Reframing DeepSeek as an Informal Learning Space: Investigating Incidental English Vocabulary Development among EFL Students in Chinese Higher Education

Chen Liyun, and Mohamad Jafre Zainol Abidin

Abstract – **This study explores how DeepSeek—a locally developed large language model (LLM) in China—functions as an informal learning space for English vocabulary acquisition among university students. Grounded in the frameworks of incidental learning and situated learning, the research examines students' academic use of DeepSeek and the extent to which unintentional vocabulary development occurs. Employing a convergent mixed-methods design, the study surveyed 320 non-English major undergraduates across three Chinese universities through structured questionnaires and open-ended reflections. Quantitative findings reveal that while DeepSeek is predominantly utilized for academic tasks such as summarization, translation, and paraphrasing, over 60% of students reported incidental vocabulary gains. High-frequency users demonstrated significantly higher confidence and motivation in using academic English. Thematic analysis identified four key learning dynamics: exposure to disciplinary vocabulary, strategic lexical noticing, reduced anxiety through safe experimentation, and motivation fueled by AI-generated outputs. These results suggest that DeepSeek fosters both cognitive and affective dimensions of language learning through authentic academic engagement. The study advances scholarship on AI-assisted language learning by highlighting the potential of localized LLMs in EFL contexts and offers pedagogical implications for their reflective and scaffolded integration into higher education curricula.**

Keywords – **DeepSeek; Large Language Models (LLMs), Incidental Vocabulary Learning, Situated Learning, English as a Foreign Language (EFL), Artificial Intelligence in Higher Education, Cognitive and Affective Learning Outcomes**

I. INTRODUCTION

Background and Context

The integration of artificial intelligence (AI) into higher education has profoundly transformed how students interact with information, conduct research, and develop academic skills. Among the most impactful innovations are large language models (LLMs)—AI systems capable of generating human-like text, providing real-time language assistance, and facilitating interdisciplinary knowledge construction (Kasneci et al., 2023; Zawacki-Richter et al., 2019). Tools such as ChatGPT and Gemini have demonstrated considerable potential in English as a Foreign Language (EFL) learning, particularly in supporting writing fluency and vocabulary development (Dwivedi et al., 2023). However, much of the existing literature remains focused on English-dominant or Western contexts, leaving a research gap in understanding the role of localized, bilingual LLMs in non-Western educational settings.

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DeepSeek in the Chinese Higher Education Context

DeepSeek, a China-developed bilingual LLM, has gained rapid popularity among university students for academic tasks such as summarization, paraphrasing, and translation. Operating within China's digital infrastructure, DeepSeek supports both Mandarin and English, while adhering to local linguistic, rhetorical, and regulatory conventions (Zhang, 2024). Although originally designed as a productivity tool rather than an educational platform, DeepSeek has been widely adopted for self-regulated learning, frequently used informally by students outside of formal classroom settings.

This emergent usage pattern positions DeepSeek as a potential site for incidental learning, where English vocabulary acquisition may occur unintentionally as students engage with cognitively demanding academic tasks. Despite this potential, empirical research systematically examining how such informal engagement contributes to English vocabulary development among Chinese university students remains scarce.

Incidental and Situated Vocabulary Learning

This study is anchored in two complementary theoretical perspectives.

First, incidental learning theory (Hulstijn, 2003) posits that vocabulary acquisition can occur without deliberate intention when learners engage in meaning-focused tasks rich in linguistic input. Crucially, incidental learning differs from implicit learning (Ellis, 1994): while incidental learning involves conscious attention to content, implicit learning proceeds without focal awareness.

Second, situated learning theory (Lave & Wenger, 1991) conceptualizes learning as participation in authentic social practices. In higher education, academic reading and writing activities serve as critical pathways into disciplinary discourse communities. When students use DeepSeek to process academic material—through summarization, paraphrasing, or translation—they engage peripherally in the linguistic practices of their fields.

Together, these perspectives provide a robust framework for understanding how an LLM initially designed for text generation can inadvertently function as a space for vocabulary acquisition embedded within students' academic routines.

Research Gap

Despite the surge of research on AI-assisted language learning (AI-LL), the focus has largely remained on globally dominant platforms and formal instructional contexts. Limited attention has been paid to localized LLMs like DeepSeek, characterized by bilingual design and culturally contextualized outputs, or to informal, self-regulated learning practices enabled by non-pedagogical AI tools.

This gap is particularly salient in China, where English remains a compulsory subject across disciplines, yet classroom instruction alone often falls short in supporting domain-specific vocabulary development. Understanding how cognitive, affective, and contextual factors interact in AI-mediated vocabulary learning is therefore critical for advancing both theory and practice.

Research Objectives and Questions

This study aims to investigate the role of DeepSeek in facilitating incidental English vocabulary development among non-English major undergraduates in China. Specifically, the study addresses the following research questions:

(1) What academic purposes and usage patterns characterize students' engagement with DeepSeek?
(2) To what extent do students perceive DeepSeek as contributing to their English vocabulary development?
(3) What cognitive (e.g., retention, recognition) and affective (e.g., motivation, confidence) outcomes are associated with DeepSeek use?

By addressing these questions, this study seeks to contribute theoretically by reframing LLMs as situated language learning spaces and practically by informing pedagogical strategies for integrating AI tools into EFL contexts.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Large Language Models in EFL Learning

Large language models (LLMs), particularly those based on transformer architectures, have been extensively studied in educational contexts for their roles in facilitating text generation, paraphrasing, translation, and real-time feedback (Dwivedi et al., 2023; Kasneci et al., 2023). In English as a Foreign Language (EFL) learning, tools such as ChatGPT and Gemini have demonstrated their potential to enhance writing fluency, reading comprehension, and metalinguistic awareness (Lee, 2023).

These systems empower students to engage in autonomous inquiry, practice academic phrasing, and access contextualized language use.

However, current research remains heavily skewed towards global, English-dominant platforms, with limited attention paid to localized LLMs such as DeepSeek. Developed within the Chinese technological and linguistic ecosystem, DeepSeek facilitates bilingual interaction (Chinese-English) while adhering to local cultural, ethical, and regulatory norms (Zhang, 2024). Its distinct features—controlled lexical outputs, localized genre sensitivity, and dual-language interfacing—position it as a uniquely valuable tool for EFL learners in China. Nevertheless, its potential as a facilitator of language acquisition, rather than merely content processing, remains underexplored.

Vocabulary Development in Informal Digital Environments

Vocabulary acquisition is a critical determinant of EFL learners' academic success, particularly in contexts requiring engagement with English-medium texts and assignments (Nation, 2001; Coxhead, 2000). Traditionally, vocabulary instruction has been explicit, classroom-based, and teacher-directed.

However, emerging evidence indicates that technology-mediated environments offer new opportunities for incidental vocabulary acquisition outside formal instruction (Godwin-Jones, 2018).

Digital platforms—from YouTube to AI-based tools—embed new lexical items within meaningful, multimodal contexts (Webb, 2008; Peters et al., 2019). LLMs further enhance this process by generating paraphrases, examples, and reformulations that reinforce exposure to target vocabulary.

Nonetheless, exposure alone is insufficient; successful incidental acquisition depends on learners' attention, engagement, and frequency of interaction (Schmitt et al., 2011).

Clarifying the Distinction between Incidental and Implicit Learning

A recurrent challenge in vocabulary research is the conflation of incidental learning and implicit learning. As Ellis (1994) and Hulstijn (2003) emphasize, these are distinct processes:

(1) Incidental learning occurs when learners focus on meaning rather than form, yet still consciously notice and retain new language.
(2) Implicit learning, by contrast, is unconscious and does not involve focal attention.

In the context of LLMs such as DeepSeek, vocabulary development is primarily incidental rather than implicit. Students may acquire new words while solving academic tasks—for instance, when asking DeepSeek to paraphrase an abstract or summarize an article.

This distinction is critical for evaluating AI's potential in language education: while not instructional by design, DeepSeek creates conditions conducive to incidental lexical acquisition through repeated, meaningful engagement.

Furthermore, LLMs offer high-frequency, stylistically varied exposure to academic lexis, presenting learners with multiple lexical alternatives (e.g., "analyse," "evaluate," "examine") across diverse syntactic environments, thereby supporting noticing (Schmidt, 2001) and form-meaning mapping.

Situated Learning and Disciplinary Language Socialization

Beyond incidental learning, students' use of DeepSeek engages them in situated academic practices. Situated learning theory (Lave & Wenger, 1991) posits that knowledge is acquired through legitimate peripheral

participation in authentic communities of practice. In higher education, academic reading and writing constitute key avenues for disciplinary enculturation (Hyland, 2009).

When students use DeepSeek to summarize journal articles, translate research abstracts, or generate essay outlines, they are not merely processing information—they are actively participating in the genre-specific, discipline-oriented use of language.

This process reflects a situated trajectory of lexical internalization, wherein learners gradually adopt the terminology and rhetorical structures characteristic of their fields (Charles, 2007; Li & Hafner, 2022).

Unlike traditional instructional tools, LLMs like DeepSeek mediate social-linguistic interaction, simulating expert-like discourse, supporting iterative output generation, and providing immediate, context-aware scaffolding that facilitates both academic socialization and vocabulary transfer.

Research Gap and Study Contribution

Although recent scholarship has examined AI-assisted language learning in East Asia (Sun et al., 2023), research on bilingual, culturally adapted LLMs such as DeepSeek remains limited. Existing studies largely center on global platforms and formal learning environments, overlooking critical dimensions such as:

(1) Informal, self-initiated vocabulary learning through academic AI tools;
(2) The interplay between cognitive and affective outcomes (e.g., motivation, confidence);
(3) The role of AI-generated text in scaffolding disciplinary language acquisition.

Addressing these gaps, this study investigates whether and how incidental vocabulary development occurs through DeepSeek within the Chinese university context. By drawing on the dual lenses of incidental learning and situated academic socialization, this research provides both empirical evidence and theoretical insight into how LLMs—despite not being pedagogical by design—can emerge as authentic, impactful learning spaces within higher education.

III. METHODOLOGY

Research Design

This study adopted a convergent mixed-methods design (Creswell & Plano Clark, 2017) to investigate how Chinese university students incidentally acquire English vocabulary through their academic use of DeepSeek.

The rationale for this design was threefold:

(1) to triangulate quantitative perceptions with qualitative reflections;
(2) to capture both cognitive and affective dimensions of vocabulary development; and
(3) to examine usage patterns in self-regulated, informal learning environments.

By integrating numerical trends and rich narrative accounts, the design provided a comprehensive understanding of DeepSeek's educational impact.

Participants

Participants were 320 non-English major undergraduates recruited from three public universities in western and central China. A stratified sampling strategy was employed to ensure demographic diversity across gender, year of study, and academic discipline (e.g., education, engineering, fine arts).

All participants had passed the College English Test Band 4 (CET-4). To control for baseline vocabulary proficiency, the Vocabulary Size Test (VST) developed by Nation and Beglar (2007) was administered, confirming that participants possessed receptive vocabulary sizes between 3,000–5,000-word families, generally considered the threshold for academic reading competence.

TABLE I: DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

Variable	Categoryy	Frequency (n)	Percentage (%)
Gender	Male / Female	144 / 176	45.0 / 55.0
Year of Study	Sophomore / Junior / Senior	108 / 112 / 100	33.8 / 35.0 / 31.2
Major	Education / Engineering / Fine Arts	80 / 90 / 85	25.0 / 28.1 / 26.6

Instruments

Structured Questionnaire

The structured questionnaire comprised two main sections:

(a) Section A gathered participants' demographic information and DeepSeek usage profiles, including:

- Frequency of use (Less than once per week; 1–2 times per week; 3 or more times per week)
- Primary task types (e.g., summarization, translation, paraphrasing, idea generation)

(b) Section B consisted of 18 Likert-scale items (1 = strongly disagree, 5 = strongly agree), adapted from validated instruments on incidental vocabulary learning and AI engagement (Elgort, 2011; Schmitt et al., 2011; Zhang & Wang, 2023). These items measured:

- Cognitive outcomes: lexical retention, recognition, and contextual understanding
- Affective outcomes: motivation, confidence, and willingness to experiment
- Metacognitive behaviours: noticing, tracking, and reusing target vocabulary

Reliability analysis indicated high internal consistency (Cronbach's $\alpha = 0.915$). The questionnaire was pilot-tested with 30 students and reviewed by two EFL assessment experts to ensure validity.

Open-Ended Reflection

To complement the quantitative data, participants responded to an open-ended question:

> *"Describe any changes in your English vocabulary use or learning experience that you attribute to your use of DeepSeek."*

These qualitative responses provided nuanced insights into students' engagement strategies, perceived vocabulary growth, and affective experiences.

Data Collection Procedures

Data collection was conducted online in March 2025 via university learning platforms and WeChat groups commonly used for academic communication. Participation was voluntary and anonymous, with electronic informed consent obtained prior to survey access.

Out of 342 responses received, 320 were retained after rigorous data screening for completion, logic consistency, and eligibility.

All research procedures were reviewed and approved by the Academic Ethics Committees of the three participating universities.

Data Analysis

Quantitative Analysis

Quantitative data were analysed using SPSS 28.0. Analytical procedures included:

(a) Descriptive statistics (means, standard deviations) to profile participant responses
(b) Pearson correlation analysis to examine relationships between DeepSeek usage frequency and perceived vocabulary learning outcomes
(c) One-way ANOVA to compare vocabulary outcomes across different frequency groups and primary task type.
(d) Post-hoc Tukey tests to identify pairwise differences
(e) Effect sizes (η^2) were reported where appropriate to evaluate the practical significance of findings.

Qualitative Analysis

Qualitative responses from 246 participants were analyzed using thematic analysis (Braun & Clarke, 2006), following a six-phase coding framework:

(a) Familiarization with data
(b) Initial coding
(c) Theme generation
(d) Reviewing themes
(e) Defining and naming themes
(f) Writing up and illustrating findings with direct quotations

Both inductive and theory-driven (deductive) coding approaches were employed, guided by concepts from incidental learning theory (Hulstijn, 2003) and situated academic engagement (Lave & Wenger, 1991). Coding reliability was enhanced through peer debriefing by two trained bilingual coders.

IV. FINDINGS

This chapter presents the results of the quantitative and qualitative analyses, organized around the three research questions. It is structured into four main sections: (1) patterns of DeepSeek usage, (2) perceived vocabulary learning outcomes, (3) comparative analysis by usage frequency and task type, and (4) thematic insights from open-ended responses, including challenges encountered by students.

Patterns of DeepSeek Usage

Survey data revealed diverse patterns of DeepSeek usage among participants for academic tasks. As summarized in Table II, 72.5% of students reported using DeepSeek at least once per week, with 38.1% engaging with the tool three or more times weekly.

TABLE II FREQUENCY AND PURPOSE OF DEEPSEEK USE

Frequency of Use	% of Students	Common Tasks
Less than once/week	27.5%	Translation, occasional paraphrasing
1–2 times/week	34.4%	Summarization, essay outlining
3+ times/week	38.1%	Reading support, full-essay drafting

The most frequently reported academic tasks included summarization (61.3%), paraphrasing (54.8%), and translation (42.9%). These activities reflect active engagement with discipline-specific academic language through DeepSeek.

Perceived Vocabulary Learning Outcomes

Students generally expressed positive perceptions of DeepSeek's contribution to their English vocabulary development. The highest mean scores were observed for:

(1) Confidence in using academic vocabulary (M = 4.15, SD = 0.72)
(2) Motivation to explore lexical alternatives (M = 3.98, SD = 0.70)
(3) Retention of newly encountered terms (M = 3.88, SD = 0.68)
(4) Contextual understanding of usage (M = 3.81, SD = 0.74)

These findings suggest that DeepSeek not only facilitates vocabulary exposure but also promotes learners' confidence and metacognitive engagement with academic English.

Comparative Analysis: Usage Frequency and Task Type

Frequency of Use and Perceived Outcomes

A one-way ANOVA revealed significant differences in vocabulary confidence across usage frequency groups ($F(2, 317) = 5.42$, $p < .01$, $\eta^2 = .079$). Post-hoc Tukey comparisons indicated that high-frequency users (⩾3 times per week) reported significantly greater vocabulary confidence than low-frequency users (<1 time per week).

TABLE III ANOVA RESULTS BY USAGE FREQUENCY

Group	M (Confidence)	SD	F-value	P-value
Low (<1/wk)	3.82	0.71		
Moderate (1–2/wk)	4.01	0.69	5.42	<.01
High (≥3/wk)	4.28	0.64		

These results underscore the positive relationship between frequent DeepSeek use and perceived gains in academic vocabulary confidence.

Task Type and Motivation

When categorized by primary task type, students who primarily used DeepSeek for summarization reported significantly higher motivation (M = 4.06) compared to those who used it mainly for translation (M = 3.72), ($F(1, 318) = 4.31$, $p < .05$).

This suggests that tasks requiring higher-order synthesis, such as summarization, may foster greater lexical engagement and motivational gains.

Thematic Insights from Open-Ended Responses

Analysis of 246 qualitative reflections identified four core themes regarding how DeepSeek influenced students' vocabulary development:

Theme 1: Exposure to Disciplinary Vocabulary

"When I ask DeepSeek to summarize papers, it gives me phrases used by real researchers in my field. I didn't learn these in class." (R112)

Students valued DeepSeek's provision of authentic, genre-specific language, facilitating participation in disciplinary discourse communities (Lave & Wenger, 1991).

Theme 2: Confidence through Safe Experimentation

"I try new words more freely with DeepSeek because I know it will correct me. It feels safer than guessing on my own." (R245)

Students reported reduced anxiety and increased willingness to experiment with new vocabulary, aligning with self-efficacy theory (Bandura, 1997).

Theme 3: Strategic Lexical Awareness and Noticing

"Now I look at how words are used. I save DeepSeek's examples and try to reuse them." (R78)

Evidence of noticing (Schmidt, 2001) and metacognitive engagement emerged, as learners actively tracked and recycled new vocabulary.

Theme 4: Motivation from Output Quality

"It's like learning by example. I get excited when my ideas sound more academic after I use DeepSeek." (R73)

AI-generated outputs stimulated learners' intrinsic motivation to enhance the sophistication and precision of their academic language.

Challenges and Negative Feedback

Approximately 9.1% (n = 29) of respondents reported mixed or negative experiences. Common challenges included:

Overcomplex language output: "Sometimes DeepSeek gives words I don't know how to use." (R97)

Mismatch with learner level: "It helps, but some sentences are too native-like for my writing." (R213)

Further analysis revealed that critical feedback was more prevalent among low-frequency users and participants with lower receptive vocabulary levels (VST < 3500). These findings highlight the need for adaptive output difficulty and vocabulary glossing features to better align DeepSeek's assistance with learners' proficiency.

V. DISCUSSION

This section interprets the key findings through the dual lenses of incidental and situated learning theories. It is organized into three thematic strands: (1) academic engagement and LLM usage patterns, (2) vocabulary development outcomes, and (3) theoretical and pedagogical implications.

DeepSeek as a Medium for Situated Academic Engagement

The findings suggest that DeepSeek is primarily used by Chinese undergraduates to support academic reading and writing—particularly tasks such as summarization, paraphrasing, and translation. Although these are not explicitly vocabulary-focused activities, they immerse learners in discipline-specific discourse and expose them to authentic lexical input. This aligns with situated learning theory (Lave & Wenger, 1991), which emphasizes learning through peripheral participation in real-world practices.

The act of interacting with DeepSeek to process academic texts reflects learners' engagement at the margins of expert discourse communities (Hyland, 2009). DeepSeek functions as a genre-based scaffolding tool, simulating disciplinary patterns and structures. Notably, the frequency of DeepSeek usage emerged as a strong predictor of perceived vocabulary confidence, underscoring the role of routine engagement in fostering deeper linguistic participation.

Vocabulary Development as an Incidental Outcome

Despite the absence of explicit vocabulary instruction, many participants reported enhanced lexical awareness, retention, and confidence—pointing to incidental learning (Hulstijn, 2003) as a primary mechanism. Students acquired new vocabulary not by intention, but as a byproduct of cognitively demanding, meaning-focused academic tasks.

Crucially, this study reinforces the conceptual distinction between incidental and implicit learning (Ellis, 1994). DeepSeek provided salient and structured linguistic input—through paraphrasing, synonyms, and recontextualized expressions—that learner consciously noticed and selectively reused. These findings support noticing (Schmidt, 2001) and form-meaning mapping as foundational processes for durable vocabulary acquisition (Schmitt et al., 2011).

The elevated ratings for confidence and motivation are consistent with prior research on AI-enhanced writing tools

(Kasneci et al., 2023), suggesting that affective factors play a central role in sustaining learner engagement with LLMs.

Addressing Limitations: Mismatched Input and User Adaptation

While the majority of participants benefited from DeepSeek, approximately 9.1% reported challenges related to overcomplex output or lack of adaptability. These concerns were especially pronounced among lower-proficiency learners (VST < 3500) and infrequent users, who found DeepSeek's suggestions either too native-like or beyond their productive range.

These findings resonate with recent critiques of LLM deployment in EFL contexts (Liu et al., 2024), highlighting the need for adaptive scaffolding, such as proficiency-aligned output, vocabulary glossing, and simplified examples. Importantly, they point to a broader pedagogical need: the integration of teacher mediation to facilitate learners' decoding, evaluation, and appropriation of AI-generated content.

Pedagogical Implications for AI-Augmented EFL Learning

This study yields several practical strategies for educators aiming to incorporate DeepSeek into EFL learning environments:

(1) Noticing Tasks: Instructors can guide learners to compare original and AI-generated sentences, identifying lexical or syntactic shifts.
(2) Vocabulary Logs: Students may maintain AI-assisted word journals that record new terms, usage contexts, and attempted reuse.
(3) AI-Augmented Writing: Teachers can embed DeepSeek into drafting workflows—for brainstorming, paraphrasing, or editing—while encouraging critical evaluation of outputs.
(4) Digital Ethics and Literacy: To prevent overreliance or academic misconduct, educators should embed discussions of AI literacy and source transparency into instruction.

By integrating these strategies, instructors can leverage LLMs not only as content support tools but also as instruments for intentional and reflective vocabulary development.

Theoretical Contributions and Conceptual Advancements

This study contributes to second language acquisition (SLA) theory in three significant ways:

(1) Reconceptualizing LLMs as Incidental Learning Spaces: While DeepSeek was not designed as an instructional tool, its role in facilitating unintentional vocabulary acquisition challenges the conventional boundary between "learning platforms" and "productivity tools."
(2) Extending Situated Learning to AI Contexts: The study shows that students' interaction with LLMs can represent a new form of legitimate peripheral participation—mediated not by human experts, but by machine-generated discourse tailored to academic genres.
(3) Foregrounding Affective Dynamics: Confidence and motivation—often overlooked in vocabulary research—emerged as critical enablers of sustained engagement with AI tools. This calls for expanded models that integrate cognitive, contextual, and affective variables in AI-LL settings.

VI. CONCLUSION

This study explored how DeepSeek, a localized large language model (LLM) developed in China, serves as an emergent informal learning space for incidental English vocabulary development among non-English major university students. Guided by the theoretical frameworks of incidental learning and situated learning, the research employed a convergent mixed-methods design to examine academic usage patterns, vocabulary learning outcomes, and learners' perceptions within self-regulated, AI-mediated environments.

Summary of Key Findings

The findings revealed that students primarily engaged with DeepSeek for academic support tasks such as summarization, paraphrasing, and translation. Despite the absence of explicit vocabulary learning intentions, incidental vocabulary development was widely reported. Quantitative results demonstrated significant perceived gains in confidence, motivation, and contextual understanding, particularly among high-frequency users. Thematic analysis of qualitative reflections reinforced these results, highlighting learners' increased exposure to disciplinary language, strategic noticing behaviours, and positive affective engagement.

However, challenges emerged among a subset of users, particularly those with lower proficiency levels, who experienced difficulties in adapting to DeepSeek's complex linguistic outputs. This underscores the importance of adaptive scaffolding and teacher mediation when integrating AI tools into language learning contexts.

Theoretical and Practical Contributions

Theoretical Contributions

This study advances the field of AI-assisted language learning (AI-LL) by:

(a) Extending incidental learning theory to AI-mediated academic practices, demonstrating that unintentional vocabulary acquisition can occur through engagement with productivity-oriented platforms.
(b) Adapting situated learning theory to digital academic environments, illustrating that interaction with localized LLMs fosters peripheral participation in disciplinary discourse communities.
(c) Highlighting the affective dimension of AI-LL, positioning confidence and motivation as central drivers of learner persistence and strategic adaptation.

These contributions call for a more holistic understanding of AI in second language acquisition, one that integrates cognitive, contextual, and emotional dimensions.

Pedagogical Contributions

This study provides empirical support for the pedagogical integration of LLMs into EFL curricula, emphasizing:

(a) The design of noticing-enhanced tasks that prompt lexical comparison and strategic attention.
(b) The use of AI-assisted vocabulary logs to promote active engagement with new terms and usage contexts.
(c) The incorporation of AI literacy and ethics training to foster responsible, reflective use of AI technologies in academic work.

These practices align LLM deployment with both incidental vocabulary growth and intentional skill development, enhancing students' autonomy and academic literacy.

Policy Implications for Local AI Integration

To maximize the educational potential of LLMs like DeepSeek, policymakers and institutional leaders should:

(a) Embed LLM literacy programs into university-level digital literacy curricula, equipping students with critical engagement skills.
(b) Integrate AI ethics modules into EFL instruction, addressing issues such as plagiarism, overreliance, and source transparency.
(c) Support research and development of culturally adapted AI tools that align with local linguistic practices and learner proficiency profiles.

Such initiatives will ensure that emerging AI technologies contribute not only to productivity, but also to equitable, pedagogically informed language development across diverse educational settings.

Limitations and Future Directions

Several limitations warrant consideration. First, vocabulary development was assessed primarily through self-reported perceptions, which may be subject to bias. Future studies should incorporate standardized vocabulary assessments and longitudinal tracking to objectively capture learning trajectories over time. Second, the participant sample was restricted to non-English major undergraduates; expanding research to include English majors, postgraduate learners, or diverse disciplinary backgrounds could reveal important variations.

Future research should also explore:

(1) Cross-platform comparisons (e.g., DeepSeek vs. ChatGPT) to examine cultural and algorithmic differences in learning outcomes;
(2) Longitudinal impacts of sustained LLM engagement on both productive (use) and receptive (comprehension) vocabulary skills;
(3) Teacher-AI-student mediation frameworks, investigating how human guidance can optimize autonomous learning in AI-augmented environments.

By addressing these dimensions, subsequent research can further elucidate the complex dynamics of AI-mediated vocabulary development and inform the design of more inclusive, adaptive, and effective language learning ecosystems.

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