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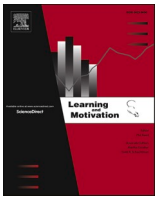

Does artificial intelligence-assisted learning positively affect college students' motivation, emotion regulation, and academic uncertainty? Insight from situated learning theory

Haozhuo Lin [a], Qiu Chen [b,*]

[a] School of Marxism, Wenzhou University Of Technology, Wenzhou 32500, China
[b] School of Humanities, Wenzhou University, Wenzhou 32500, China

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ABSTRACT

This study aimed to explore the effects of AI-assisted learning on undergraduate students' motivation, emotion regulation, and academic uncertainty within the framework of Situated Learning Theory. Conducted at a Chinese university, the quasi-experimental pretest-posttest control group design involved 78 undergraduates from a humanities school, aged 18–22, with 60 % female and 40 % male participants. They were randomly assigned by intact classes to either an AI-assisted learning group (n = 39), receiving adaptive feedback, real-time support, and task adjustments via DeepSeek, or a control group (n = 39), receiving traditional instruction with identical content. Validated quantitative instruments measured motivation, emotion regulation, and academic uncertainty at pretest and posttest, with ANCOVA and MANCOVA analyses controlling for baseline scores. Results revealed significantly higher motivation and emotion regulation, alongside reduced academic uncertainty, in the AI group compared to the control group, supported by a strong multivariate effect. These findings suggest that AI-assisted learning fosters resilient, engaged learning environments in Chinese EFL contexts, offering practical implications for integrating adaptive technologies to support student affect and academic clarity.

1. Research background

Artificial intelligence (AI), defined as computer systems designed to mimic human cognitive functions like learning, reasoning, and problem-solving (McCarthy et al., 2006; Shah, 2023), has become a pivotal force in reshaping educational practices. These systems leverage algorithms and data processing to enable adaptive and interactive learning experiences (Herrmann & Weigert, 2024; Hwang et al., 2020; Kumar & Thakur, 2012). In English as a Foreign Language (EFL) education, AI's growing acceptance stems from its ability to deliver personalized feedback and foster engagement, addressing diverse learner needs in dynamic ways. In China, where EFL instruction faces challenges such as large class sizes, exam-driven curricula, and limited exposure to native speakers, AI tools have gained traction as a means to enhance communicative competence and make learning more accessible. For instance, mobile applications and intelligent tutoring systems have significantly boosted student engagement in Chinese EFL classrooms, as shown by Sun et al. (2024). This integration reflects a broader shift toward leveraging AI to create inclusive, effective learning environments within China's rapidly expanding digital education landscape.

* Corresponding author.
E-mail addresses: lhaozhuo@wzu.edu.cn (H. Lin), chenqiu@wzu.edu.cn, qiutianwzu@126.com (Q. Chen).

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Among AI tools, DeepSeek, developed by DeepSeek-AI, stands out as an advanced large language model designed for educational applications, offering robust natural language processing and context-sensitive responses (DeepSeek-AI et al., 2025; DeepSeek-AI et al., 2024). Its strengths in EFL contexts include providing precise, adaptive feedback that enhances learner autonomy and motivation. Research by Albuhairy and Algaraady (2025) demonstrated DeepSeek's superior ability to detect context-based errors in L2 writing, suggesting its potential for EFL learners in China, where tailored feedback is critical. Similarly, Lyu and Abdul Salam (2025) found that DeepSeek improved self-efficacy and digital literacy among Chinese EFL learners, aligning with findings from Shao (2025) on AI-assited motivational gains. Gao et al. (2025) further highlighted DeepSeek's reliability in EFL writing assessment, noting its consistency in evaluating content and organization. Zhao et al. (2023) also emphasized its multimodal capabilities, which support knowledge retention in language tasks. These studies, alongside Dong et al.'s (2025) meta-analysis on AI's positive impact on academic performance, underscore DeepSeek's role in fostering engagement and autonomy in China's EFL settings, where personalized learning is often constrained by traditional teaching methods.

Despite these advantages, DeepSeek's application in EFL learning presents challenges that require careful consideration. Its sensitivity to ambiguous or non-standard inputs can lead to inaccurate feedback, particularly in China's diverse linguistic contexts, where code-switching and regional variations are common (Duan, 2025). Research also indicates potential drawbacks, such as reduced critical thinking or motivation when AI is overused without proper guidance, as noted by Wu (2023) and Yan et al. (2024). Silitonga et al. (2023) similarly cautioned that unstructured AI use may hinder engagement. In EFL writing, Mohammed et al. (2025) found DeepSeek less effective than some models in providing detailed semantic feedback, requiring refined prompts for optimal performance. Gao et al. (2025) further noted variability in DeepSeek's reliability across different versions, with earlier models outperforming newer ones in nuanced assessments. These challenges, echoed in broader AI studies (Almelweth, 2022; Lee et al., 2022), highlight the need for human oversight and tailored implementation in China's EFL classrooms to balance DeepSeek's strengths with its limitations, ensuring effective and culturally responsive integration.

This study is rooted in Situated Learning Theory (SLT), which holds that learning thrives in authentic, socially rich contexts where individuals actively engage in meaningful tasks (Lave & Wenger, 1991). The theory emphasizes legitimate peripheral participation, a process through which learners move from novice roles to full involvement in a community of practice, gaining knowledge through social interactions and context-driven activities. Its core assumption is that learning is a dynamic, socially mediated process shaped by real-world relevance and collaboration, rather than an isolated cognitive act (Renkl, 2001). In the Chinese EFL context, where large class sizes and exam-focused curricula often limit opportunities for interactive practice, this framework underscores the value of authentic language tasks to boost engagement and reduce uncertainty. For instance, Gao (2023) demonstrated that contextualized learning environments enhance motivation and self-efficacy among Chinese EFL learners. By prioritizing social and contextual engagement, SLT offers a robust foundation for exploring how technology can reshape EFL education in China.

SLT provides a compelling lens for understanding the benefits of AI-assisted learning in EFL settings. AI tools, such as DeepSeek, create immersive, context-rich environments by offering adaptive feedback and real-world language scenarios, which align with the theory's focus on authentic participation (Alfredo et al., 2024). In Chinese EFL classrooms, where access to native speakers is often scarce, AI's ability to tailor content and pacing meets individual learner needs, fosters confidence, and reduces academic uncertainty (Zhang, 2025). Moreover, AI supports emotional resilience by monitoring affective states and providing scaffolding, which enhances learners' ability to manage challenges in high-pressure academic settings (Khare et al., 2024). Sun et al. (2024) found that AI-powered tools significantly increase engagement in Chinese EFL contexts, supporting this approach. By enabling collaborative and contextually relevant learning experiences, AI tools empower Chinese EFL learners to tackle linguistic challenges with greater autonomy and emotional stability, setting the stage for this study to examine their impact on motivation, emotion regulation, and academic certainty.

Motivation is defined as the intrinsic and extrinsic drive to engage in learning tasks, plays a pivotal role in shaping EFL learners' persistence and success (Dörnyei, 2001). For EFL learners, as underscored by Dörnyei (1990), motivation encompasses the desire to master language skills, engage in communicative practice, and overcome linguistic challenges, which is critical in a setting where large class sizes and rote learning often limit interactive opportunities. In China, where English proficiency is a gateway to academic and professional advancement, motivation is essential to sustain effort amid cultural and linguistic barriers (You & Dörnyei, 2016). Research shows that motivated EFL learners exhibit greater engagement and resilience, leading to improved language outcomes (Amalia et al., 2025). AI-assisted learning can enhance motivation by offering personalized feedback and adaptive tasks that align with learners' needs, fostering autonomy and a sense of achievement. For instance, Huang and Derakhshan (2025) and Yuan and Liu (2025) noted that AI-powered tools can significantly boost engagement among Chinese EFL students by tailoring practice to individual proficiency levels.

Emotion regulation is understood as the ability to manage and respond to emotional experiences during learning (Gross, 2015). It is equally vital for EFL learners because it enables them to navigate the affective challenges of language acquisition (Gross, 2014). In the Chinese EFL context, where students face high-stakes exams and cultural expectations, emotion regulation helps learners cope with anxiety, frustration, and self-doubt, ensuring sustained engagement in language tasks. Effective emotion regulation fosters resilience, allowing students to reframe setbacks and maintain focus, as highlighted in studies on affective factors in language learning (Dewaele & Li, 2020). AI-assisted learning supports this process by providing real-time, adaptive scaffolding that reduces emotional overload and promotes strategies like cognitive reappraisal. For example, AI tools can offer immediate feedback on speaking tasks, alleviating anxiety and building confidence in Chinese EFL classrooms (Gao, 2023; Zhang, 2025). By creating supportive, context-sensitive environments, as noted by Ma et al. (2025), AI empowers learners to manage emotions effectively, enhancing their overall learning experience.

Academic uncertainty, characterized as learners' lack of confidence or clarity about academic tasks and outcomes, poses a significant challenge for EFL learners (Martin et al., 2013; Paralkar & Knutson., 2023), particularly in China's high-pressure educational

system (Pekrun, 2006). For EFL students, according to Dağtaş and Şahinkarakaş (2024), uncertainty often arises from linguistic complexities, fear of errors, and limited exposure to authentic language use, which can hinder performance and engagement. Reducing academic uncertainty is crucial, as it fosters self-efficacy and sustained effort, key predictors of language success (Chang et al., 2025). AI-assisted learning addresses this by offering tailored guidance and clear, context-driven feedback, which clarifies expectations and reduces ambiguity in language tasks. Research by Hong and Guo (2025) indicates that AI tools enhance engagement in Chinese EFL settings by providing structured, real-world practice that mitigates uncertainty. Through adaptive support, such as DeepSeek's error detection and task adjustments, AI helps Chinese EFL learners build confidence and navigate academic challenges (Liu et al., 2025), paving the way for improved language proficiency and emotional resilience.

Despite growing evidence on the potential of AI-assisted learning to enhance motivation and emotional well-being in educational settings, significant gaps persist in understanding its impact on academic uncertainty among Chinese EFL learners. Motivation, emotion regulation, and academic uncertainty are critical for language learning success, yet research often focuses on cognitive outcomes or discipline-specific applications, such as programming or arts education, rather than the affective and psychological dimensions of EFL (Gao, 2023; Sun et al., 2024). Academic uncertainty is particularly pronounced in China's exam-driven EFL context, where large class sizes and limited interactive practice exacerbate these challenges. While studies like those by Shao (2025) and Lyu and Abdul Salam (2025) highlight AI's ability to boost self-efficacy and motivation, few have explored how AI tools, through adaptive and context-rich environments, can systematically address the interplay of motivation, emotion regulation, and academic uncertainty. Moreover, SLT remains underutilized in examining how AI can foster resilience and clarity in Chinese EFL settings (Lave & Wenger, 1991). This study addresses these gaps by investigating how AI-assisted learning, grounded in situated learning principles, can enhance motivation, improve emotion regulation, and reduce academic uncertainty among Chinese EFL undergraduates. Against the backdrop of these research gaps, the current study is informed by the following research questions (RQs):

RQ1: Does AI-assisted learning significantly improve college students' motivation compared with traditional (non-AI) learning methods?

RQ2: Does AI-assisted learning significantly enhance college students' emotion regulation abilities compared with traditional learning methods?

RQ3: Does AI-assisted learning significantly reduce college students' academic uncertainty compared with traditional learning methods?

2. Method

2.1. Design of the study

The study utilized a quasi-experimental design. A quasi-experimental design is a research approach that aims to establish cause-and-effect relationships between variables without random assignment of participants to groups, often relying on naturally occurring groups or pre-existing conditions for comparison (Riazi, 2016). This design was selected due to ethical and practical constraints that made full randomization infeasible, while still allowing for robust evaluation of the intervention's impact through pre- and post-test measurements and control for confounding variables.

2.2. Participants

In the rapidly evolving landscape of higher education in China, where AI integration has become a cornerstone of pedagogical innovation, this study unfolds within a humanities program at a prominent public university in eastern China. The institution, like many others across the country, operates under the auspices of the Ministry of Education's 2018 action plan to accelerate AI adoption in universities, which has spurred widespread experimentation with AI tools to enhance student-centered learning. This semester-long course, focused on critical thinking and interdisciplinary humanities, encompassing literature, philosophy, and cultural studies serves as an ideal setting for investigating AI's role in addressing affective barriers to learning. Such programs are increasingly common in Chinese academia, where enrollment in humanities has stabilized at around 15–20 % of undergraduates amid a national push toward STEM dominance, yet faces challenges like student disengagement and uncertainty in an era of technological disruption. By embedding AI-assisted interventions in this naturalistic classroom environment, the research bridges theoretical insights from SLT with practical responses to these contextual pressures, allowing for authentic observations of how technology reshapes emotional and motivational dynamics in non-technical disciplines.

The participant cohort comprised 78 undergraduate students, aged 21–28 years ($M = 23.4$, $SD = 1.8$), with a balanced gender distribution (52 % female, 48 % male). Participants were drawn from two intact classes enrolled in the same humanities course, ensuring homogeneity in academic context and curriculum exposure. To ensure representativeness, a cluster sampling procedure was employed, whereby the two classes were randomly assigned to either the AI-Assisted Learning Group (AIALG; $n = 39$) or the Control Group (CG; $n = 39$). Cluster sampling was selected due to its practicality in educational settings, where pre-existing groups such as classes are naturally formed, thereby minimizing disruption to the academic schedule while maintaining ecological validity. Inclusion criteria were carefully defined to ensure participant suitability. Students were required to be full-time undergraduates enrolled in the target course, with no prior experience using AI-powered learning platforms to avoid confounding effects from prior exposure. Additionally, participants needed to commit to completing both pretest and posttest assessments to ensure data integrity. Exclusion criteria included part-time enrollment or incomplete participation in the required assessments. Recruitment was conducted through a structured and ethical process. All ethical considerations were carefully observed in accordance with the Declaration of Helsinki, and

course instructors presented the study to students during a regular class session. A detailed information sheet was provided, outlining the study's purpose, procedures, and voluntary nature. Students were assured of confidentiality and their right to withdraw without penalty. Written informed consent was obtained from all participants prior to the study's commencement, ensuring ethical compliance and participant autonomy.

2.3. Measures

To gather the required data, this study employed three validated instruments, each selected for their robust psychometric properties and alignment with the research objectives. The first instrument, the Motivation Questionnaire (MQ), was developed by Vallerand et al. (1989) to assess learners' motivational orientations within academic settings. It was chosen because its grounding in Self-Determination Theory (SDT) provides a comprehensive framework for capturing the continuum of motivation, which aligns with the study's focus on AI-powered learning impacts. The MQ comprises 28 items across seven dimensions: amotivation (4 items), external regulation by attendance (4 items), external regulation by social interaction (4 items), introjected regulation (4 items), identified regulation (4 items), integrated regulation (4 items), and intrinsic motivation (4 items). Participants responded on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree), with total scores ranging from 28 to 140. An example item is: "I study because I enjoy learning new things" (intrinsic motivation). The instrument was translated into Mandarin by two bilingual researchers, with back-translation to ensure accuracy. A pilot study with 25 undergraduates confirmed clarity and cultural appropriateness, while expert review by educational psychologists verified content validity. Reliability analysis yielded a Cronbach's alpha of 0.88, surpassing the threshold of 0.70, indicating strong internal consistency.

The second instrument, the Emotion Regulation Questionnaire (ERQ), designed by Gross and John (2003), was selected for its well-established validity in measuring emotion regulation strategies, which are critical to understanding affective responses in AI-assisted learning environments. The ERQ includes 10 items divided into two dimensions: cognitive reappraisal (6 items) and expressive suppression (4 items). Participants rated items on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). An example item is: "When I want to feel less negative emotion, I change the way I'm thinking about the situation" (cognitive reappraisal). The scale was translated into Mandarin and adapted to reflect classroom scenarios, with minor wording adjustments for clarity. A pilot study with 25 students ensured item comprehensibility, and three experts in applied linguistics confirmed content validity. Reliability analysis showed Cronbach's alpha coefficients of 0.81 for cognitive reappraisal and 0.76 for expressive suppression, indicating acceptable reliability for both subscales.

The third instrument, the Academic Uncertainty Scale (AUS), was a researcher-developed 14-item measure, refined from an initial 20-item pool, to assess students' perceived uncertainty in academic tasks. It was chosen to capture context-specific uncertainties in AI-assisted and traditional learning settings, filling a gap in existing instruments. The AUS covers three dimensions: ambiguity in task expectations (5 items), unpredictability of outcomes (5 items), and lack of clarity in academic processes (4 items). Responses were recorded on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree), with total scores ranging from 14 to 70. An example item is: "I often feel uncertain about what is expected in my assignments" (ambiguity). The scale was translated into Mandarin, with adaptations to align with humanities coursework. A pilot study with 25 undergraduates led to the removal of six items for improved clarity and coherence, while expert consultation with two educational psychology specialists confirmed content validity. Reliability analysis revealed a Cronbach's alpha of 0.85, indicating strong internal consistency for the refined scale.

2.4. Data collection procedures

The data collection process was carefully designed to ensure consistency, ethical compliance, and methodological rigor across all stages. The first step involved training two instructors, both with advanced degrees in educational technology, to deliver the interventions for the AIALG and the CG. A two-day workshop equipped them with skills to use the DeepSeek platform for the AIALG, focusing on its adaptive feedback and task adjustment features, while standardizing traditional teaching methods for the CG. This training ensured that both groups received the same humanities curriculum, differing only in delivery mode, which minimized variations due to instructor differences and maintained content equivalence. After training, the authors administered pre-tests to all 78 participants to establish baseline measures of motivation, emotion regulation, and academic uncertainty. The validated scales were provided in paper-and-pencil format during a 30-minute session in a controlled classroom setting. Clear instructions were given, and participants were assured of anonymity to encourage honest responses. The pre-tests occurred one week before the intervention, allowing sufficient time for scoring and data entry while ensuring no exposure to the intervention conditions.

The interventions were delivered over a 12-week semester, with both groups engaging in the same humanities curriculum focused on critical thinking and interdisciplinary analysis. For the AIALG, the intervention utilized DeepSeek, an AI platform designed to create personalized, adaptive learning experiences aligned with SLT. In weekly 90-minute sessions, students participated in activities such as critical reading, essay writing, and case study analyses. DeepSeek provided real-time feedback tailored to individual responses, adjusted task difficulty based on performance, and offered immediate support for questions through an interactive interface. For example, when students analyzed a philosophical text, the AI suggested alternative interpretations or clarified concepts, adapting its prompts to match their understanding. This approach supported a dynamic, learner-centered environment that promoted autonomy and reduced uncertainty by clarifying task expectations.

Additionally, the AIALG intervention included collaborative activities to enhance situated learning. Students engaged in AI-assisted group discussions twice weekly, where DeepSeek moderated by posing context-specific questions and providing feedback on group interactions. For instance, during a literature analysis task, the AI prompted students to connect themes to cultural contexts, adjusting

question complexity based on group responses. Over the 12 weeks, this continuous feedback loop aimed to boost motivation and emotion regulation by helping students track their progress and refine their learning strategies. These activities fostered an interactive, context-sensitive environment that supported both cognitive and emotional development.

The CG, in contrast, received the same curriculum through traditional instructional methods without AI support. Weekly 90-minute sessions included face-to-face lectures, standard digital tools like PowerPoint slides, and instructor feedback delivered post-submission, typically within a week. For example, feedback on essay writing tasks was uniform and not tailored to individual needs. Group discussions were led by the instructor without adaptive technology, offering less immediate guidance and fewer opportunities for real-time clarification. While ensuring content equivalence, this approach provided limited support for self-regulated learning, potentially leading to higher academic uncertainty compared to the AIALG. After the 12-week intervention, post-tests were conducted under the same conditions as the pre-tests. The MQ, ERQ, and AUS were administered in a controlled classroom setting, with 30 min allocated for completion. Participants were reminded of confidentiality to ensure candid responses. The post-tests took place within one week of the intervention's end to capture immediate effects. To maintain data quality, all instruments were checked for completeness, and responses were securely stored for analysis.

2.5. Data analysis

All data analyses were conducted using SPSS Statistics version 26. The study employed both descriptive and inferential statistics to provide a comprehensive analysis of the data. Descriptive statistics, including means (Ms) and standard deviations (SDs). Parametric inferential tests were selected because they offer high statistical power and precision when assumptions are met, making them suitable for detecting intervention effects in this quasi-experimental design. Before proceeding, assumptions for parametric tests were rigorously checked. The Kolmogorov-Smirnov test confirmed normal distribution of all dependent variables ($p > .05$), Levene's test verified homogeneity of variances ($p > .05$), and homogeneity of regression slopes was established through preliminary ANCOVA models ($p > .05$).

To confirm baseline equivalence, independent samples *t*-tests were conducted on pretest scores, revealing no significant differences between the AIALG and CG ($p > .05$ for all variables). For the main analyses, one-way ANCOVAs assessed posttest differences for each dependent variable, with pretest scores as covariates to control for initial variability and enhance effect estimation. A multivariate analysis of covariance (MANCOVA), using Pillai's Trace for its robustness, examined the combined effect across all dependent variables. Effect sizes were reported using partial eta squared (η^2p), interpreted per Cohen's guidelines (small: 0.01, medium: 0.06, large: 0.14). Mediation analyses, conducted via the PROCESS macro with 5000 bootstrap samples, explored potential indirect effects of the intervention on academic uncertainty through motivation and emotion regulation. Additionally, a one-sample *t*-test compared the attitude questionnaire's mean score to its neutral midpoint (3.0) to evaluate perceptions of AI integration.

3. Results

This section reports the statistical findings addressing the three research questions, The analysis proceeds in three stages: first, establishing baseline equivalence between the AIALG and the CG; second, evaluating posttest differences with pretest scores as covariates; and third, examining the combined effect of the intervention on all outcomes. Effect sizes (partial η^2) are reported to quantify the magnitude of effects. To confirm the comparability of the AIALG ($n = 39$) and CG ($n = 39$) prior to the intervention, independent-samples *t*-tests were conducted on pretest scores for motivation, emotion regulation, and academic uncertainty. Table 1 presents the descriptive statistics and *t*-test results.

As shown in Table 1, no significant differences were found between the AIALG and CG at baseline. For motivation, the AIALG ($M = 82.72$, $SD = 9.66$) and CG ($M = 85.23$, $SD = 9.24$) were comparable, $t(76) = -1.17$, $p = .244$. Similarly, emotion regulation pretest scores showed no significant difference between the AIALG ($M = 30.77$, $SD = 4.74$) and CG ($M = 30.64$, $SD = 5.35$), $t(76) = 0.11$, $p = .911$. For academic uncertainty, the AIALG ($M = 42.03$, $SD = 4.79$) and CG ($M = 43.05$, $SD = 5.69$) also did not differ significantly, $t(76) = -0.86$, $p = .392$. These results confirm that the groups were statistically equivalent at baseline, ensuring that posttest differences can be attributed to the intervention rather than pre-existing disparities.

To address the research questions, ANCOVAs were conducted to compare posttest scores between the AIALG and CG, with pretest scores as covariates to control for baseline differences. Table 2 presents the adjusted posttest means and ANCOVA results for each dependent variable.

RQ1: Does AI-assisted learning significantly improve college students' motivation compared with traditional learning methods?

Table 1
Baseline Equivalence Between AIALG and CG (Independent-Samples t-Tests).

Variable	Group	M	SD	t(76)	p
Motivation Pretest	AIALG	82.72	9.657	−1.17	.244
	CG	85.23	9.241		
Emotion Regulation Pretest	AIALG	30.77	4.743	0.11	.911
	CG	30.64	5.353		
Academic Uncertainty Pretest	AIALG	42.03	4.793	−0.86	.392
	CG	43.05	5.689		

Table 2
Adjusted Posttest Means and ANCOVA Results Comparing AIALG and CG.

Dependent Variable	Adj. M (AIALG)	Adj. M (CG)	F(1, 73)	p	Partial η^2
Motivation Posttest	109.54	87.46	143.24	< .001	.662
Emotion Regulation Posttest	41.79	31.51	98.60	< .001	.575
Academic Uncertainty Posttest	29.03	38.44	61.42	< .001	.457

The ANCOVA results for motivation revealed a significant effect of group, $F(1, 73) = 143.24$, $p < .001$, partial $\eta^2 = .662$. The AIALG (Adj. M = 109.54) demonstrated substantially higher motivation than the CG (Adj. M = 87.46). The large effect size (partial $\eta^2 = .662$) indicates that AI-assisted learning accounted for approximately 66.2 % of the variance in posttest motivation scores, suggesting a robust improvement in students' motivation compared to traditional methods.

RQ2: Does AI-assisted learning significantly enhance college students' emotion regulation abilities compared with traditional learning methods?

For emotion regulation, the ANCOVA indicated a significant group effect, $F(1, 73) = 98.60$, $p < .001$, partial $\eta^2 = .575$. The AIALG (Adj. M = 41.79) outperformed the CG (Adj. M = 31.51), with AI-assisted learning explaining 57.5 % of the variance in posttest emotion regulation scores. This large effect size underscores the substantial enhancement in emotion regulation abilities for students in the AIALG compared to those receiving traditional instruction.

RQ3: Does AI-assisted learning significantly reduce college students' academic uncertainty compared with traditional learning methods?

The ANCOVA for academic uncertainty showed a significant group effect, $F(1, 73) = 61.42$, $p < .001$, partial $\eta^2 = .457$. The AIALG (Adj. M = 29.03) reported significantly lower academic uncertainty than the CG (Adj. M = 38.44). The moderate-to-large effect size (partial $\eta^2 = .457$) indicates that AI-assisted learning accounted for 45.7 % of the variance in academic uncertainty, highlighting its effectiveness in reducing uncertainty compared to traditional methods. Collectively, these findings demonstrate that AI-assisted learning significantly improved motivation and emotion regulation while reducing academic uncertainty, with large effect sizes indicating meaningful practical impacts.

To examine the overall effect of AI-assisted learning across the three dependent variables, a MANCOVA was conducted, controlling for pretest scores. Table 3 presents the multivariate results.

The MANCOVA revealed a significant overall effect of group membership, Pillai's Trace = .840, $F(3, 71) = 124.23$, $p < .001$, partial $\eta^2 = .840$. Consistent results across Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root confirmed this finding. The very large effect size (partial $\eta^2 = .840$) indicates that AI-assisted learning explained 84 % of the variance in the combined outcomes, underscoring its substantial impact across motivation, emotion regulation, and academic uncertainty. This suggests that the intervention holistically enhanced students' psychological and academic outcomes compared to traditional instruction.

4. Discussion

The primary aim of this study was to investigate the effects of AI-assisted learning on Chinese undergraduate students' motivation, emotion regulation, and academic uncertainty. The findings revealed substantial benefits for the AI group. Specifically, this group showed significantly higher posttest scores in motivation and emotion regulation, along with lower academic uncertainty compared to the CG, as evidenced by large effect sizes in ANCOVA analyses. Moreover, multivariate results confirmed a strong overall intervention effect, while mediation analysis indicated that AI's influence on reducing uncertainty was mainly direct rather than through motivation or emotion regulation. These outcomes resonate with recent research highlighting AI's role in enhancing educational experiences. For instance, they align closely with Dong et al.'s (2025) meta-analysis, which reported a large positive effect of AI on academic performance across diverse settings, influenced by factors like education level and intervention length. Similarly, our observed gains in motivation and reductions in anxiety mirror Shao, (2025) findings, where Duolingo-based AI tools led to notable affective and motivational improvements among EFL learners. In addition, Sun et al. (2025) demonstrated AI's capacity to foster ongoing learning intentions through elements like creativity and flow, which supports the broader applicability of our results in promoting sustained engagement. What sets our study apart, however, is its emphasis on academic uncertainty within a situated learning framework; this adds a unique layer to the literature by showing how AI can directly mitigate uncertainty in real-time, context-embedded tasks, beyond general performance boosts.

Building on these comparisons, our results also correspond with studies emphasizing AI's motivational and inclusive benefits. Jafarian and Kramer (2025), for example, found that AI-assisted audio modules boosted motivation and reading engagement, especially for students facing attention challenges, much like the adaptive features in our DeepSeek intervention. Fan et al. (2025) further

Table 3
MANCOVA Results for Combined Posttest Outcomes Controlling for Baseline Scores.

Test	Value	F(3, 71)	p	Partial η^2
Pillai's Trace	.840	124.23	< .001	.840
Wilks' Lambda	.160	124.23	< .001	.840
Hotelling's Trace	5.249	124.23	< .001	.840
Roy's Largest Root	5.249	124.23	< .001	.840

reinforced the motivational advantages of AI in pair programming, though they noted stronger social presence in human collaborations. Lyu and Abdul Salam (2025) echoed our enhancements in self-efficacy and motivation among adult EFL learners, underscoring AI's versatility across demographics. Regarding attitudes, the positive views toward AI in our study parallel Chan and Lee's (2023) and Lee et al. (2022) emphasis on user-friendly interfaces and clear guidance for fostering acceptance. Likewise, Abdaljaleel et al. (2024) and Saif et al. (2023) linked lower anxiety and perceived threats to higher AI adoption, providing context for the anxiety-reducing effects we observed. Overall, this research contributes distinctively by integrating emotion regulation into AI's impact on uncertainty in a Chinese EFL context, enriching the field with evidence-based insights for tailored, resilient learning environments.

The results affirm that AI-assisted learning significantly improves college students' motivation over traditional methods. From the perspective of SLT, this enhancement occurs because AI embeds learning in authentic contexts. In these contexts, EFL students participate in meaningful language tasks that mimic real-life interactions, and this process fosters active engagement and knowledge construction (Billett, 1996; Lave & Wenger, 1991). AI tools like DeepSeek provide adaptive feedback and personalized challenges. These tools align with the theory's emphasis on legitimate peripheral participation, and they allow learners to gradually build competence in a supportive environment (Shah, 2023). For EFL learners, these features offer outstanding benefits such as immediate reinforcement and autonomy in language practice. Such benefits reduce demotivation from generic instruction and promote intrinsic drive. Deci & Ryan, (1985, 2000) support this idea in SDT, as AI fulfills needs for autonomy, competence, and relatedness through customized support, which boosts intrinsic motivation and persistence in language tasks. Empirical evidence further justifies these gains. For example, Ma and Chen (2024) have shown that AI-powered applications heighten affective, cognitive, and behavioral engagement while curbing procrastination, and this creates a more dynamic learning process. In a similar way, Babanoğlu et al. (2025) noted that prospective teachers envision AI as enhancing motivation by diversifying materials and evoking student satisfaction in EFL settings. Yu and Tao (2025) also found that AI tools foster positive emotions by heightening perceived control and task value, which align with motivational improvements. Consequently, AI transforms passive learning into dynamic experiences. This transformation directly contributes to heightened motivation in EFL settings and addresses common barriers like monotony in traditional classrooms.

Furthermore, AI-assisted learning markedly enhances emotion regulation abilities compared to traditional methods. SLT explains this by highlighting how AI facilitates learning through contextual scaffolding. This scaffolding enables EFL students to manage emotions in real-time during language activities that reflect everyday challenges (Lave & Wenger, 1991). The theory posits that such situated practices help learners develop resilience as they navigate uncertainties with tailored support, and this turns potential frustration into opportunities for emotional growth. Outstanding AI benefits for EFL include real-time adjustments that minimize overwhelm. These adjustments allow students to employ adaptive strategies like cognitive reappraisal amid cultural and linguistic barriers (Crompton et al., 2024; Wen et al., 2025). This is reinforced by Control-Value Theory, where increased perceived control over tasks reduces negative emotions and bolsters regulation (Pekrun, 2006). Cognitive Load Theory adds that by adjusting difficulty, AI lowers extraneous demands, which prevents anxiety and aids emotional balance (Sweller, 1988). These theoretical alignments are backed by research showing AI-assisted environments alleviate emotional distress like anxiety in EFL students. Although such environments may occasionally induce frustration if not well-supported, they ultimately foster better emotional health and engagement (Yang & Wu, & Deris, 2025; Zong & Yang, 2025). Xiao et al. (2024) confirmed AI's role in improving self-esteem and academic enjoyment, and these improvements contribute to stronger emotion regulation in online language contexts. In addition, Yang and Rui (2025) noted that the integration of AI technologies may elicit both positive and negative emotions among EFL students, but adaptive features promote regulation. Thus, AI empowers EFL learners to regulate emotions effectively. This empowerment creates a more positive and resilient learning atmosphere that counters the emotional strains often associated with foreign language acquisition.

Finally, the study shows that AI-assisted learning significantly reduces academic uncertainty. Through the lens of SLT, this reduction arises from AI's role in situating knowledge acquisition in collaborative, context-embedded scenarios. In these scenarios, EFL students gain clarity by engaging with adaptive resources that clarify ambiguities in language use (Arnseth, 2008; Lave & Wenger, 1991). The theory underscores community-based learning, and AI extends this by offering on-demand guidance that bridges gaps in understanding, which fosters confidence in uncertain academic contexts. For EFL learners, AI's benefits shine in providing personalized pathways that alleviate doubts about proficiency (Wen et al., 2025). Examples include immediate feedback tools that support comprehension without overwhelming users. Social Cognitive Theory supports this through boosted self-efficacy from calibrated feedback, and this enables better coping with academic pressures (Bandura, 1986). This direct impact is justified by findings that AI-assisted instruction enhances learning achievement and self-regulated strategies. Such instruction reduces uncertainty by promoting autonomy and lowering anxiety in EFL environments (Du, 2025; Muthmainnah et al., 2024). Moreover Mohebbi (2025) indicated that AI has the potential to foster positive emotions by enhancing learners' perceived control and task value, while diminishing uncertainties related to performance and engagement. Hong and Guo (2025) and AbuSahyon et al. (2023) further explored how AI-assisted social-emotional learning frameworks transform EFL students' engagement and emotional well-being by providing tailored experiences based on emotional and cognitive needs. Overall, this direct impact enriches EFL education by promoting certainty and independence. This promotion offers a pathway to overcome persistent challenges like learner doubt in non-native language settings.

The study's findings bring both theoretical and practical implications. Theoretically, this study strengthens SLT by illustrating how AI-powered tools create authentic, participatory contexts for EFL learning in China, where large class sizes and exam-oriented education often hinder motivation and emotional resilience. By embedding language tasks in real-world scenarios, AI platforms like DeepSeek foster legitimate peripheral participation, which enhances motivation and emotion regulation among learners (Lave & Wenger, 1991). In the Chinese EFL context, these tools address challenges such as limited opportunities for communicative practice by offering adaptive feedback that simulates immersive language environments and directly reduces academic uncertainty. SDT supports this, as AI meets students' needs for autonomy and competence through personalized support, which is critical in high-pressure

academic settings (Deci & Ryan, 1985, 2000). Similarly, Control-Value Theory explains how AI's provision of perceived control mitigates anxiety and promotes positive emotions during EFL tasks (Pekrun, 2006). These insights highlight AI's role in enhancing self-efficacy and engagement in collectivist educational cultures. Additionally, studies highlight AI's potential to bridge gaps in access to interactive learning resources in China's diverse educational landscape. As a result, this study enriches theoretical frameworks by emphasizing AI's direct contribution to resilient learning environments, particularly for Chinese undergraduates in humanities programs facing motivational and emotional challenges.

Practically, Chinese EFL educators can adopt AI tools like DeepSeek to provide tailored feedback on speaking and writing, and they should design tasks that integrate AI practice with peer interactions to maintain engagement while avoiding over-reliance. Teachers need professional development programs focused on AI literacy, including strategies for ethical use and customization to address varied proficiency levels in large classrooms. Students can benefit from using these platforms for self-directed exercises, such as responding to AI-generated prompts for reflective writing, which supports emotion regulation and reduces uncertainty in oral tasks. Administrators and policymakers in China should prioritize scalable infrastructure, leveraging government support for digital education to ensure access in under-resourced regions, and adopt frameworks for transparent integration. Such strategies address technological barriers and enhance adoption. By implementing these measures, stakeholders can build inclusive ecosystems that complement traditional, exam-focused methods and foster long-term success in Chinese EFL education.

5. Conclusions and limitations

This study set out to explore the impact of AI-assisted learning on undergraduate students' motivation, emotion regulation, and academic uncertainty, guided by SLT. Conducted with 78 undergraduates from a humanities school at a Chinese university, the quasi-experimental pretest-posttest design compared an AI-assisted learning group, which used DeepSeek for adaptive feedback and real-time support, with a CG receiving traditional instruction. The results showed that AI-assisted learning significantly enhanced students' motivation, improved their emotion regulation abilities, and reduced academic uncertainty compared to conventional methods. These findings indicate that AI tools foster authentic, context-rich learning environments, aligning with the principles of situated learning. Through personalized feedback and tailored support, AI promotes autonomy and self-efficacy, enabling Chinese EFL learners to manage emotional challenges and engage more confidently in language tasks (Gao et al., 2025). Such outcomes highlight the potential of AI to transform EFL education by addressing key affective and cognitive barriers, as supported by research on technology-enhanced learning in similar contexts.

Despite these insights, the study encountered several limitations, which open doors for innovative future research. The sample was confined to 78 undergraduates from a single Chinese university, limiting the applicability of findings across diverse disciplines and cultural settings. Assigning intact classes to groups introduced potential influences from instructor or class dynamics, even with statistical controls in place. The intervention lasted only one semester, which may not capture sustained effects, and the use of quantitative self-reports missed deeper insights into students' personal experiences. To address these issues, future studies could adopt cluster-randomized trials involving larger, multi-institutional samples to strengthen causal claims and broaden generalizability. Longitudinal research incorporating wearable devices to track real-time emotional and cognitive responses during AI-assisted tasks could offer detailed insights into learner dynamics. Exploring AI integration with augmented reality to create immersive EFL environments, such as virtual language immersion programs, could further minimize uncertainty. Additionally, qualitative methods like narrative interviews or digital reflective journals could capture students' unique perspectives on various AI platforms, comparing tools like DeepSeek with emerging models to optimize designs for diverse learner needs, as suggested in recent EFL studies.

CRediT authorship contribution statement

Haozhuo Lin: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation. **Qiu Chen:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization.

Artificial intelligence (AI) and AI assisted technology usage in article writing

AI tools (ChatGPT by OpenAI and Grammarly) were used only for minor language editing. All conceptualization, data analysis, and interpretation were completed by the authors.

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Data availability

Data will be made available on request.

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