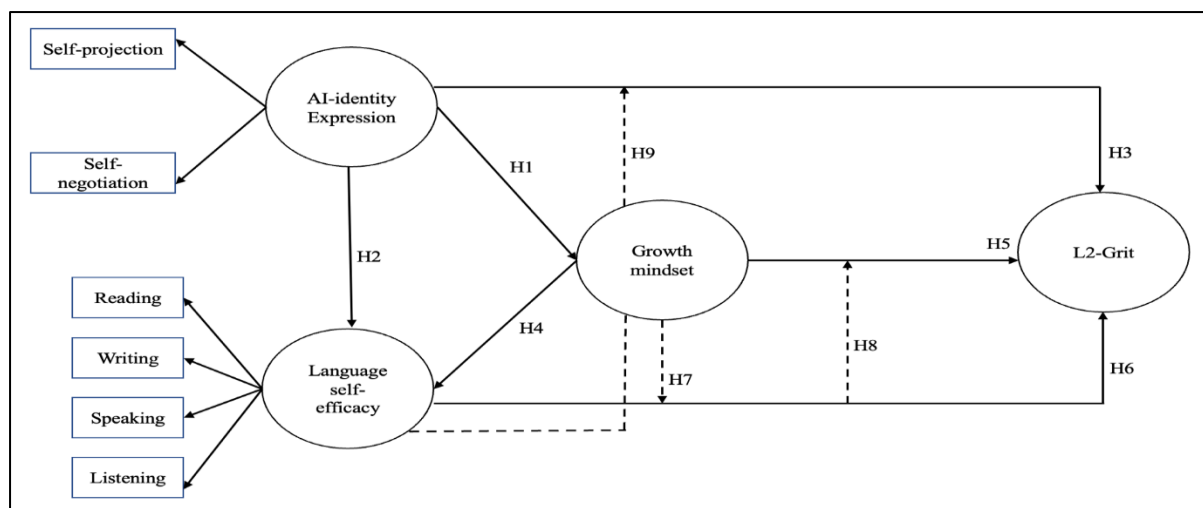


Figure 1. Conceptual diagram of the hypothesised model

4. Methodology

4.1. Design and Participants

This study employed a quantitative, cross-sectional survey design to investigate the structural relationships among AI-enhanced identity expression, growth mindset, LSE, and L2 grit. The design was suitable because it enabled the simultaneous estimation of both direct and indirect pathways within a structural equation modelling (SEM) framework. Participants were undergraduate students enrolled in universities across Nigeria, whose first language is English (L2). An initial screening question was included in the survey to determine eligibility by asking whether respondents had previously used AI tools for language learning or writing assistance. Those who answered “No” were automatically excluded to ensure relevance to the study. Although convenience sampling was used for accessibility, this inclusion criterion helped ensure that participants had the necessary exposure to AI-assisted language learning.

An initial recruitment protocol was established to guarantee ethical participation. Invitations were sent to students enrolled in various English language programmes. Interested participants registered using their institutional email addresses and mobile numbers. Then they received an information sheet outlining the study objectives, their rights to voluntary participation, withdrawal options, and data protection measures. After obtaining institutional ethical approval, an anonymous survey link was distributed to 849 registered students, with 721 providing valid responses, resulting in a response rate of 84.9%. Ethical assurances were reaffirmed at the beginning of the online questionnaire, which required participants to give digital informed consent before proceeding. The final sample includes participants with diverse gender identities, years of study, ages, and disciplinary backgrounds (see Table 1).

Table 1. Demographic profile of participants (n = 721)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	284	39.4
	Female	437	60.6
Age (years)	18 – 20	186	25.8
	21 – 25	372	51.6
	26 – 30	113	15.7
	31 +	50	6.9
Year of Study	First year	168	23.3
	Second year	209	29.0
	Third year	192	26.6

	Fourth year	152	21.1
Program	English language	281	39.0
	English Literature	172	23.9
	Linguistics	154	21.4
	English Education	114	15.8

4.2. Measures

The study employed four instruments, including a self-developed AI-Identity Expression Scale (AI-IES) and adapted versions of the Language Self-Efficacy Scale (LSES), Growth Mindset Scale (GMS), and L2 Grit Scale (L2-GS).

4.2.1. AI-Identity Expression Scale (AI-IES)

Given the absence of an established measure capturing identity processes in AI-mediated language learning, this study developed the AI-Enhanced Identity Expression Scale (AI-IES) to evaluate how learners project and negotiate their linguistic and cultural selves when using AI tools. The conceptualisation drew on Bucholtz and Hall's (2005) interactional theory of identity, Darwin and Norton's (2015) model of investment, Dörnyei's (2009) L2 Motivational Self System, and recent CALL scholarship positioning AI as an amplifier of both opportunity and risk in learner identity formation (Klimanova, 2021).

Rooted in these frameworks, the scale was developed as a two-part construct consisting of two theoretically derived dimensions: (a) projection of the desired L2 self, which assesses how learners utilise AI-mediated writing and dialogue to express or enact their imagined English-using identities (e.g., I use AI tools to convey the kind of English speaker or writer I aim to become), and (b) negotiation of self through AI Feedback, which reflects learners' agency in selectively accepting or rejecting AI suggestions to maintain linguistic authenticity (e.g., I decide which AI suggestions align with my personal way of using English).

An initial pool of twelve items was created based on previous qualitative insights and research on identity work in CALL and AI-assisted writing. After review by two applied linguistics scholars, the items were refined for clarity, simplicity, and relevance to Nigerian L2 learners, resulting in a final 10-item scale (five items per dimension). Responses were rated on a five-point Likert scale from 1 = Strongly disagree to 5 = Strongly agree, with higher scores indicating stronger AI-mediated identity expression.

4.2.2. Language Self-Efficacy Scale (LSES)

The LSES was created by Sağlam and Arslan (2018) to measure learners' confidence in performing key language tasks across the four skill areas of reading, writing, speaking, and listening. The original 22-item tool, validated with undergraduate English students, showed reliable psychometric qualities with acceptable model-fit indices ($\chi^2/df = 2.02$, RMSEA = 0.06, RMR = 0.04, GFI = 0.89, AGFI = 0.86, CFI = 0.95, NFI = 0.90), confirming construct reliability and factorial validity. To adapt the instrument for the current AI-supported L2 context in Nigeria, the items were adjusted to show learners' self-assessed ability to complete English tasks. The revised scale was reviewed by two language education specialists with published research in LSE, who assessed the items for clarity, relevance, and redundancy. Following their suggestions, the scale was reduced from 22 to 15 items to better suit the context, while maintaining balanced coverage of the four language domains. Responses were recorded on a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), with higher scores indicating greater perceived self-efficacy in using the English language.

4.2.3. Growth Mindset Scale (GMS)

The GMS was developed by Sigmundsson and Haga (2024) to measure learners' beliefs about the malleability of their abilities through effort and learning. The original instrument includes eight items rated on a five-point Likert scale ranging from 1 = Not like me at all to 5 = Very much like me. This response format, based on Likert's (1932) tradition, is widely used in motivational research due to its comparability with related constructs, such as passion and grit (Sigmundsson et al., 2020). In its original validation, the scale showed satisfactory internal consistency (Cronbach's $\alpha = 0.83$). For the present study, the wording of the items was adapted to the L2 context, reflecting learners' growth-oriented beliefs about English language learning. Two experts in language motivation reviewed the adapted items for semantic clarity, contextual relevance, and cultural suitability. After minor adjustments, all eight items were kept. Higher average scores indicate a stronger growth mindset orientation towards English learning.

4.2.4. L2 Grit Scale (L2-GS)

The L2 Grit Scale was developed by Teimouri et al. (2020) to measure students' perseverance and sustained interest in learning English as a foreign or L2. The instrument was designed explicitly as a language-domain-specific version of the general grit framework proposed by Duckworth et al. (2007). The scale comprises two sub-dimensions: (a) Perseverance of Effort (PoE), which captures learners' persistence in pursuing language goals despite difficulties, and (b) Consistency of Interest (CoI), which assesses the stability of learners' motivation and interest over time.

The original validation study confirmed strong psychometric properties, with twelve items retained after exploratory and confirmatory factor analyses—six items for perseverance (e.g., I will not give up learning English until I master it) and six items for consistency of interest (e.g., My interest in learning English changes from year to year). Items are rated on a five-point Likert scale ranging from 1 = Not at all like me to 5 = Very much like me, with higher composite scores indicating stronger L2 grit. For the present study, minor linguistic refinements were made to ensure cultural and contextual relevance for Nigerian L2 learners.

4.3. Instrument Validation

Because the LSES, GMS, and L2-GS were all adapted to the current study context, each was subjected to Confirmatory Factor Analysis (CFA) to verify construct validity and factorial stability. In contrast, the newly developed AI-IES underwent additional validation steps. This process included expert review and a cognitive interview with ten English and linguistics students, followed by Exploratory Factor Analysis (EFA) to identify the underlying factor structure and a subsequent CFA to confirm dimensional adequacy.

The initial version of the AI-IES was assessed by two specialists in applied linguistics and educational measurement. They reviewed each item for conceptual relevance, linguistic clarity, and its ability to represent the intended constructs (self-projection and self-negotiation) accurately. Three items were refined for accuracy and contextual fit, but no items were removed. After their evaluations, the Item Content Validity Index (I-CVI) was calculated at 0.83, showing strong agreement among experts and adequate content validity for a newly developed instrument. To further confirm face validity, cognitive interviews were carried out with ten English and Linguistics undergraduates. The students examined the wording of items and interpreted meanings aloud to spot ambiguities. Most items were rated as clear and relevant, except for one under the self-negotiation construct, which was adjusted for clarity: "I keep my own English writing style or ideas even when AI suggests different expressions."

Following the expert review and cognitive interview, the instrument was then subjected to EFA. The EFA began by examining the dataset's factorability. From Table 2, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.893, surpassing the recommended threshold of 0.80,

and Bartlett’s test of sphericity was significant, $\chi^2 (45) = 978.41, p < .001$, confirming that inter-item correlations were suitable for EFA. The principal component analysis (PCA) with varimax rotation identified two components with eigenvalues greater than 1. These components explain 67.49% of the total variance (Table 3). The scree plot (Figure 2) showed a clear break after the second component, further supporting a two-factor solution, which is consistent with the theoretical framework of self-projection and self-negotiation dimensions.

Table 2. KMO and Bartlett’s Test for Sampling Adequacy

Measure	Value
KMO measure of sampling adequacy	0.893
Bartlett’s test of sphericity $\chi^2 (45)$	978.41, $p < .001$

Table 3. Total variance explained for the AI-IES (PCA)

Component	Initial Eigenvalue	% of Variance	Cumulative %	Extraction Sums of Squared Loadings	% of Variance	Cumulative %
1	4.82	48.23	48.23	4.82	48.23	48.23
2	1.93	19.26	67.49	1.93	19.26	67.49
3	0.72	7.19	74.68			
4	0.56	5.64	80.32			
5	0.46	4.57	84.89			
6	0.39	3.93	88.82			
7	0.32	3.22	92.04			
8	0.29	2.94	94.98			
9	0.27	2.70	97.68			
10	0.23	2.32	100.00			

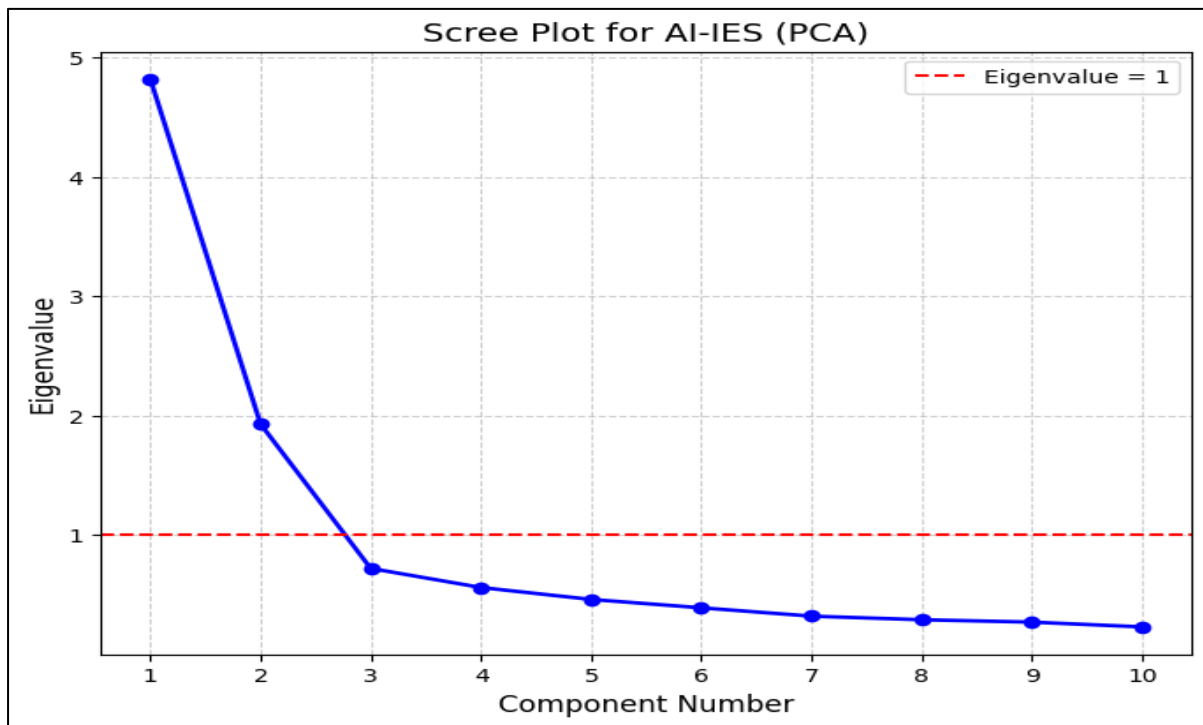


Figure 2. Scree plot for AI-IES

Subsequent rotated component analysis (Table 4) revealed that all items loaded strongly on their respective factors, with loadings ranging from 0.62 to 0.84, which are above the 0.40 benchmark for practical significance (Yusuf & Noor, 2023). The pattern confirmed a coherent two-factor model corresponding to *self-projection* and *self-negotiation*, and thus, provided empirical support for the dimensional adequacy of the AI-IES.

Table 4. *Rotated component matrix for the AI-IES*

Item	Component	
	1	2
I use AI tools to express the kind of English speaker or writer I want to become.	0.78	
I experiment with new ways of expressing my ideas in English using AI	0.81	
When using AI, I project my ideal English identity more confidently.	0.84	
I discover aspects of my English self that I want to develop with the help of AI	0.76	
I use AI tools to refine how I present myself when writing or speaking in English.	0.80	
I decide which AI suggestions fit my personal way of using English.		0.62
I keep my own style or ideas even when AI suggests different expressions.		0.69
AI feedback helps me think critically about my language choices.		0.71
I integrate AI suggestions only when they match what I want to say.		0.73
Using AI makes me more aware of how I shape my English identity.		0.68

Following the exploratory analysis of the AI-IES, all four instruments underwent CFA to confirm their underlying factor structures and overall measurement adequacy. All CFAs demonstrated satisfactory model fit based on established benchmarks: $\chi^2/df > 1.5$, RMSEA < 0.08 , SRMR < 0.08 , CFI > 0.90 , TLI > 0.90 , and GFI > 0.90 (Table 5). Each item showed a substantial standardised loading above 0.70, indicating strong representation of its intended construct (Figure 3). Evidence of convergent and discriminant validity was further supported by the average variance extracted (AVE), composite reliability (CR), and Cronbach's alpha (α). All constructs achieved AVE values exceeding 0.50, CR values above 0.70, and α coefficients greater than 0.70 (Tables 6-9), meeting recommended psychometric thresholds for internal consistency and construct validity. These findings confirm the factorial validity, reliability, and appropriateness of all instruments for subsequent structural modelling. The validated instruments are listed in the Appendix.

Table 5. *Model Fit Indices for the CFA Models*

Instrument	χ^2/df	RMSEA	SRMR	CFI	TLI	GFI
LSES	1.62	0.054	0.047	0.94	0.93	0.92
AI-IES	1.57	0.052	0.045	0.95	0.94	0.93
GMS	1.49	0.048	0.043	0.96	0.95	0.94
L2-GS	1.55	0.050	0.046	0.95	0.94	0.93

Table 6. *Convergent and discriminant validity of the AI-IES*

Construct	α	CR	AVE	1	2
1 = Self-projection	0.88	0.91	0.66	0.81	
2 = Self-negotiation	0.86	0.90	0.64	0.54	0.80

Table 7. *Convergent and discriminant validity of the LSES*

Construct	α	CR	AVE	1	2	3	4
1 = Reading	0.70	0.70	0.55	0.74			
2 = Writing	0.83	0.87	0.70	0.50	0.84		
3 = Speaking	0.87	0.92	0.78	0.56	0.46	0.88	
4 = Listening	0.75	0.76	0.58	0.50	0.53	0.41	0.58

Table 8. *Convergent and discriminant validity of the GMS*

Test	Values
α	0.82
CR	0.84
AVE	0.56

Table 9. Convergent and discriminant validity of the L2-GS

Test	Values
α	0.91
CR	0.94
AVE	0.70

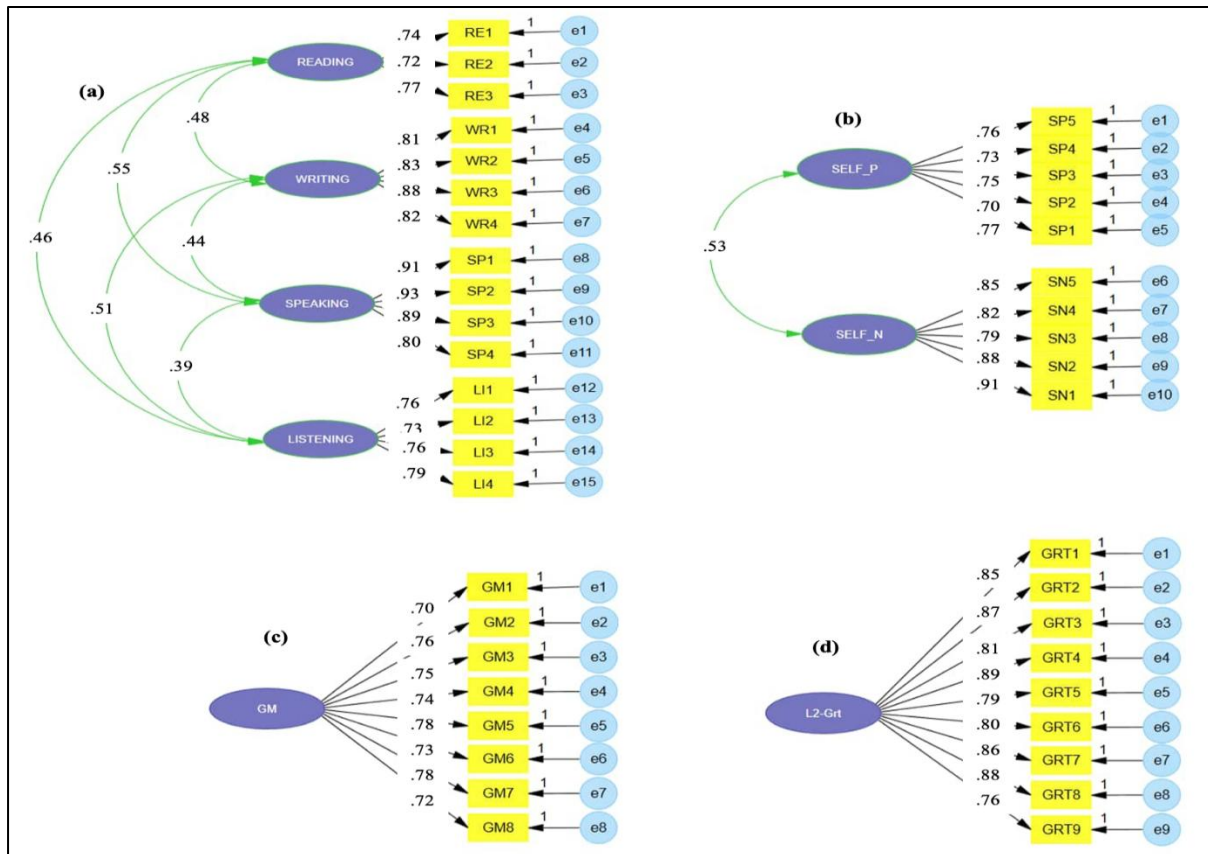


Figure 3. CFA path model for LSES (a), AI-IES (b), GMS (c), and L2-GS (d)

4.4. Analysis

Data were analysed using SEM to examine both the direct and indirect effects. Prior to the primary analysis, preliminary assumption tests were performed to check for multicollinearity using the variance inflation factor (VIF) and normality, as indicated by skewness ($|sk| = -1$ to $+1$) and kurtosis ($|ku| < 3$). After these checks, the hypothesised measurement and structural models were estimated with the maximum-likelihood method in AMOS v.29. Model adequacy was evaluated with multiple fit indices. To assess the significance of indirect effects, bootstrapping with 5,000 resamples and bias-corrected 95% confidence intervals was utilised.

5. Results

5.1. Preliminary Assumption Test

Before the primary analysis, initial assumption checks were conducted. Multicollinearity diagnostics showed no signs of redundancy among indicators, with all Variance Inflation Factor (VIF) values below the cautious threshold of 5.0 (Hair et al., 2021). Likewise, the normality test confirmed acceptable skewness ($|sk| = -1$ to $+1$) and kurtosis ($|ku| < 3$) across all observed variables, indicating approximate univariate normality suitable for SEM estimation. Tables 10 and 11 present the VIF and normality results, respectively, confirming that none of these assumptions were breached.

Table 10. *Collinearity statistics*

Construct	Mean VIF	Maximum VIF
AI-Enhanced Identity Expression	1.42	1.58
Growth Mindset	1.36	1.49
Language Self-Efficacy	1.40	1.55
L2 Grit	1.38	1.51

Table 11. *Normality test*

Construct	Skewness (sk)	Kurtosis (ku)
AI-Enhanced Identity Expression	-0.64	1.12
Growth Mindset	-0.52	1.47
Language Self-Efficacy	-0.71	1.83
L2 Grit	-0.58	1.65

5.2. Hypothesis Testing

Figure 4 displays the results of the structural model for both the direct and indirect relationships among the study variables. As illustrated, AI-enhanced identity expression significantly predicted growth mindset ($\beta = 0.44, p < 0.001$), LSE ($\beta = 0.39, p < 0.001$), and L2 grit ($\beta = 0.18, p = 0.004$). Similarly, growth mindset had significant positive effects on both LSE ($\beta = 0.46, p < 0.001$) and L2 grit ($\beta = 0.32, p < 0.001$). LSE also proved to be a strong predictor of L2 grit ($\beta = 0.38, p < 0.001$).

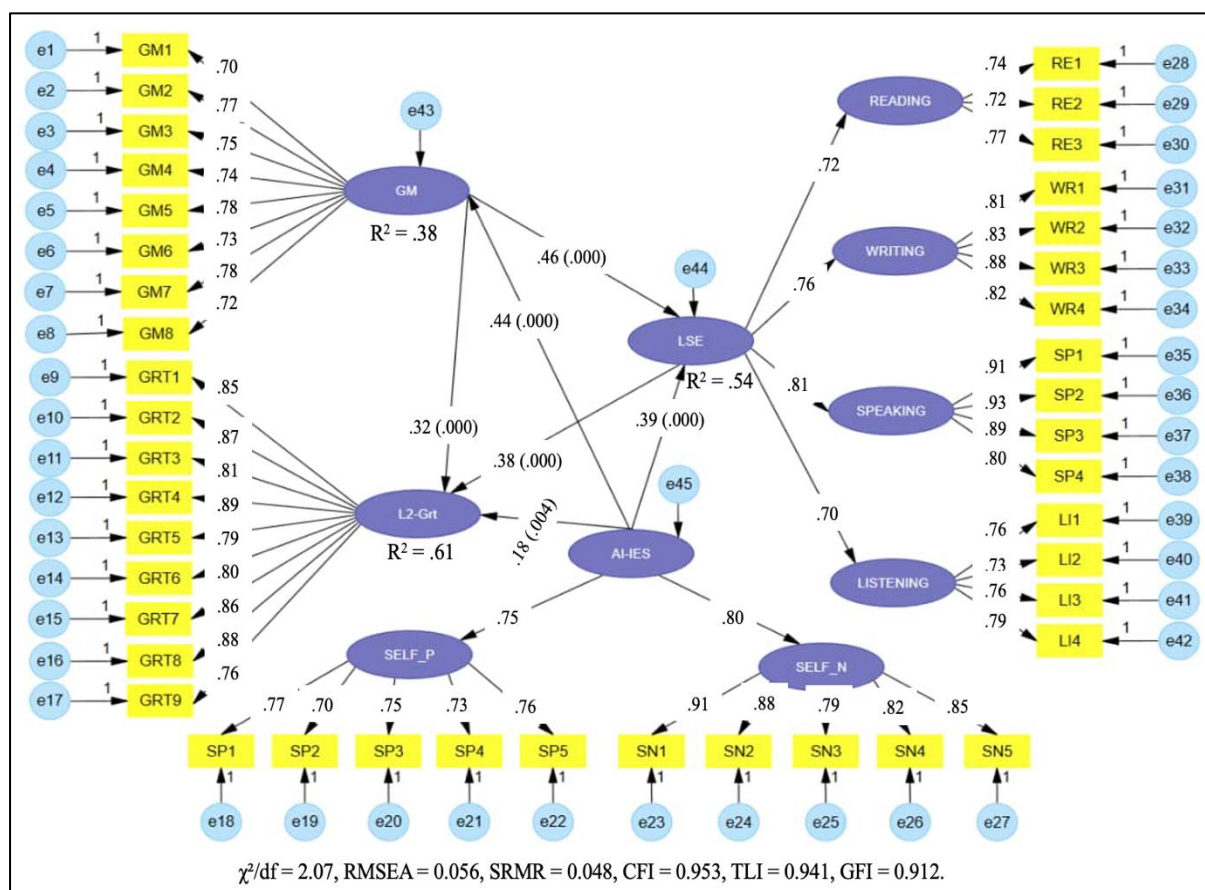


Figure 4. *SEM path model*

In terms of mediation, a growth mindset significantly transmitted the influence of AI-enhanced identity expression on LSE ($\beta = 0.20, p < 0.001$). In contrast, LSE mediated the relationship between growth mindset and L2 grit ($\beta = 0.17, p = 0.002$). The serial mediation pathway (from AI-enhanced identity

expression through growth mindset and LSE to L2 grit) was also significant ($\beta = 0.08$, $p = 0.025$). More details of the results can be found in Table 12.

Table 12. *Structural model results*

Path	Unst. Est. (β)	S. E	Std. Est. (β)	p-value	95% BcCI
AI-enhanced identity expression → growth mindset	0.42	0.06	0.44	< 0.001	[0.29, 0.56]
AI-enhanced identity expression → language self-efficacy	0.35	0.05	0.39	< 0.001	[0.26, 0.50]
AI-enhanced identity expression → L2 grit	0.21	0.07	0.18	0.004	[0.07, 0.36]
Growth mindset → language self-efficacy	0.47	0.05	0.46	< 0.001	[0.36, 0.59]
Growth mindset → L2 grit	0.33	0.06	0.32	< 0.001	[0.20, 0.47]
Language self-efficacy → L2 grit	0.41	0.06	0.38	< 0.001	[0.27, 0.54]
AI-enhanced identity expression → growth mindset → language self-efficacy	0.20	0.04	0.20	< 0.001	[0.12, 0.29]
Growth mindset → language self-efficacy → L2 grit	0.19	0.05	0.17	0.002	[0.08, 0.29]
AI-enhanced identity expression → growth mindset → language self-efficacy → L2 grit	0.10	0.03	0.08	0.025	[0.05, 0.20]

Note: Unst. Est. = unstandardized estimate, S.E. = standard error, Std. Est. = standardized estimate, BcCI = Bias-Corrected Confidence Interval

6. Discussion

6.1. Direct Effects

The analyses reveal that AI-enhanced identity expression has a notable positive impact on growth mindset, LSE, and L2 grit. Theoretically, this supports the longstanding view that identity work in language learning is closely linked to agency, authorship, and self-recognition (Bucholtz & Hall, 2005; Darvin & Norton, 2015). What sets the current findings apart is that identity work occurs not only through peer interaction or classroom participation but also via human-AI co-construction. This suggests that when learners experiment with voice, refine linguistic choices, or negotiate suggested revisions, they are not just creating text but also imagining and testing potential L2 selves. This performative process can make iterative improvement seem normal, strengthening the belief that abilities are adaptable (Norton & Toohey, 2011; Ushioda, 2011). It offers a plausible explanation for why AI-mediated identity expression can foster a stronger growth mindset.

The link between AI-enhanced identity expression and LSE similarly reflects sociocognitive principles but introduces a new dimension to them. Classical social-cognitive theory suggests that mastery experiences shape efficacy beliefs (Bandura, 1986), but most L2 research has interpreted such mastery as performance improvements (Golparvar & Khafi, 2021; Wang & Sun, 2020). The current findings indicate an additional pathway, involving identity-congruent output. This pathway suggests that when students perceive AI-assisted expression as more closely resembling the L2 self they aspire to, they experience a form of symbolic mastery. While existing AI-writing research reports enhancements in self-efficacy (e.g., Kızıldağ, 2025; Mekheimer, 2025), it rarely considers identity alignment as a

contributing factor. This diverges from previous studies by shifting the focus from performance outcomes to identity resonance as a mechanism for building confidence.

The pathways to L2 grit further develop this theoretical perspective. Grit in L2 learning has traditionally been associated with perseverance and long-term dedication (Teimouri et al., 2020). However, the current findings indicate that perseverance may be enhanced by both motivational dispositions and learners' perceptions of their evolving L2 identity within AI-supported exchanges. Based on these results, the authors suggest that if learners view AI-assisted drafting as helping them approximate a more competent or authentic version of themselves, the ongoing effort needed for language development can become more meaningful. This view extends beyond earlier grit research, which mainly regarded grit as a stable individual trait (Credé et al., 2017; Duckworth et al., 2007). Instead, the present findings position grit as partly dependent on identity processes, demonstrating that perseverance can be strengthened when learners feel more aligned with their imagined or emerging L2 selves (Norton, 2013; Papi et al., 2019).

6.2. Mediation Effects

The mediation analysis results uncover complex psychological processes that explain how AI-enhanced identity expression leads to long-term perseverance in language learning. Specifically, the results demonstrate that a growth mindset mediates the relationship between identity expression and LSE, and that self-efficacy then mediates the effect of the growth mindset on L2 grit. These pathways form a transparent serial mediation chain in which projecting one's L2 self through AI tools prompts a shift in belief systems, which then develops into confidence, and ultimately fosters perseverance. Although similar chain-mediation mechanisms have been reported in the broader L2 motivation literature (Kim et al., 2024), the current pattern differs in that it shows identity expression as the primary trigger.

Theoretically, this chain supports core social-cognitive arguments that beliefs about the malleability of ability (i.e., growth mindset) influence efficacy judgments, and that efficacy functions as the most immediate driver of persistent effort (Bandura, 1977). Recent L2 research reflects this dynamic. For instance, Ho et al. (2025) found that growth mindset language affected willingness to communicate only when self-efficacy acted as a mediator, emphasising that beliefs about improvement must be paired with beliefs about capability. The current findings extend this reasoning into an underexplored area: AI-mediated identity performance. Based on these premises, the authors suggest that when learners use AI tools to produce more polished, agentive, or coherent versions of their imagined L2 selves, they are not merely enhancing text quality; they seem to be engaging in a form of belief restructuring.

What distinguishes this mediation pattern as theoretically innovative is its suggestion that identity work acts as an initiating mechanism (Darvin & Norton, 2015). Instead of viewing grit merely as a result of dispositional traits or long-term motivational tendencies (Credé et al., 2017), the model proposes that perseverance can be influenced through short-cycle identity enactments mediated by AI. In essence, identity expression does not directly produce perseverance; instead, it triggers a psychological cascade that makes sustained effort meaningful and actionable. This positions self-efficacy as the essential hinge—where mindset guides direction, identity expression offers narrative grounding. However, grit only emerges when learners believe they can enact the identity they envision (Papi et al., 2019).

7. Implications

7.1. Theoretical Implications

The results report several important theoretical implications for understanding motivation and identity in AI-mediated language learning. First, the findings suggest that identity expression can serve as the initial step in motivational processes. This challenges models that typically view identity as a consequence of learning rather than as a force that influences the development of beliefs and attitudes. Second, the mediation pattern emphasises a more dynamic relationship between growth mindset and self-efficacy than many current models propose. Instead of acting as separate predictors, these two

beliefs form a developmental sequence activated through AI-mediated identity expression, offering a more nuanced view of how motivational beliefs interact. Third, the results demonstrate that grit responds to short-term experiences involving identity alignment, advancing theories that regard grit as a stable trait. Lastly, the study expands current perspectives on AI in language learning. Instead of perceiving AI tools solely as external supports for performance, the findings frame AI as a space where learners rehearse and develop their emerging L2 identities.

7.2 Practical Implications

The findings emphasise key actionable strategies for language educators and institutional stakeholders in AI-enhanced L2 contexts. Firstly, since AI-enhanced identity expression showed strong predictive links to growth mindset, self-efficacy, and grit, English teachers in Nigerian universities should intentionally design AI-supported tasks that encourage learners to self-project and negotiate their L2 self-image. For instance, educators could incorporate AI-writing tools or chatbot dialogues that enable students to experiment with different voices, rhetorical styles, or registers, thus making identity work visible and motivating.

Second, professional development for instructors must go beyond tool operation to include supporting identity-centred pedagogy and feedback-rich loops. Considering the mediation pathway through growth mindset and self-efficacy, training should enable teachers to foster belief-changing dialogues, assist students in critically interpreting AI suggestions, and incorporate reflective prompts. Third, at the institutional level, curriculum designers and administrators should purposefully integrate AI tools. This involves aligning AI tasks with students' long-term language goals, scheduling iterative feedback cycles, and tracking students' progress in self-efficacy. As ethical and equity concerns related to AI in education become increasingly documented, Nigerian institutions must establish transparent policies, promote data literacy, and ensure inclusive access to guarantee that identity-related work through AI remains equitable.

8. Limitations and Recommendations

Despite the study's implications, several limitations were acknowledged. First, the cross-sectional design restricts the ability to draw firm conclusions about cause and effect. The relationships among identity expression, mindset, self-efficacy, and grit probably evolve, and a single snapshot cannot determine the direction or speed of these changes. Future research could employ longitudinal or experimental methods to investigate how identity enactment through AI tools affects motivational beliefs and perseverance at various learning stages. Second, although the sample size was substantial, students were solely recruited from Nigerian universities. While this setting provides valuable insights, it may not represent how learners in other regions experience AI-mediated identity expression, particularly in environments with differing technological infrastructure or cultural norms regarding language use. Comparative studies across various countries or educational institutions would help identify which patterns are universal and which are specific to particular contexts. Third, the study relied on validated self-report measures. Although these tools effectively capture internal beliefs, they cannot fully represent the complexity of learners' interactions with AI tools. Incorporating behavioural or linguistic data (such as AI-generated drafts, revision histories, or interaction logs) would enable researchers to trace how identity expression actually develops during task performance. Combining these behavioural traces with self-report measures could provide a more comprehensive understanding of how learners interpret, evaluate, and internalise AI-mediated experiences. Finally, the study focused on individual psychological variables. Future research could be expanded by examining social or classroom-level factors, such as peer collaboration, teacher scaffolding, or institutional policies, that influence how students utilise AI tools. These broader influences may help explain why some learners build strong identity–motivation pathways while others do not.

8. Conclusion

This study examined the impact of AI-enhanced identity expression on key motivational beliefs in the L2 classroom, with a specific focus on growth mindset, LSE, and L2 grit among Nigerian undergraduates. The results indicate that when learners utilise AI tools to project, refine, and negotiate their L2 identities, these experiences translate into increased confidence and perseverance. The serial

mediation pattern shows that mindset and self-efficacy form a significant motivational sequence, explaining how identity work develops into sustained effort. Theoretically, the study advances existing models of language learner psychology by viewing identity expression as a catalyst within the motivational system. Practically, the findings reveal the importance of instructional designs that provide learners with space to experiment with their voice, express emerging L2 identities, and interpret AI feedback constructively. These insights point towards an evolving perspective of AI in the language classroom as a meaningful environment for identity development and motivational growth.

Declarations

- **Ethical Approval and Consent to Participate**

This study received ethical approval from the Institutional Review Board of Sokoto State University. All participants were thoroughly informed about the study's goals and methods, and they provided written consent prior to data collection. Participation was entirely voluntary, and the study ensured anonymity and confidentiality at all stages.

- **Competing Interests**

The author declares that there are no competing interests or potential conflicts of interest related to this research.

- **Funding**

No external funding was received for this research.

- **Author Contributions**

The author was exclusively responsible for conceiving, designing, collecting data, analysing, interpreting the study, and also for drafting and revising the manuscript.

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- **Disclosure of AI usage**

In this assignment, I used Grammarly Premium for language editing and proofreading. The outputs were reviewed, adapted, and integrated into my own work, which reflects my personal understanding and complies with the academic integrity policies of my institution.

- **Data availability statement**

The data are available on request from the corresponding author.

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Appendices

Growth Mindset Scale
Adapted from Sigmundsson & Haga (2024)

S/N	Items	Not like me at all	Not much like me	Somewhat like me	Mostly like me	Very much like me
1	I know that with effort I can improve my English skills.					
2	I can influence and change my English development.					
3	I can improve my English through regular practice.					
4	I like to take new English challenges.					
5	I see learning English as my main goal.					
6	Effort makes me a better English learner.					
7	I want to spend more time improving my English with AI tools.					
8	I have faith in my English ability and my potential to grow.					

L2 Grit Scale
Adopted from Teimouri et al. (2022)

S/N	Items	Not like me at all	Not much like me	Somewhat like me	Mostly like me	Very much like me
1	I am a diligent English language learner.					
2	My interests in learning English change from year to year					
3	When it comes to English, I am a hard-working learner.					
4	I think I have lost my interest in learning English					
5	Now that I have decided to learn English, nothing can prevent me from reaching this goal.					
6	I will not allow anything to stop me from my progress in learning English.					
7	I am not as interested in learning English as I used to be.					
8	I was obsessed with learning English in the past but have lost interest recently.					
9	I put much time and effort into improving my English language weaknesses.					

English Language Self-Efficacy Scale
Adapted from (Sağlam & Arslan, 2018)

S/N	Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am confident that I can...						
Reading						
1	Understand short English articles or online texts					
2	Understand English news or magazine content.					
3	Comprehend English stories or book excerpts.					
Writing						
4	Write English texts with correct spelling and punctuation.					
5	Revise my English writing to improve grammar and coherence.					
6	Identify and correct my own mistakes when writing in English.					
7	Write English exams					
Speaking						
8	Make short dialogues in English.					
9	Express myself clearly in informal conversations.					
10	Speak about a given topic in English without much preparation.					
11	Express my feelings and thoughts in different forms in English.					
Listening						
12	Understand English conversations in videos or classes.					
13	Follow English songs or podcasts.					
14	Do listening activities that involve answering questions or writing what I hear.					
15	Write what I hear while listening to English.					

AI-Enhanced Identity Expression Scale (AI-IES)
Self-developed

S/N	Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Self-Projection						
1	I use AI tools to express the kind of English speaker or writer I want to become.					
2	I experiment with new ways of expressing my ideas in English using AI					
3	When using AI, I project my ideal English identity more confidently.					
4	I discover aspects of my English self that I want to develop with the help of AI					
5	I use AI tools to refine how I present myself when writing or speaking in English.					
Self-Negotiation						
1	I decide which AI suggestions fit my personal way of using English.					
2	I keep my own style or ideas even when AI suggests different expressions.					
3	AI feedback helps me think critically about my language choices.					
4	I integrate AI suggestions only when they match what I want to say.					
5	Using AI makes me more aware of how I shape my English identity.					