

How formal and informal English use predict self-perceived and actual L2 proficiency: The mediation of emotions

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Abstract

The study investigates the mediation of enjoyment and anxiety in the influence of informal digital use of English (IDUE), family English use (FEU), and classroom English use (CEU) on self-perceived and actual L2 proficiency. Partial Least Squares Structural Equation Modeling (PLS-SEM) was conducted to analyze data from 531 young EFL learners in secondary schools. Results showed that only CEU directly affected actual L2 proficiency. IDUE, FEU, and CEU showed significant indirect effects on self-perceived L2 proficiency through the mediation of enjoyment, whereas no such effects were reported for actual L2 proficiency. Anxiety significantly mediated the influence of CEU on self-perceived and actual L2 proficiency, but not those of IDUE and FEU on the outcome variables. Further, the interaction between IDUE and FEU negatively and significantly predicted self-perceived proficiency. The findings enrich L2 learning research by jointly modeling different learning ecologies and revealing differential mediating mechanisms of learner emotions and the interaction between different ecologies of informal English use.

Keywords

informal digital use of English; classroom English use; family English use; emotions; Chinese EFL learners

Introduction

The learning ecology comprises diverse learning activities across both formal and informal contexts (Barron, 2004). English learning unfolds across multiple ecologies, such as IDUE, FEU, and CEU. These ecologies differ in their spatial-temporal characteristics, learning attributes, and scope of learner control, and provide different

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configurations of activities, resources, and interactions (Lai & Sundqvist, 2026). IDUE, or “self-directed, informal English learning using a range of different digital devices (e.g. smartphones, desktop computers) and resources (e.g. web apps, social media) independent of formal contexts” (Lee, 2019, p. 768), has attracted increasing attention with the rapid advancement of digital technologies. IDUE may provide abundant and authentic language exposure and opportunities for self-directed learning (Lai & Zheng, 2018). Unlike more individualized forms of informal digital learning, FEU is embedded in family routines and relationships. Different from informal language learning, CEU tends to occur in institutionalized and pedagogically structured settings (Tecedor, 2016). From a usage-based perspective, learners’ language use plays an important role in their L2 development (Ellis & Wulff, 2020). Accordingly, IDUE, FEU, and CEU are conceptualized as antecedent learning conditions that may shape learners’ L2 proficiency by providing opportunities for English use. Consistent with the view that formal and informal language use should be understood in relation to one another rather than as isolated domains (Lai & Sundqvist, 2026), it is therefore crucial to investigate how these English-use ecologies jointly shape learners’ L2 proficiency.

English use may also influence learners’ emotions (e.g., Lee et al., 2024a; Zou et al., 2026). Specifically, research has shown that technology-mediated language learning can shape learners’ emotional experiences (Derakhshan & Li, 2026; Derakhshan & Park, 2026), suggesting that learners’ IDUE practice may similarly shape their positive and negative emotions. FEU, another form of informal English use that often occurs in relationally supportive environments, may shape learners’ emotions by providing emotional security and low-pressure opportunities for English practice. Additionally, CEU may influence emotions through instructional support and classroom evaluation. The emotions may, in turn, contribute to learners’ L2 proficiency (e.g., Alqarni, 2024; Gao, 2024). However, insufficient research has been conducted to investigate whether the paths from these ecologies of English use to L2 proficiency are mediated by emotions. Given that foreign language enjoyment (FLE) and foreign language anxiety (FLA) are regarded as typical positive and negative emotions in L2 learning (Dewaele & MacIntyre, 2014), they may serve as important mediators between English-use ecologies and L2 proficiency.

The proposed mediating roles of FLE and FLA in the relationship between English use and L2 proficiency are theoretically grounded in self-determination theory (Ryan & Deci, 2017, 2020) and broaden-and-build theory (Fredrickson, 2001). According to self-determination theory, learners’ well-being and emotions are shaped by the satisfaction of their basic psychological needs, including autonomy, competence, relatedness, and novelty (González-Cutre et al., 2016; Ryan & Deci, 2017, 2020). English use in the classroom, family, and informal digital settings may satisfy these needs and shape learners’ emotional experiences. Specifically, IDUE provides self-directed learning experiences (Lee, 2022) and novel content that may satisfy learners’ needs for autonomy and novelty, potentially contributing to an increased level of enjoyment while alleviating anxiety. Similarly, FEU occurs in relationally supportive contexts that may satisfy relatedness needs, which can promote enjoyment and reduce anxiety. CEU may fulfill the needs for competence through structured instruction and feedback, and relatedness through teacher and peer support, thus increasing enjoyment and reducing anxiety. In turn, broaden-and-build theory posits that positive emotions can broaden the range of thoughts and actions available to learners and foster the development of personal resources, whereas negative emotions may narrow this range and constrain the development of such resources (Fredrickson, 2001). Through these mechanisms, FLE and FLA may differentially affect learners’ L2 proficiency.

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Further, it is important to differentiate between self-perceived proficiency (SPP) and actual proficiency (AP). Existing studies have adopted different approaches to assessing learners' L2 proficiency (Alrabai, 2025; Gao, 2024; Tang et al., 2024). The findings suggest that SPP and AP may be influenced by different underlying mechanisms. Examining the mediating relationships is crucial for revealing how different forms of English use relate to perceived and actual L2 proficiency through affective mechanisms. While informal digital learning of English (IDLE) provides learners with rich authentic input, engaging in informal language use is not automatically seamless; negative emotional factors such as anxiety, peer judgment, and lack of self-efficacy can create strong hesitation among learners (Nguyen, 2026). This reluctance highlights the complex affective mechanisms that mediate between language exposure and actual linguistic development.

Therefore, this study aims to investigate the mediation of FLE and FLA in the paths from IDUE, FEU, and CEU to SPP and AP and the interaction effects of these exogenous variables on endogenous variables by focusing on Chinese secondary school students. This group of young learners deserves further investigation because they are in a key developmental stage for L2 learning (Sun et al., 2024). The Chinese context is particularly informative for several reasons. With the rapid growth of digital technologies, Chinese EFL learners are increasingly exposed to English beyond the classroom through informal digital learning (Liu et al., 2025a), yet such digital English use remains relatively new and may evoke unique affective challenges (Teng, 2024). At the same time, English remains a high-stakes school subject in Chinese education, where classroom learning and family support are often closely tied to examination success. This context may provide new insights into how different forms of English use shape learners' emotions and their L2 proficiency. The findings of the study could enrich self-determination theory and broaden-and-build theory and help educators develop effective strategies to support students' L2 development.

Literature Review

Language use and L2 proficiency

The current literature has shown an association between language use and L2 proficiency. For example, Zou et al. (2025) surveyed Chinese university students and reported that IDUE significantly predicted L2 achievement. IDUE was also found to positively influence L2 vocabulary (e.g., Lee & Dressman, 2018; Sundqvist, 2019) and L2 speaking proficiency (e.g., Lee & Dressman, 2018). Additionally, Azzolini et al. (2022) highlighted the roles of formal classroom instruction and informal English exposure in promoting learners' L2 competence. In their study on EFL learners in Hong Kong, Tsang (2025) investigated how different types of input relate to listening proficiency. It was found that formal input did not significantly correlate with SPP or AP and that extramural exposure significantly predicted these outcome variables.

Language use and emotions

Language use was also found to be associated with emotions. In their research on FL students in Spain, Acosta-Manzano et al. (2024) found that informal language use was positively correlated with enjoyment but negatively correlated with anxiety. In addition, Lee et al. (2024a) collected data from Korean secondary and tertiary EFL learners and reported that IDUE positively predicted enjoyment. Zou et al. (2026) surveyed Chinese and Iranian university students and reported that IDUE significantly predicted enjoyment among Chinese EFL learners but not among the Iranian group. The above

findings echo those of Zhang (2026), who noted the role of digital tools in shaping learners' emotions. Further, Liu and Zhao's (2026) review demonstrated that learners' self-directed engagement with digital tools may promote enjoyment and alleviate anxiety.

Emotions and L2 proficiency

Multiple studies have reported inconsistent findings on the relationship between emotions and L2 proficiency. Some studies have shown the positive influence of enjoyment on SPP (e.g., Tang et al., 2024; Zhao et al., 2026) and AP (e.g., Alqarni, 2024; Dewaele & Botes, 2025). Alqarni (2024) surveyed university students in Saudi Arabia and reported that learners' enjoyment significantly and positively predicted their GPA. Longitudinal evidence has further demonstrated that language learning motivation significantly predicted perceived gains in online English learning over time (Teng, 2025). However, other research has shown that the relationship between the above variables failed to reach statistical significance. In their study on English learners in universities and secondary schools, Dewaele et al. (2022) found that enjoyment did not show a significant effect on test scores. In addition, some studies have revealed that anxiety was found to be associated with SPP (e.g., Gao, 2024) and AP (e.g., Alrabai, 2025; Dewaele et al., 2022; Hu et al., 2024; Li & Han, 2022). Gao (2024) collected data from Chinese university students and reported that anxiety significantly and negatively affected SPP. In their study on Chinese primary school students, Hu et al. (2024) observed a negative correlation between anxiety and test scores.

Previous research has revealed different findings regarding the relative strength of the effects of enjoyment and anxiety. Some reported that anxiety had a stronger effect on L2 learning outcomes than enjoyment. For example, Dewaele et al. (2022) found that anxiety had a larger effect on academic achievement than enjoyment. However, other studies showed contradictory findings. Li and Li (2023) examined the influence of learner emotions on achievement over time. Results showed that enjoyment was the strongest and most enduring factor influencing learners' academic achievement over nine weeks, whereas anxiety only significantly predicted L2 achievement in the first six weeks.

Conceptual Framework

Drawing upon self-determination theory and broaden-and-build theory, we propose a conceptual framework that positions FLE and FLA as dual mediators in the relationship between English use and L2 proficiency. The proposed directional ordering is theoretically grounded in the usage-based perspective, which emphasizes the role of accumulated language-use experience in L2 development (Ellis & Wulff, 2020). From this perspective, these English-use ecologies are conceptualized as antecedent learning conditions that may influence L2 proficiency. These ecologies may also shape learners' emotional experiences by providing distinct configurations of psychological need satisfaction. Specifically, IDUE is proposed to fulfill learners' needs for autonomy through self-directed learning (Lee, 2022), and for novelty through exposure to novel digital content. FEU is posited to satisfy the relatedness need through family bonding and relational support. In addition, CEU is proposed to fulfill the needs for competence through structured instruction and feedback, and for relatedness through teacher and peer support. According to self-determination theory, the satisfaction of these needs promotes positive emotions such as FLE and reduces negative emotions such as FLA (Ryan & Deci, 2017, 2020). FLE and FLA, in turn, may transmit the influence of English-use ecologies to L2 proficiency through distinct mechanisms. According to

broaden-and-build theory, FLE may broaden the range of thoughts and actions available to learners and foster the development of personal resources, whereas FLA may narrow the range and restrict learners' attentional scope (Fredrickson, 2001), thereby differentially influencing L2 proficiency. Furthermore, the framework considers potential interaction effects among the three types of English use, reflecting the complex dynamic systems perspective that multiple learning ecologies interact in non-linear ways (Marek & Wu, 2014).

Based on the conceptual framework, we posed the following hypotheses (see Figure 1):

- H1a-1b: IDUE positively predicts SPP/AP.
- H2a-2b: FEU positively predicts SPP/AP.
- H3a-3b: CEU positively predicts SPP/AP.
- H1c: IDUE positively predicts FLE.
- H1d: IDUE negatively predicts FLA.
- H2c: FEU positively predicts FLE.
- H2d: FEU negatively predicts FLA.
- H3c: CEU positively predicts FLE.
- H3d: CEU negatively predicts FLA.
- H4a-4b: FLE positively predicts SPP/AP.
- H4c-4d: FLA negatively predicts SPP/AP.

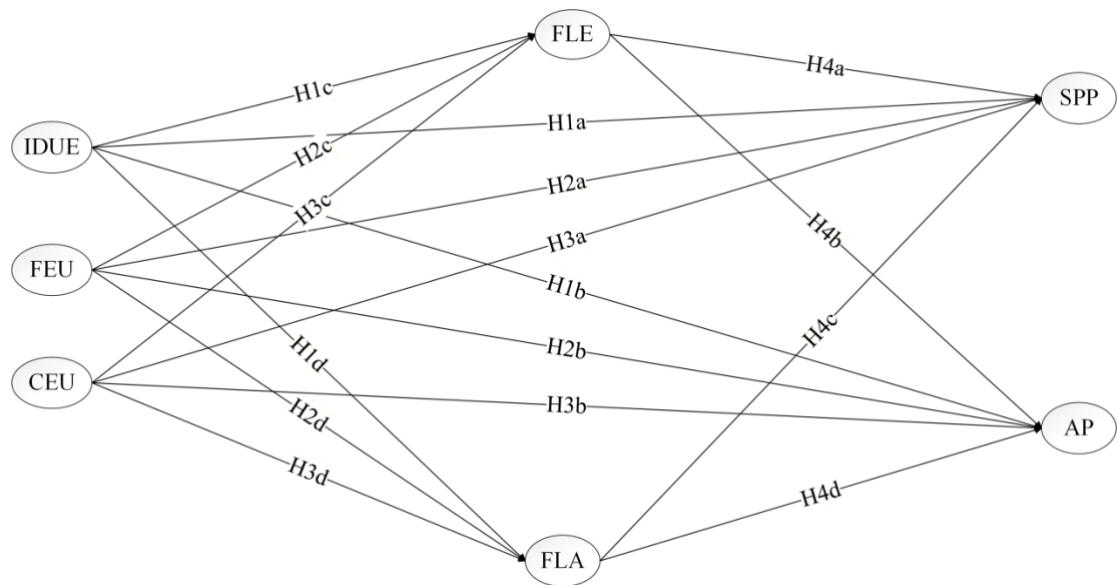


Figure 1. *The conceptual framework*

Methodology

Context and participants

The study recruited 586 students through convenience sampling with attempts to include diverse secondary schools in China. Schools were selected from both urban and rural areas to ensure regional diversity. The sample covered regions at different levels of socioeconomic development, ranging from highly developed areas to less-developed regions. The screening criteria were as follows. Responses were considered invalid if participants consistently selected the same scale option or if participants' English learning experience or proficiency was inconsistent with the construct and intended

difficulty level of the proficiency test. After the screening of invalid data, 531 responses were retained for data analysis. The final sample came from 67 junior high schools and 39 senior high schools in China. There were 343 junior high school students (64.60%) and 188 senior high school students (35.40%). Participants included 276 males (51.98%) and 255 females (48.02%). Their ages ranged from 12 to 18 ($M = 15.21$, $SD = 1.80$). Among them, 175 students (32.96%) attended schools in urban areas, and 356 students (67.04%) attended schools in rural areas.

Instruments

The instruments included the following three parts. The first part was used to collect participants' demographic information, such as gender, age, and educational level. The second part consisted of the Likert scales designed to measure CEU, FEU, IDUE, FLE, FLA, and SPP. The third part was used to assess learners' AP.

The FLE scale was designed based on Dewaele and MacIntyre (2014) and the Programme for International Student Assessment for math learning (OECD, 2013). Following the expert review and the practice in previous studies (e.g., Liu et al., 2024), items that made reference to the teacher and classroom atmosphere were removed. Five items were used to examine the enjoyment experienced by Chinese EFL learners. Responses were measured on a 5-point Likert scale from 1 = *strongly disagree* to 5 = *strongly agree*. Participants' FLA was measured through the short-form foreign language classroom anxiety scale (Botes et al., 2022). Responses to the eight items were assessed on a 5-point Likert scale from 1 = *strongly disagree* to 5 = *strongly agree*.

The IDUE scale was adapted from Jurković (2019), Lee and Dražati (2019), and Lee and Lee (2021). Six items were used to examine the frequency of IDUE practices. The items were reviewed by experts, and minor revisions were made based on their suggestions. Further confirmation was provided by high school students, who noted that the items precisely captured their IDUE and were readily understandable. Participants answered the question: "In the past month, how often have you used digital resources for the following activities each week?" An example item is "I communicate in English on social media." Responses to the items were categorized into 7 time intervals from "never" to "more than 5 hours." The time allocated to those activities was recalculated in increments of 50 minutes. In accordance with the min-max scaling procedure, responses were mapped to their respective median time values based on a conversion scheme: 1 → 0, 2 → 0.1, 3 → 0.4, 4 → 0.9, 5 → 1.8, 6 → 4.2, and 7 → 6.

The FEU scale was designed to measure the frequency of English use with family members. Participants answered the question on a five-point Likert scale, with the options of *never*, *rarely*, *sometimes*, *often*, and *all the time*. The CEU scale was used to assess the frequency of English use during their English language classes. Participants responded on a six-point Likert scale, with the options of *almost never*, *very little of the time*, *less than half of the time*, *about half of the time*, *most of the time*, and *almost all the time*. The SPP scale was adopted to measure learners' perceptions of their English proficiency in comparison with their peers. Participants rated the answers on a five-point scale, from 1 = *much worse* to 5 = *much better*.

The above scales showed satisfactory reliability and validity. The scales' content validity was established through expert review, and their clarity was confirmed by a group of secondary school students. The FLE scale showed satisfactory reliability (Cronbach's $\alpha = 0.952$) and convergent validity ($CR = 0.953$, $AVE = 0.804$). The FLA scale demonstrated acceptable reliability (Cronbach's $\alpha = 0.841$) and convergent validity ($CR = 0.838$, $AVE = 0.517$). The IDUE scale showed acceptable reliability (Cronbach's $\alpha = 0.822$) and convergent validity ($CR = 0.827$, $AVE = 0.491$). For

discriminant validity, the square roots of AVE were larger than the correlation coefficients in the matrix, indicating the establishment of acceptable discriminant validity (see Table 1). The measurement model for the scales also demonstrated an acceptable model fit ($\chi^2(108) = 238.906$, RMSEA = 0.048, SRMR = 0.057, CFI = 0.971, TLI = 0.964), which indicates the establishment of acceptable construct validity.

Table 1. *Discriminant validity of the scales.*

	1 FLE	2 FLA	3 IDUE	4 FEU	5 CEU
1 FLE	0.897				
2 FLA	-0.206	0.700			
3 IDUE	0.334	0.036	0.719		
4 FEU	0.347	-0.057	0.239	1.000	
5 CEU	0.463	-0.197	0.309	0.288	1.000

Note. The square roots of AVE are in bold, and the correlation coefficients are on the off-diagonal in the matrix.

The L2 proficiency tests were designed by a group of L2 assessment experts in accordance with the English Curriculum Standards for Compulsory Education (MoE, 2022). The tests incorporated a sequence of interconnected and scenario-based activities (Kunnan et al., 2022). The tests were administered via a computer-based format. The initial aim of the tests was to measure students' English proficiency across all four language skills. However, the pilot study showed that the writing tasks had a low facility value. Additionally, the computer-based writing task also assessed typing proficiency, which undermined the accuracy of the writing assessment for some students. Thus, the final test was limited to assessing listening, speaking, and reading skills. The tests for junior and senior high school students showed acceptable reliability (Cronbach's $\alpha = 0.970$ and 0.948) and construct validity ($\chi^2(87) = 121.970$, RMSEA = 0.033, SRMR = 0.036, CFI = 0.991, TLI = 0.989; $\chi^2(101) = 172.165$, RMSEA = 0.058, SRMR = 0.048, CFI = 0.970, TLI = 0.965). Students' listening and reading performance was objectively scored, and their speaking performance was assessed by independent raters. The inter-rater reliability was acceptable (Kendall Coefficient of Concordance ≥ 0.940). The remaining inconsistencies in the rating process were discussed and resolved by the raters. To ensure that the scores were comparable across educational levels, the original scores were standardized with the mean set to 500 and the standard deviation set to 100, based on the Item Response Theory model.

Data collection

We informed the students and their parents of the nature, procedures, goals, data confidentiality, and voluntary participation in the study, and obtained their informed consent. All participants completed the survey using uniformly equipped touchscreen tablets. The survey was monitored by experimenters who had been trained in the research constructs and the standardized procedures for administering the instruments.

Data analysis

RStudio was utilized to perform all data analyses. The potential control variables, including gender, age, and school district, were first examined using correlational and t-test analyses. The hypothesized model was estimated using PLS-SEM. PLS-SEM

shows greater statistical power than the Covariance-Based SEM (CB-SEM) when the data are not normally distributed (Hair et al., 2019), and provides more accurate mediation estimates than CB-SEM (Sarstedt et al., 2020). PLS-SEM also constitutes an appropriate methodological approach for L2 research (Sanjaya & Anggraeni, 2026). Thus, PLS-SEM with a bootstrapping procedure involving 5,000 resamples was used to examine the hypothesized relationships among the above variables.

Results

T-test and correlational analyses

Participants' gender and school district were dummy-coded. The t-test showed no significant gender differences in enjoyment, $t(527.714) = -1.737$, $p = 0.08$; anxiety, $t(528.937) = -0.777$, $p = 0.44$; SPP, $t(527.941) = -0.443$, $p = 0.66$; or AP, $t(528.999) = -0.490$, $p = 0.62$. Following the practice of Sánchez-Pérez et al. (2018, 2024), who first examined potential covariates through t-tests and only included those showing significant group differences as control variables, gender was not included as a control variable because no significant gender differences were detected. Given the well-documented role of gender in shaping learner emotions (e.g., Dewaele & MacIntyre, 2014; Lee et al., 2024a), we further estimated an alternative model including gender as a control variable. The results showed that the inclusion of gender did not substantially alter the magnitude, direction, or significance of the key structural paths, and the main conclusions remained unchanged. Therefore, gender was not retained in the final model for parsimony.

For the school district, students from urban areas reported significantly higher levels of SPP, $t(362.53) = 3.284$, $p < .01$, and AP, $t(339.32) = 11.008$, $p < .001$. Therefore, the school district was included as a control variable.

Table 2. *Correlational analysis results.*

	1	2	3	4	5	6	7	8
1 IDUE	1							
2 FEU	0.165***	1						
3 CEU	0.236***	0.284***	1					
4 FLE	0.247***	0.346***	0.465***	1				
5 FLA	-0.157***	-0.256***	-0.390***	-	1			
6 SPP	0.185***	0.249***	0.373***	0.549***	-0.544***	1		
7 AP	0.257***	0.271***	0.290***	0.341***	-0.326***	0.548***	1	
8 Age	0.043	-0.277***	-0.264***	-0.137**	0.154***	-0.117**	0.034	1

Note. ** $p < 0.01$, *** $p < 0.001$.

Table 2 shows the results of the correlation analysis. Age was negatively correlated with FEU, CEU, FLE, and SPP, but positively correlated with FLA. Thus, age was also included as a control variable in the following PLS-SEM analysis.

The structural model

The structural model was evaluated through the following indices. The coefficient of determination (R^2) measures the proportion of variance in each endogenous construct explained by its predictors (Hair et al., 2021). Following Chin et al. (2008), R^2 values of 0.19, 0.33, and 0.67 can be interpreted as indicating weak, moderate, and substantial explanatory power. Based on this criterion, the structural model showed moderate explanatory power for SPP ($R^2 = 0.387$) and AP ($R^2 = 0.334$), weak explanatory power for FLE ($R^2 = 0.284$), and relatively low explanatory power for FLA ($R^2 = 0.159$). Additionally, the model's predictive relevance was assessed using Stone-Geisser's Q^2 values (Hair et al., 2021). Q^2 values greater than zero indicate that the model has predictive relevance for the endogenous constructs (Hair et al., 2021). All endogenous constructs in the present model had Q^2 values greater than zero, indicating that the model had predictive relevance for FLE, FLA, SPP, and AP. Among these constructs, SPP had the highest Q^2 value ($Q^2 = 0.368$), followed by AP ($Q^2 = 0.314$), FLE ($Q^2 = 0.222$), and FLA ($Q^2 = 0.049$).

Taken together, the R^2 and Q^2 results indicate that the structural model demonstrates overall satisfactory explanatory power and predictive relevance, particularly for SPP and AP, which are the ultimate outcomes of the study. Among the endogenous constructs, SPP showed the highest levels of both explanatory power and predictive relevance. AP also showed moderate explanatory power and predictive relevance, but both were lower than those for SPP. These findings suggest that affective experiences and English-use ecologies are more closely tied to learners' self-perceptions of their English proficiency than to their test performance. FLE showed both greater explanatory power and higher predictive relevance than FLA, suggesting that the English-use ecologies in the model explained and predicted FLE more effectively than FLA. The relatively low R^2 and Q^2 values for FLA suggest that FLA may also be influenced by additional individual or contextual factors not included in the model.

Furthermore, f^2 effect sizes were calculated to assess the relative contribution of each predictor to the explained variance in the endogenous constructs (Hair et al., 2021; see Table 3). Following Cohen (1988), f^2 values of 0.02, 0.15, and 0.35 indicate small, medium, and large effects. For SPP, FLA ($f^2 = 0.088$) and FLE ($f^2 = 0.037$) both showed small effects, whereas the effects of the English-use variables were below the threshold for a small effect ($f^2 \leq 0.003$). For AP, FLA showed a small effect ($f^2 = 0.029$), whereas the effects of FLE and the English-use variables were below the threshold for a small effect ($f^2 \leq 0.008$). These findings indicate that FLA made a greater contribution than FLE to the explained variance in both SPP and AP. These results further demonstrated that learners' emotions contributed more to explaining proficiency than the English-use variables. For FLE, CEU showed a small effect ($f^2 = 0.038$), whereas the effects of IDUE and FEU remained below the threshold for a small effect ($f^2 = 0.017$ and $f^2 = 0.011$, respectively). For FLA, CEU showed a small effect ($f^2 = 0.023$), whereas the effects of IDUE and FEU remained below the threshold for a small effect ($f^2 \leq 0.004$). These results indicate that, among the English-use ecologies, CEU made the largest contribution to the explained variance in both FLE and FLA. Finally, collinearity was assessed using the Variance Inflation Factor (VIF) values. All VIF values did not exceed 5 (see Table 3), which indicates the absence of any multicollinearity issues (Hair et al., 2023).

Table 3. *Results of the direct effects analyses.*

Paths	β	t	CI (95 %)	f^2	VIF
H1a: IDUE -> SPP	0.008	0.082	[-0.176, 0.225]	0	1.164
H1b: IDUE -> AP	-0.075	-0.491	[-0.331, 0.276]	0.001	1.128
H1c: IDUE -> FLE	0.348	3.139	[0.117, 0.553]	0.017	1.052
H1d: IDUE -> FLA	-0.060	-0.468	[-0.331, 0.176]	0.003	1.153
H2a: FEU -> SPP	0.029	0.248	[-0.200, 0.259]	0	1.164
H2b: FEU -> AP	0.236	1.947	[-0.001, 0.476]	0.006	1.128
H2c: FEU -> FLE	0.317	2.557	[0.085, 0.564]	0.011	1.052
H2d: FEU -> FLA	-0.121	-0.805	[-0.425, 0.170]	0.004	1.153
H3a: CEU -> SPP	0.114	1.198	[-0.073, 0.297]	0.003	1.395
H3b: CEU -> AP	0.194	2.032	[0.009, 0.381]	0.008	2.080
H3c: CEU -> FLE	0.422	4.361	[0.237, 0.610]	0.038	1.093
H3d: CEU -> FLA	-0.307	-3.002	[-0.509, -0.110]	0.023	1.256
H4a: FLE -> SPP	0.250	4.947	[0.153, 0.351]	0.037	1.791
H4b: FLE -> AP	0.090	1.679	[-0.017, 0.193]	0.004	1.084
H4c: FLA -> SPP	-0.331	-7.442	[-0.416, -0.239]	0.088	1.191
H4d: FLA -> AP	-0.195	-4.193	[-0.290, -0.106]	0.029	1.089
SD -> SPP	0.114	3.273	[0.044, 0.181]	0.019	1.183
SD -> AP	0.416	11.015	[0.342, 0.490]	0.232	1.333
Age -> FLE	0.041	1.016	[-0.038, 0.120]	0.002	2.072
Age -> FLA	0.010	0.202	[-0.083, 0.105]	0	1.789
Age -> SPP	-0.012	-0.321	[-0.085, 0.059]	0	1.030

Note. The significant paths are in bold.

Figure 2 presents the results of the structural model. Table 3 demonstrates the results of the direct effects analyses. It was found that H1c, H2c, H3b, H3c, H3d, H4a, H4c, and H4d were accepted, whereas other hypotheses were rejected. Specifically, IDUE positively and significantly predicted enjoyment ($\beta = 0.348$, $t = 3.139$); FEU showed a positive and significant effect on enjoyment ($\beta = 0.317$, $t = 2.557$); CEU positively and significantly affected enjoyment ($\beta = 0.422$, $t = 4.361$). Among the predictors of enjoyment, CEU showed the strongest effect, followed by IDUE and FEU. For anxiety, only CEU demonstrated a negative effect ($\beta = -0.307$, $t = -3.002$), whereas neither IDUE nor FEU significantly predicted anxiety. For the outcome variable of SPP, enjoyment showed a positive and significant effect ($\beta = 0.250$, $t = 4.947$), whereas anxiety showed a negative effect ($\beta = -0.331$, $t = -7.442$). Additionally, AP was positively predicted by CEU ($\beta = 0.194$, $t = 2.032$) and negatively predicted by anxiety ($\beta = -0.195$, $t = -4.193$).

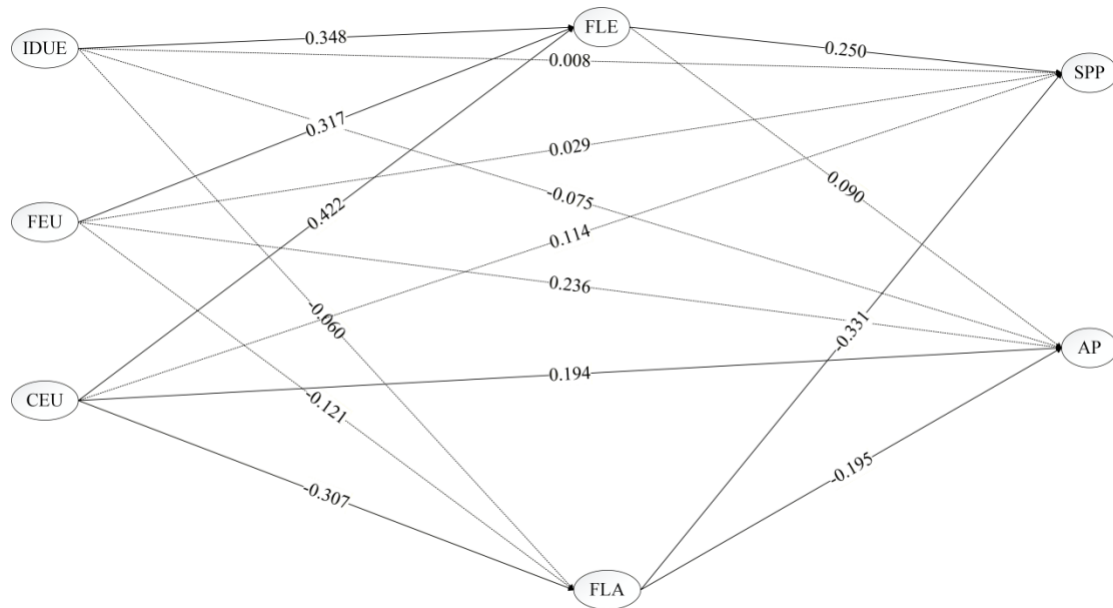


Figure 2. The structural model

Table 4. Results of the indirect effects analyses.

Paths	β	t	CI (95 %)
IDUE -> FLE -> SPP	0.087	2.623	[0.029, 0.156]
IDUE -> FLE -> AP	0.031	1.395	[-0.008, 0.083]
IDUE -> FLA -> SPP	0.020	0.455	[-0.067, 0.113]
IDUE -> FLA -> AP	0.012	0.432	[-0.037, 0.076]
FEU -> FLE -> SPP	0.079	2.339	[0.023, 0.154]
FEU -> FLE -> AP	0.029	1.368	[-0.006, 0.076]
FEU -> FLA -> SPP	0.040	0.787	[-0.056, 0.145]
FEU -> FLA -> AP	0.024	0.757	[-0.033, 0.091]
CEU -> FLE -> SPP	0.106	3.369	[0.051, 0.177]
CEU -> FLE -> AP	0.038	1.551	[-0.008, 0.090]
CEU -> FLA -> SPP	0.101	2.635	[0.032, 0.186]
CEU -> FLA -> AP	0.060	2.305	[0.017, 0.119]
Age -> FLE -> SPP	0.010	1.000	[-0.009, 0.031]
Age -> FLE -> AP	0.004	0.789	[-0.004, 0.016]
Age -> FLA -> SPP	-0.003	-0.199	[-0.034, 0.028]
Age -> FLA -> AP	-0.002	-0.195	[-0.021, 0.018]

Note. The significant paths are in bold.

Table 4 shows the results of the indirect effects analyses. Results showed the following significant relationships. Enjoyment significantly mediated the relationships between IDUE and SPP ($\beta = 0.087$, $t = 2.623$), between FEU and SPP ($\beta = 0.079$, $t =$

2.339), and between CEU and SPP ($\beta = 0.106$, $t = 3.369$). Among the enjoyment-mediated paths to SPP, CEU showed the largest indirect effect, followed by IDUE and FEU. Anxiety significantly mediated the paths from CEU to SPP ($\beta = 0.101$, $t = 2.635$) and from CEU to AP ($\beta = 0.060$, $t = 2.305$)¹. The indirect effect of anxiety was stronger for SPP than for AP. In contrast, other mediating relationships were found to be non-significant.

Table 5 shows the results of the interaction effects analyses. The interaction between IDUE and FEU had a significant and negative effect on SPP ($\beta = -0.206$, $t = -2.095$). In contrast, none of the other interactions had a significant effect on the endogenous variables.

Table 5. Results of the interaction effects analyses.

Paths	β	t	CI (95 %)
IDUE * FEU -> FLE	-0.129	-1.148	[-0.337, 0.106]
IDUE * FEU -> FLA	0.055	0.413	[-0.218, 0.297]
IDUE * FEU -> SPP	-0.206	-2.095	[-0.398, -0.011]
IDUE * FEU -> AP	-0.130	-0.845	[-0.433, 0.164]
IDUE * CEU -> FLE	-0.116	-0.991	[-0.361, 0.098]
IDUE * CEU -> FLA	0.015	0.105	[-0.238, 0.327]
IDUE * CEU -> SPP	0.253	1.932	[-0.015, 0.499]
IDUE * CEU -> AP	0.222	1.401	[-0.156, 0.476]
FEU * CEU -> FLE	-0.089	-0.509	[-0.436, 0.234]
FEU * CEU -> FLA	-0.057	-0.286	[-0.439, 0.335]
FEU * CEU -> SPP	0.001	0.003	[-0.319, 0.323]
FEU * CEU -> AP	-0.163	-0.965	[-0.495, 0.164]

Note. The significant paths are in bold.

Discussion

Relationships between language use and L2 proficiency

Results of direct effects analysis showed that IDUE, FEU, and CEU did not significantly predict SPP. This suggests that learners who use English in the classroom, family, or digital settings do not tend to show higher self-perceptions of their proficiency. In addition, CEU had a direct effect on AP, whereas IDUE and FEU showed no significant effect. More frequent informal English use does not directly translate into improved learning outcomes. This may be attributed to the structured nature of classroom environments, where scaffolding is distributed across tools and social interactions, and teachers use discussion and feedback to support learning (Puntambekar, 2022). Moreover, in the exam-oriented Chinese context, students' test performance is mainly affected by formal instruction and English use practices in

¹The sign of an indirect effect is determined by the product of its two constituent paths. Because CEU negatively predicted FLA and FLA negatively predicted both SPP and AP, the resulting indirect effects of CEU on SPP and AP through FLA were positive.

classrooms. In contrast, the effects of informal digital language use may depend on learners' strategic engagement and agency in regulating learning opportunities (Lai et al., 2025, 2026). Thus, such use may not directly result in gains in actual or self-perceived proficiency. In addition, without systematic scaffolding, informal language use in the family may not directly contribute to SPP or AP.

Most of the interaction effects among IDUE, FEU, and CEU were statistically non-significant, indicating that the effects of the three types of English use are mainly additive. Only the interaction between IDUE and FEU negatively and significantly predicted SPP. This indicates that learners who participate in both IDUE and FEU practices more frequently tend to report lower SPP than would be expected from the additive effect of those exposures. The interaction effect provides empirical evidence for the conceptual framework, which posits that multiple learning ecologies interact in non-linear ways (Marek & Wu, 2014). One plausible interpretation may draw on the big-fish-little-pond effect (Marsh et al., 2015). When students are simultaneously embedded in rich digital environments that provide exposure to proficient English influencers and in family contexts where parental expectations for English use are high, these learning resources may not be effectively integrated. Such learning experiences may heighten learners' awareness of their own deficiencies. Their benchmarks for 'competent English learners' may be recalibrated upward. This may lead them to perceive their English proficiency less favorably (van der Westhuizen et al., 2023).

The role of enjoyment in the link between language use and L2 proficiency

Results showed that IDUE, FEU, and CEU significantly predicted enjoyment. The findings corroborate previous research (Acosta-Manzano et al., 2024; Lee et al., 2024a, 2024b; Liu et al., 2025b). The positive role of IDUE in predicting enjoyment may be attributed to the autonomy and novelty needs that IDUE could fulfill. Learners could autonomously select digital learning resources (Lee, 2022; Zadorozhnyy & Lee, 2025). This could satisfy learners' need for autonomy and increase their enjoyment. Moreover, learners in many Chinese secondary school classrooms do not have access to digital technologies. Under such circumstances, IDUE practices could provide learners with novel experiences that are rarely available in classrooms, thus satisfying their need for novelty and promoting their enjoyment. Additionally, the significant influence of FEU on enjoyment may be explained by the relatedness need that FEU practices could satisfy. FEU tends to occur within relationally connected environments, which may alleviate psychological pressure and result in increased enjoyment. CEU could satisfy the needs for competence and relatedness. Frequent CEU practices may foster a sense of mastery and create opportunities for interaction with teachers and peers, contributing to increased enjoyment.

The significant influence of enjoyment on SPP is in line with previous research (Tang et al., 2024; Zhao et al., 2026). However, enjoyment did not show a significant effect on AP, which is consistent with Dewaele et al. (2022). According to Fredrickson (2001), enjoyment can broaden the range of thoughts and actions available to learners. These broadened repertoires may enhance learners' confidence and positive self-evaluations of their L2 proficiency, thus translating more readily into higher SPP. The non-significant effect of FLE on AP suggests a possible boundary condition of the broaden-and-build mechanism. Although enjoyment may broaden learners' thought-action repertoires (Fredrickson, 2001), translating these broadened repertoires into higher test scores may require additional mechanisms, such as strategy use and sustained language practice.

Results of mediation analyses showed that IDUE, FEU, and CEU indirectly influenced SPP through the mediation of enjoyment, whereas no such indirect effects were significant for AP. More frequent English use in digital, family, or classroom settings could satisfy the needs for novelty, competence, autonomy, or relatedness, which results in greater enjoyment (Ryan & Deci, 2017, 2020). The increased enjoyment, in turn, could broaden thought-action repertoires and promote more expansive self-concepts as competent users of English (Fredrickson, 2001).

Among the three types of English use, CEU showed the largest direct influence on FLE, followed by IDUE and FEU. This pattern was consistent with the f^2 results, which showed that, among the English-use ecologies, CEU made the largest contribution to the explained variance in FLE. This suggests that classrooms are the settings where need-satisfying English use most effectively contributes to increased enjoyment and, in turn, more favorable self-perceptions of English proficiency. These findings align with the proposed conceptual framework, which posits that different English-use ecologies promote enjoyment through distinct need-satisfaction pathways. The largest effect of CEU on FLE may be attributable to its potential to satisfy the needs for competence through structured instruction and feedback, and for relatedness through teacher and peer support, thus contributing to higher levels of FLE. In contrast, although IDUE could fulfill autonomy and novelty needs, it may provide less systematic feedback and less stable competence support than CEU. FEU exhibited the weakest effect because, although it could satisfy the relatedness need through family support, it may offer fewer opportunities for structured practice and proficiency-oriented interaction.

The role of anxiety in the link between language use and L2 proficiency

It was found that CEU showed a significant effect on anxiety, whereas IDUE and FEU did not significantly predict anxiety. This pattern was consistent with the f^2 results, which showed that CEU made a greater contribution to the explained variance in FLA than either IDUE or FEU. Anxiety is often related to learners' fear of negative evaluation and peer comparison (Kruk, 2018). Classrooms typically place learners in evaluative environments where their performance is exposed to scrutiny. Thus, more frequent CEU practices could help cultivate a cohesive classroom environment and lessen students' concerns about receiving negative evaluations, thus alleviating their anxiety. Additionally, CEU may address learners' competence concerns by providing more opportunities for practice and mastery experiences, thereby reducing the anxiety that stems from fear of negative evaluation. The non-significant effects of IDUE and FEU on anxiety may be explained by the relatively low evaluative pressure associated with informal English use. Given that IDUE often provides low-pressure and non-judgmental environments (Zadorozhnyy & Lee, 2025) and FEU often occurs in supportive settings, learners are less likely to be exposed to evaluative pressure. Further, the significant effect of CEU on anxiety may also reflect the classroom-based nature of the anxiety scale used in this study. Compared with IDUE and FEU, CEU is more closely aligned with classroom learning experiences, and therefore may be more likely to predict anxiety captured by a classroom-based scale. The findings refine the conceptual framework by revealing that the relationships between English use and anxiety reduction may depend on the evaluative intensity of the learning ecology.

The negative influence of anxiety on SPP and AP is consistent with previous research (e.g., Alrabai, 2025; Gao, 2024). Anxiety may narrow learners' attentional scope and the range of thoughts and actions available to them (Fredrickson, 2001), which may constrain opportunities for resource development and diminish their self-perceptions of English proficiency. Learners with higher levels of anxiety tend to be

less confident and hold less favorable perceptions of their proficiency (Gao, 2024; Lee & Lee, 2020). For AP, anxiety may narrow learners' attentional scope (Fredrickson, 2001) and disrupt their concentration on test tasks (MacIntyre & Gregersen, 2012), potentially undermining their test performance.

Furthermore, anxiety significantly mediated the influence of CEU on both SPP and AP, but not those of IDUE or FEU on the outcome variables. This indicates that more frequent English use in classrooms can improve learners' perceived and actual L2 proficiency through reduced anxiety. The above differences suggest that the mediating effect of FLA is the most salient in formal evaluative environments. Different from informal English use that typically occurs in low-pressure environments, formal English use tends to occur in evaluative settings where anxiety is activated and alleviated more intensely. Additionally, informal English use is often unstructured and intended for recreational or communication purposes, while formal use is typically associated with academic pursuits and supported through scaffolding. This may explain the non-significant mediation of anxiety in the paths from FEU and IDUE to L2 proficiency.

The anxiety-mediated indirect effect was found to be stronger for SPP than for AP. This suggests that anxiety is more closely tied to learners' perceived proficiency than to their test performance. One possible explanation is that SPP is more sensitive to affective experiences. Reduced anxiety may improve learners' confidence and self-evaluation of their English proficiency. By contrast, AP reflects performance on a specific proficiency test, and improvements in actual performance may require additional mechanisms, such as sustained practice and accumulated knowledge.

The above findings refine the conceptual framework, indicating that enjoyment is a broad mediator across all three ecologies of English use, whereas anxiety functions as a context-specific mediator that is triggered by formal English-use practices. The original formulation of the framework, based on self-determination theory, predicted that need satisfaction across all ecologies would reduce anxiety. However, the results suggest that this prediction holds specifically for CEU. This advances the conceptual framework by identifying evaluative intensity as a potential boundary condition that may shape whether the anxiety-mediated pathway is activated.

Implications

Theoretical implications

The study has the following theoretical implications. Integrating self-determination theory with broaden-and-build theory constitutes a theoretically robust conceptual framework for explaining the mediating mechanisms of learner emotions in the link between English use and L2 proficiency. This study refines the assumption that relates more frequent English use to better L2 learning outcomes and adds insight to the existing literature by exploring the mediation of affective factors. The positive influence of CEU, FEU, and IDUE on SPP is contingent upon the activation of enjoyment. However, only CEU influenced AP both directly and indirectly via anxiety. The findings reveal that the influence of English use on L2 proficiency is transmitted through two distinct affective pathways. Enjoyment functions as a universal mediator across all three ecologies, whereas anxiety is activated in formal classroom settings. This dual mediation pathway contributes to the literature on the asymmetry of positive and negative emotions (Li & Li, 2023) by demonstrating that enjoyment and anxiety are activated by different ecological affordances of English use and exert differential effects on actual and perceived proficiency.

In addition, the study extends the broaden-and-build theory by identifying an asymmetry in its effects. The significant influence of FLE on SPP and its non-significant influence on AP provide a more nuanced picture of the broaden-and-build mechanism. Enjoyment predicted SPP across all ecologies but did not significantly influence AP, suggesting that the resources broadened through positive emotions may require additional mechanisms to translate into gains in test performance. This suggests a potential boundary condition of the broaden-and-build mechanism. Anxiety, conversely, negatively predicted both self-perception and actual performance. This asymmetry reveals that the broadening and narrowing mechanisms are not symmetric in L2 learning.

The study advances the literature by jointly modeling the three types of English use. The interaction effect of IDUE and FEU on SPP is in line with complex dynamic systems perspectives, in which multiple subsystems interact in non-linear ways (Marek & Wu, 2014). Learners who use English more frequently in the two informal settings may experience lower self-perceptions of proficiency due to stronger upward comparisons. The finding indicates that the big-fish-little-pond effect (Marsh et al., 2015) can be extended to informal settings involving both informal digital and family use of English. These insights fill important gaps, especially in relation to the integration of different forms of English use.

Practical implications

This study has the following pedagogical implications. Among the three English-use ecologies, CEU showed the largest indirect effects on SPP through emotions and was the only ecology that indirectly influenced AP via anxiety. This suggests that teachers could design classroom activities that make English use meaningful, interactive, and emotionally engaging and help create a low-threat learning environment in which more frequent CEU practices could more effectively promote students' L2 proficiency. Additionally, the mediation of enjoyment in the path from FEU to SPP suggests the importance of framing FEU as supportive and enjoyable rather than evaluative. Educators could offer specific recommendations for low-pressure English use within family environments, such as short daily conversations in English or shared watching of English videos followed by simple discussions.

Given that IDUE influences SPP through the mediation of enjoyment, teachers and policymakers could view IDUE practices as a way to make English more personally meaningful and enjoyable. Schools could design lists of English learning applications or games that align with students' interests and learning needs, and encourage them to treat these activities as 'English for fun' rather than as additional homework. Additionally, teachers can scaffold learners' purposeful, agentive, and strategic engagement with digital resources by guiding them to attend to both meaning and form, compile useful expressions, and reflect on their learning experiences.

In addition, the interaction effect between IDUE and FEU on SPP suggests that teachers might attend to students who report higher levels of English use across both digital and family environments and investigate whether they feel overburdened. Involving parents in discussions about maintaining realistic expectations may also help prevent cycles of adverse social comparison. The findings suggest that while increasing opportunities for English use tends to be helpful, it may be equally important to attend to learners' social-comparison reference points and psychological feedback processes. Family members could help learners interpret digital English experiences constructively, rather than framing such experiences in overly comparative terms.

Conclusion

This study investigated the mediation of FLE and FLA in the paths from IDUE, FEU, and CEU to SPP and AP. Grounded in the conceptual framework integrating self-determination theory and the broaden-and-build theory, the study revealed the differential mediating mechanisms of FLE and FLA. The three forms of English use indirectly influenced SPP via enjoyment, whereas no such effects were reported for AP. In addition, the paths from CEU to both SPP and AP were significantly mediated by anxiety. Further, the interaction between IDUE and FEU negatively predicted SPP. The above findings contribute to the literature by revealing how different forms of English use influence perceived and actual L2 proficiency through affective mechanisms.

We acknowledge the following limitations of this study. First, this study examined the mediation of enjoyment and anxiety in the paths from English use to L2 proficiency. Further research may examine other mediating variables to enrich the understanding of the topic. Second, the unidimensional operationalization of CEU, FEU, and SPP may not sufficiently account for their inherent complexity. Third, this study is limited due to its reliance on self-reported questionnaires, suggesting the need to triangulate the findings through other data collection methods. Fourth, this study adopted a cross-sectional design. Future longitudinal research could examine changes and potential reciprocal relationships among English use, emotions, and L2 proficiency over time. Finally, the sample consisted of secondary school students in the Chinese context. The generalizability of the findings warrants investigation in future research.

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