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The Affordances of AI for Informal Digital Learning of English: An Ecological Systems Perspective

Xiaochen Wang *Yang Gao*
School of Foreign Studies, Xi'an Jiaotong University, 710049, China
Corresponding author: Gaoyang666@xjtu.edu.cn

Abstract

Artificial intelligence (AI) is reshaping how university students engage with English beyond formal instruction, yet limited attention has been paid to how AI affords informal digital learning of English (IDLE). Guided by ecological systems theory, this study explored how AI creates learning opportunities for students' IDLE. A qualitative research design was adopted, and semi-structured interviews were conducted with 20 university students who had experience using AI tools for IDLE. The data were analyzed through theory-informed thematic analysis combining deductive and inductive coding. The findings identified five interconnected affordance dimensions: learner affordances (personalized goal support, self-paced learning control, low-anxiety experimentation, and confidence enhancement), technological affordances (immediate language feedback, generative language scaffolding, multimodal resource expansion, and adaptive practice design), interactional affordances (simulated conversation, dialogic meaning negotiation, and communicative rehearsal), institutional affordances (classroom extension, teacher feedback supplementation, and coursework support), and developmental affordances (learning routine

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formation, strategic AI use, and AI literacy development). The study reframes AI as an affordance-generating resource and offers implications for responsible AI-mediated IDLE practice and pedagogy.

Keywords: Artificial intelligence; Informal digital learning of English; Ecological systems theory; AI affordances; University students

Introduction

Artificial intelligence (AI) is increasingly reshaping the ecology of English learning by expanding where, when, and how learners engage with the language beyond formal instruction (Crompton et al., 2024; Lee et al., 2026). In this changing landscape, informal digital learning of English (IDLE) has become an important concept for understanding learners' self-directed English practices outside the classroom, often mediated by digital technologies and driven by personal interests, needs, and goals (Liu & Ma, 2024; Liu et al., 2025). Prior research has shown that IDLE can provide learners with authentic input, flexible participation, and opportunities for receptive and productive language use, thereby contributing to vocabulary development, willingness to communicate, engagement, and learner autonomy (Ali, 2026; Lee & Cho, 2025). More recent work has begun to consider the role of AI in IDLE, particularly in providing feedback, facilitating interaction, supporting writing, and offering personalized assistance (Nguyen et al., 2025; Zou et al., 2025). However, existing research has paid limited attention to how AI, as a newly emerging technological resource, affords IDLE itself. This gap makes it necessary to examine how AI creates new learning possibilities within students' IDLE practices.

To address this gap, the present study explores how AI affords university students' IDLE. Guided by ecological systems theory, the study conceptualizes AI-mediated IDLE as a language learning practice embedded in students' broader digital, social, and educational ecologies. The study contributes to IDLE research by reframing AI as an affordance-generating resource rather than a simple learning tool. It also extends AI-supported language learning research by offering an ecological account of how AI may enrich learners' IDLE experiences and inform pedagogical support for responsible out-of-class AI use in contemporary higher education contexts.

Literature Review

AI in IDLE

IDLE refers to learners' engagement with English beyond formal classroom settings through digital technologies (Lee & Lee, 2021). Unlike teacher-directed instruction, IDLE is usually shaped by learners' own interests, needs, goals, and everyday digital practices (Lee, 2026). It includes a wide range of activities, such as watching English videos, using language learning applications, listening to podcasts, participating in online communities, playing digital games, and interacting with English content on

social media (Namaziandost, 2025). These activities provide learners with authentic language input, flexible learning opportunities, and spaces for both receptive and productive language use (Solhi et al., 2026). Previous research has shown that IDLE can contribute to vocabulary development, willingness to communicate, learning engagement, learner autonomy, and expanded exposure to English (Huynh, 2025). Therefore, IDLE should not be viewed merely as an informal supplement to classroom learning (Mashhadi et al., 2026). Rather, it represents a meaningful form of digitally mediated language learning embedded in learners' daily lives and increasingly central to understanding English learning in technology-rich environments.

The emergence of AI has further transformed the nature of IDLE by introducing new forms of interaction, feedback, and content generation (Liu & Ma, 2024). In traditional IDLE, learners mainly rely on existing digital resources, such as videos, websites, online dictionaries, language applications, and social networking platforms (Lee, 2026). Their learning often involves searching, selecting, watching, reading, or communicating through available materials (Guo et al., 2026). By contrast, AI tools can respond to learners' immediate needs by generating explanations, examples, dialogues, translations, writing revisions, pronunciation suggestions, grammar feedback, and personalized learning tasks (Liu, 2026). This development shifts IDLE from resource-access learning to interactive and generative learning. Learners are no longer only consumers of digital English materials, but active participants who co-construct learning opportunities with intelligent systems (Wang et al., 2025). In this sense, AI becomes a new technological resource that expands what learners can do in IDLE, offering personalized scaffolding, immediate feedback, multimodal exposure, low-pressure practice, and more flexible pathways for autonomous English learning (Rezai et al., 2026).

Recent scholarship has begun to examine AI-mediated IDLE from several perspectives. First, some studies have explored its learning effects, focusing on how AI-supported IDLE may enhance engagement, writing performance, oral practice, vocabulary learning, motivation, confidence, and learner autonomy (Wang et al., 2026; Zhou & Liu, 2026). Second, other studies have considered the factors shaping students' use of AI in IDLE, including AI literacy, self-regulation, perceived usefulness, learning goals, technological access, teacher support, and prior digital learning experience (Guan et al., 2024; Liu & Hossain, 2026). These studies have contributed valuable insights into whether AI-mediated IDLE is effective and what conditions may influence students' participation. However, relatively little is known about how AI actually affords IDLE as a new learning ecology. Addressing this gap, the present study investigates how AI functions as an affordance-generating resource for university students' IDLE.

Ecological Systems Theory as the Theoretical Framework

Ecological systems theory provides a useful lens for understanding the affordances of AI for IDLE because it views learning as an outcome of continuous interaction between individuals and their surrounding environments (Rezai et al., 2024). Originating from Bronfenbrenner's work, the theory emphasizes that learners' development is shaped not only by personal characteristics, but also by direct learning settings, social relationships, institutional arrangements, wider cultural values, and changes over time (Bronfenbrenner, 1979). This perspective is

particularly relevant to IDLE, which takes place beyond formal classroom boundaries and is embedded in learners' everyday digital practices (Guo & Lee, 2023). When AI enters IDLE, it does not simply add another technological tool to students' learning routines (Liu, 2026). Rather, it reorganizes how learners access resources, receive feedback, practice language, manage learning choices, and connect classroom and out-of-class experiences (Wang & Guo, 2026). Therefore, ecological systems theory is appropriate for this study because it enables AI to be examined as a new ecological resource that generates learning affordances across multiple layers of students' English learning environments.

In this study, ecological systems theory is used as a guiding framework rather than a fixed classification scheme. Instead of mechanically applying the original ecological levels, the study translates the theory into five affordance dimensions that better capture students' experiences of AI-mediated IDLE. Learner affordances refer to how AI supports students' autonomy, confidence, interest, low-anxiety practice, and self-regulated learning. Technological affordances concern the functions of AI tools themselves, including immediate feedback, personalized scaffolding, multimodal input, language revision, and learning-material generation. Interactional affordances describe how AI reshapes opportunities for communication, such as simulated dialogue, oral rehearsal, peer preparation, and readiness for authentic interaction. Institutional affordances refer to the ways AI extends classroom learning, supplements teacher feedback, assists coursework, and supports examination preparation. Developmental affordances capture how students' AI use evolves over time, including the formation of learning routines, strategic prompting, and AI literacy. Together, these dimensions explain how AI affords IDLE within a broader learning ecology.

Methodology

Research Design

This study adopted a qualitative research design to examine how AI affords university students' IDLE. Semi-structured interviews were used as the primary method because they allowed participants to provide detailed accounts of how they used AI tools beyond the classroom, what kinds of learning support they perceived, and how these experiences were embedded in their broader learning environments. Guided by ecological systems theory, the study conceptualized AI-mediated IDLE as a situated learning practice shaped by interactions among learners, digital tools, social relationships, institutional contexts, and developmental experiences. Accordingly, the study was guided by the following research question:

> How does AI afford university students' informal digital learning of English from an ecological systems perspective?

Participants

Participants were recruited through purposive sampling to ensure that all informants had relevant experience with the phenomenon under investigation. Two inclusion criteria were used: first, participants must have used AI tools for IDLE; second, they must have understood the research purpose and design and still agreed voluntarily to participate. A total of 20 university students were included in the study. In terms of

gender, the sample consisted of eight male students and twelve female students. Regarding institutional background, six participants came from Project 985 universities, seven from Project 211 universities, and seven from other higher education institutions in China. This distribution helped capture students' AI-mediated IDLE experiences across different institutional contexts. All participants were assigned pseudonyms to protect their identities and ensure confidentiality throughout data collection, analysis, and reporting.

Instruments

The main research instrument was a semi-structured interview protocol developed in line with the purpose of the study and ecological systems theory. The interview questions were designed to elicit students' experiences of using AI tools for IDLE. The protocol included four parts. The first part collected background information, such as students' English learning experience, AI tool use, and general familiarity with IDLE. The second part focused on how students used AI tools in out-of-class English learning activities, including speaking, writing, reading, vocabulary learning, translation, feedback seeking, and resource generation. The third part explored students' perceived affordances of AI-mediated IDLE across learner, technological, interactional, institutional, and developmental dimensions. The final part invited participants to reflect on memorable experiences, changes in learning habits, and the perceived value of AI for IDLE. Follow-up questions and probes were used to obtain richer examples and clarification.

Data Collection

Semi-structured interviews were conducted via Tencent Meeting in May 2026. Before the interviews, participants were informed of the research purpose, interview procedure, voluntary nature of participation, and confidentiality measures. After obtaining informed consent, interviews were conducted individually in a quiet and convenient setting, either face-to-face or online according to participants' availability. Each interview lasted approximately 30 to 45 minutes and was audio-recorded with participants' permission. During the interviews, participants were encouraged to describe concrete examples of how they used AI tools for IDLE, what learning opportunities they perceived, and how such experiences were connected to their broader learning environments. The interviewer also used prompts to clarify meanings and elicit detailed accounts. After the interviews, all recordings were transcribed verbatim. To protect participants' privacy, identifying information was removed, and pseudonyms were used in all transcripts and subsequent analysis.

Data Analysis

The interview data were analyzed using theory-informed thematic analysis. The analysis combined deductive and inductive coding procedures in order to examine AI affordances in students' IDLE while remaining open to meanings emerging from the data. First, all interview transcripts were read repeatedly to develop a holistic understanding of participants' AI-mediated IDLE experiences. Second, an initial coding framework was developed with reference to ecological systems theory and the research question. Third, two researchers independently coded the transcripts and identified meaningful units related to AI-generated learning opportunities. After the

initial coding, the two coders compared their coding results, discussed discrepancies, and refined the codebook through repeated reference to the original transcripts. Inter-coder reliability was calculated using Cohen's kappa, and the result indicated a high level of agreement ($\kappa = 0.92$). Finally, similar codes were grouped into broader themes, and representative excerpts were selected to illustrate each affordance dimension.

Findings

Learner Affordances

Personalized Goal Support

Personalized goal support emerged as a key learner affordance in students' AI-mediated IDLE practices. In out-of-class English learning, participants did not use AI merely as a general search tool; rather, they described it as a responsive learning partner that could adjust explanations, examples, and tasks according to their specific goals, proficiency levels, and immediate learning needs. P4's account shows that AI helped transform a broad intention to improve speaking into concrete daily conversation tasks, making informal learning more purposeful and manageable. Similarly, P13's reflection indicates that AI enabled students to diagnose their weak areas and receive targeted support for academic writing and vocabulary development. Together, these accounts suggest that AI afforded IDLE by turning individualized learning needs into accessible, goal-oriented, and personally meaningful learning actions within students' everyday digital routines, as illustrated in the following excerpts:

> P4: "*When I wanted to improve my spoken English, I asked AI to design daily conversation topics for me. It felt more suitable than randomly searching for materials online because the topics were connected to my own interests.*"
>
> P13: "*I usually tell AI what I am weak at, such as academic writing or vocabulary. Then it gives me examples and practice that fit my level, so I feel the learning process is more targeted.*"

Self-Paced Learning Control

Self-paced learning control was another important learner affordance created by AI-mediated IDLE. Participants reported that AI allowed them to decide when to learn, what to practice, how long to continue, and how many times to revisit the same problem without being constrained by classroom schedules or teacher availability. P8's account illustrates how AI enabled fragmented but purposeful English learning, as short periods of free time could be transformed into informal learning opportunities. In contrast, P17 emphasized the value of slowing down the learning process, especially when difficult explanations needed to be repeated, simplified, or rephrased. These accounts suggest that AI afforded students greater control over the rhythm and intensity of their out-of-class English learning. Rather than following a fixed instructional pace, learners could adjust AI-mediated IDLE to their own attention, energy, and understanding, as shown in the following excerpts:

> P8: "*I often use AI when I only have a little free time, such as before class or while waiting for a bus. I may ask it to give me a short dialogue or explain one*

expression, so even ten minutes can become useful."

P17: "*Sometimes I do not understand the first explanation, but I do not feel pressured. I can ask AI to explain it again, make it easier, or give another example until I really understand it.*"

Low-Anxiety Experimentation

Low-anxiety experimentation emerged as a salient learner affordance in students' AI-mediated IDLE experiences. In IDLE, participants frequently described AI as a private and non-judgmental space where they could test expressions, practice pronunciation, ask simple questions, and make mistakes without worrying about negative evaluation from teachers or peers. P2's account shows that AI reduced the emotional pressure commonly associated with speaking practice, especially for students who felt nervous when communicating in English with real people. P15's reflection further indicates that AI made it easier for learners to ask basic or repeated questions that they might avoid asking in a classroom setting. Together, these accounts suggest that AI afforded IDLE by creating a safe rehearsal space for trial, revision, and experimentation. This low-pressure environment encouraged students to engage more actively with English beyond the classroom, as illustrated below:

P2: "*When I practice speaking with AI, I feel much less nervous because it will not interrupt me or laugh at my pronunciation. I can repeat the same sentence many times before I try to say it to others.*"

P15: "*Some questions are actually very simple, and I may feel embarrassed to ask classmates or teachers. But with AI, I can ask directly, even if the question sounds basic, and then I slowly build up my understanding.*"

Confidence Enhancement

Confidence enhancement was also identified as a meaningful learner affordance of AI-mediated IDLE. Participants indicated that AI support made their progress more visible by providing explanations, alternative expressions, corrective feedback, and opportunities for repeated practice. P6's account suggests that AI helped students reinterpret mistakes as manageable learning problems rather than signs of poor ability, thereby reducing self-doubt in English learning. P19's reflection shows a different form of confidence, as AI support helped the learner prepare for authentic academic communication and feel more capable of using English in real situations. These accounts indicate that AI did not simply provide technical assistance; it also reshaped students' emotional relationship with English learning. By making improvement more observable and practice more accessible, AI afforded students a stronger sense of competence and encouraged continued participation in IDLE, as shown in the following excerpts:

P6: "*Before using AI, I often thought my English sentences were just wrong and I did not know how to improve them. When AI explains the problem and gives a better version, I feel that my mistakes can actually be fixed.*"

P19: "*I once used AI to help me prepare questions for an English group discussion. When I finally spoke in class, I felt more prepared than before, and that experience made me believe I could use English more actively.*"

Technological Affordances

Immediate Language Feedback

Immediate language feedback was one of the most frequently mentioned technological affordances in students' AI-mediated IDLE practices. Participants described AI as a readily available feedback source that could respond to their language problems at the moment when difficulties occurred, especially in writing, grammar, vocabulary choice, and sentence-level expression. P1's account shows that AI made out-of-class writing practice more actionable because students could identify unnatural expressions immediately rather than leaving problems unresolved. P12's reflection further suggests that AI feedback was valued not only for correction, but also for explanation, as students could ask why a form was inappropriate and how it could be improved. These accounts indicate that AI strengthened the feedback loop in IDLE by making language support more immediate, accessible, and explanatory. For students who often lacked timely feedback outside the classroom, this function became an important condition for sustained informal learning.

P1: "*When I write a paragraph by myself, I usually cannot tell which sentences sound unnatural. AI can point them out immediately and give me a more natural version, so I know what to revise.*"

P12: "*I do not only ask AI to correct my grammar. I often ask why it is wrong, and sometimes it explains the rule with examples. That helps me remember the problem better.*"

Generative Language Scaffolding

Generative language scaffolding also emerged as a central technological affordance of AI-mediated IDLE. Unlike conventional digital resources that mainly require students to search, select, and consume existing materials, AI enabled participants to generate examples, expressions, outlines, dialogues, and practice tasks according to their immediate learning needs. P5's account illustrates how AI helped bridge the gap between an intended meaning and an appropriate English expression, particularly when students knew what they wanted to say but lacked linguistic resources. P18's reflection shows that AI could also support higher-level language production by offering a tentative structure for writing, which students could then evaluate, revise, and personalize. These accounts suggest that AI did not simply provide ready-made answers; rather, it offered flexible scaffolds that students could adapt during informal learning. In this way, AI made IDLE more generative, responsive, and closely connected to students' own language production.

P5: "*Sometimes I have an idea in Chinese, but I do not know how to say it naturally in English. I ask AI to give me several possible expressions, and then I choose the one that fits my meaning.*"

P18: "*Before writing an English assignment, I sometimes ask AI to help me organize the structure. I do not copy it directly, but the outline gives me a starting point.*"

Multimodal Resource Expansion

Multimodal resource expansion was another technological affordance that shaped students' IDLE with AI. Participants reported that AI helped them move beyond single-text learning by creating or reorganizing materials in different forms, such as dialogues, vocabulary lists, short explanations, listening scripts, pronunciation models, and topic-based learning packages. P9's account shows how AI-supported materials could connect reading, listening, and speaking practice, allowing students to turn a written dialogue into an oral learning activity. P14's reflection further indicates that AI helped learners build contextualized resources around a topic, including background knowledge, useful expressions, and sample conversations. These accounts suggest that AI expanded the range and usability of digital English resources available in IDLE. Instead of relying only on scattered online materials, students could assemble more coherent learning resources that matched their interests, proficiency levels, and preferred modes of learning.

P9: "*I sometimes ask AI to create a short dialogue about travel or campus life. Then I listen to it with the voice function and practice reading it aloud, so it becomes both listening and speaking practice.*"

P14: "*When I learn a topic, such as environmental issues, AI can give me key words, background information, and example sentences. It feels more organized than searching many websites separately.*"

Adaptive Practice Design

Adaptive practice design was identified as a further technological affordance in students' AI-mediated IDLE experiences. Participants explained that AI could adjust practice materials according to their current level, recent mistakes, and changing learning goals, which made informal learning more targeted than using fixed exercises or general online resources. P3's account shows that AI helped lower the entry barrier by generating easier reading materials and comprehension questions when the learner found authentic texts too difficult. P20's reflection presents a different pattern, in which AI responded to repeated tense errors by creating focused grammar practice. These accounts indicate that AI made practice in IDLE more adaptive and cyclical: students encountered a problem, received feedback, requested further practice, and then returned to the same skill with more support. Such adaptability helped students sustain out-of-class learning without depending entirely on predesigned textbooks, apps, or teacher-assigned exercises.

P3: "*I told AI that some English articles were too difficult for me, so it made a shorter reading passage with easier words and several questions. That made me more willing to continue reading.*"

P20: "*After AI found that I often made mistakes with tense, I asked it to give me more practice on that part. The exercises were connected to my own mistakes, so they felt more useful.*"

Interactional Affordances

Simulated Conversation

Simulated conversation emerged as an important interactional affordance in students' AI-mediated IDLE practices. Participants described AI as an accessible conversational partner that allowed them to practice English in situations where real interlocutors were unavailable or difficult to approach. In this sense, AI changed

IDLE from a largely input-oriented activity into a more interactive experience, especially for students who wanted more opportunities to speak, respond, and maintain conversations in English. P7's account shows how AI created a daily conversational space that compensated for the limited availability of English-speaking partners in students' immediate environments. P16's reflection further indicates that AI-based role-play could make practice more situated, particularly when students needed to prepare for specific communicative events. These accounts suggest that AI afforded IDLE by creating flexible and repeatable interactional spaces where students could use English for meaningful communication beyond the classroom.

P7: "*I sometimes ask AI to act as a foreign friend and chat with me about daily life. It gives me more chances to speak English, especially when I cannot find someone around me to practice with.*"

P16: "*Before an English interview, I used AI to play the role of the interviewer. It asked me follow-up questions, so the practice felt more like a real conversation rather than just memorizing answers.*"

Dialogic Meaning Negotiation

Dialogic meaning negotiation was another interactional affordance that characterized students' AI-mediated IDLE experiences. Rather than receiving information from AI in a one-way manner, participants often engaged in a process of questioning, clarification, reformulation, and comparison. This dialogic process enabled students to refine their understanding of vocabulary, sentence meaning, pragmatic appropriateness, and stylistic differences during informal learning. P10's account shows that AI allowed students to adjust the level of explanation when they encountered unfamiliar expressions, making comprehension more gradual and manageable. P2's reflection highlights a different form of negotiation, in which students compared multiple versions of the same sentence to understand how language choices varied across contexts. These accounts indicate that AI afforded IDLE by supporting an interactive process of meaning-making. Through repeated exchanges with AI, students could move beyond surface-level answers and develop a more situated understanding of English use.

P10: "*If AI gives me an expression that I do not fully understand, I ask it to explain the meaning in simpler English or give me more examples. I feel I can keep asking until the meaning becomes clear.*"

P2: "*I often ask AI to rewrite the same sentence in different styles, such as formal, casual, and academic. By comparing the versions, I can see which expression is more suitable for different situations.*"

Communicative Rehearsal

Communicative rehearsal also appeared as a meaningful interactional affordance of AI-mediated IDLE. Participants used AI not only for general language practice, but also to prepare for upcoming real-life or academic communication, such as presentations, classroom discussions, interviews, and English emails. In these cases, AI served as a rehearsal space that helped students organize ideas, test expressions, anticipate possible responses, and reduce uncertainty before entering actual communicative situations. P11's account illustrates how AI supported oral

preparation by helping students check whether their wording was clear and natural before a presentation. P18's reflection shows that AI also supported written communication by allowing students to revise and practice an email before sending it to a real recipient. These accounts suggest that AI did not replace authentic communication. Instead, it afforded students a preparatory interactional space that made participation in real English communication more manageable and confident.

P11: "*Before giving a presentation, I ask AI to check whether my wording is clear and natural. After revising with AI, I feel more prepared when I have to speak in front of others.*"

P18: "*When I need to write an email in English, I first practice with AI and ask it to make the tone more polite. After several revisions, I feel more confident sending it to a real person.*"

Institutional Affordances

Classroom Extension

Classroom extension emerged as an institutional affordance of AI-mediated IDLE. Participants described AI as a resource that helped them continue, revisit, and expand classroom learning after formal instruction had ended. In this sense, AI did not separate IDLE from institutional learning; rather, it created a bridge between what students encountered in class and what they explored independently beyond the classroom. P6's account shows that AI allowed students to return to classroom knowledge at their own pace, especially when textbook explanations or classroom time were insufficient for full understanding. P13's reflection further indicates that AI helped students extend classroom topics by generating related expressions, examples, and background knowledge. These accounts suggest that AI afforded IDLE by making formal learning more continuous and expandable. Through AI, classroom content could be transformed into further inquiry, practice, and exploration in students' everyday digital learning environments.

P6: "*After class, I sometimes ask AI to explain the grammar point again. In class, the teacher may move quickly, but AI can explain it more slowly and give me several examples.*"

P13: "*When we discuss a topic in class, I use AI after class to learn more expressions and background information. It helps me continue the topic instead of stopping after the lesson.*"

Teacher Feedback Supplementation

Teacher feedback supplementation was another institutional affordance identified in students' AI-mediated IDLE practices. Participants did not present AI as a replacement for teachers, but as an additional source of language support when teacher feedback was limited, delayed, or unavailable outside class time. This was particularly evident in writing, translation, presentation preparation, and sentence-level revision, where students often needed immediate comments before submitting or sharing their work. P1's account shows that AI helped students conduct preliminary revisions before seeking teacher feedback, which made their questions more focused and their drafts more polished. P17's reflection suggests that students also exercised judgment when using AI feedback, selecting useful suggestions rather than accepting all revisions uncritically. These accounts indicate that AI afforded

IDLE by extending the reach of institutional feedback beyond classroom boundaries. It allowed students to engage in more continuous revision while still recognizing the value of teacher guidance.

P1: "*Teachers cannot check every sentence I write, so I usually ask AI to find obvious problems first. After that, if I still have questions, I can ask the teacher more specifically.*"

P17: "*Before submitting my assignment, I ask AI to give some suggestions. I do not use everything it says, but it helps me notice problems that I may ignore by myself.*"

Coursework Support

Coursework support also appeared as a meaningful institutional affordance of AI-mediated IDLE. Participants used AI to make course-related English tasks more understandable, manageable, and actionable outside formal classroom settings. Rather than treating coursework as separate from informal learning, students often used AI to interpret assignment requirements, organize presentation ideas, polish English expressions, and prepare for group projects. P5's account illustrates how AI helped students clarify task expectations when English-language instructions were difficult to understand, thereby reducing uncertainty at the beginning of coursework. P20's reflection shows that AI also supported collaborative course tasks by helping students improve their individual contributions before discussing them with classmates. These accounts suggest that AI afforded IDLE by turning institutional requirements into opportunities for self-directed English learning. Through AI support, students could move from passive task completion to more active preparation, revision, and participation in course-related language practices.

P5: "*Sometimes the assignment instructions are written in English, and I am not completely sure what I should do. I ask AI to explain the requirements in simpler words, and then I know how to start.*"

P20: "*For group projects, I often use AI to polish my part before meeting my classmates. It helps me express my ideas more clearly, so I feel I can contribute better to the discussion.*"

Developmental Affordances

Learning Routine Formation

Learning routine formation emerged as a developmental affordance of AI-mediated IDLE. Participants reported that AI made IDLE easier to start and easier to maintain, especially because it was available at any time and could respond to small learning needs in daily life. Over time, some students moved from occasional AI use to more regular practices, such as daily conversations, vocabulary review, sentence revision, short reading tasks, or pronunciation practice. P4's account shows how a simple nightly interaction with AI gradually developed into a stable learning habit. P12's reflection presents a more fragmented pattern, in which AI helped embed English learning into waiting time, commuting time, or short breaks between classes. These accounts suggest that AI afforded IDLE not only by providing learning materials, but also by helping students integrate English learning into everyday routines. In this way, informal learning became more continuous, accessible, and personally sustainable.

P4: "*At first, I only used AI when I had homework problems. Later, I started to chat with it for five minutes every night, and gradually it became part of my English learning routine.*"

P12: "*When I am waiting for class or taking the bus, I use AI to review a few words or practice a short dialogue. It is not a long study session, but it makes English learning more regular.*"

Strategic AI Use

Strategic AI use was another developmental affordance found in students' AI-mediated IDLE experiences. Participants described a gradual shift from asking simple or general questions to using AI in more deliberate and reflective ways. As they became more familiar with AI tools, students learned to provide clearer contexts, set specific roles, adjust task difficulty, request multiple versions, compare outputs, and ask follow-up questions. P8's account shows that students' prompting practices became more contextualized over time, which improved the relevance of AI responses. P15's reflection further indicates that students did not necessarily accept AI's first answer but used comparison and selection as part of their learning process. These accounts suggest that AI afforded IDLE by encouraging students to develop more active control over digital learning interactions. The value of AI-mediated IDLE therefore lay not only in what AI provided, but also in how students gradually learned to use AI more strategically.

P8: "*At the beginning, I only asked very simple questions, like 'How to say this in English?' Later, I learned to give AI more background and tell it my purpose, so the answers became much more useful.*"

P15: "*I usually do not accept the first answer immediately. I ask AI to give me two or three versions, and then I compare them to decide which one is more suitable for my situation.*"

AI Literacy Development

AI literacy development also emerged as an important developmental affordance of AI-mediated IDLE. Through repeated use of AI for IDLE, participants gradually became more aware of both the usefulness and limitations of AI-generated language support. They learned that AI outputs could be helpful for explanation, revision, and practice, but might also contain unnatural expressions, inaccurate information, or suggestions that did not fit their intended context. P3's account shows that students began to question AI output when an expression sounded unusual, rather than accepting it automatically. P19's reflection further suggests that students developed verification habits by comparing AI responses with other sources. These accounts indicate that AI-mediated IDLE contributed not only to English learning, but also to students' capacity to evaluate, verify, and use AI responsibly. In this sense, AI afforded a developmental space where language learning and critical digital competence evolved together.

P3: "*Sometimes AI gives me an expression that sounds a little strange, so I do not use it directly. I ask it to explain why the expression is appropriate, or I check it again in another way.*"

P19: "*I think AI is useful, but I have learned that I cannot trust everything it says. If the answer is important, I compare it with other sources or ask again in a*

different way."

Discussion

The present study examined how AI affords university students' IDLE from the perspective of ecological systems theory. The findings show that AI does not support IDLE through a single technological function, but through multiple ecological pathways that reshape students' agency, tool use, interactional opportunities, institutional support, and developmental trajectories. Across the five affordance dimensions, AI was found to make IDLE more personalized, responsive, interactive, institutionally connected, and developmentally sustainable. This finding suggests that AI should not be understood merely as an auxiliary learning tool added to students' existing digital practices. Rather, it functions as an affordance-generating resource that reorganizes how learners access support, practice language, negotiate meaning, connect classroom and out-of-class learning, and gradually develop more strategic learning practices. In this sense, AI-mediated IDLE represents not only a new form of technology-supported informal learning, but also an emerging learning ecology in which learners, tools, contexts, and time are dynamically intertwined.

First, the learner affordances identified in this study show that AI can strengthen students' personal agency in IDLE by supporting individualized goals, self-paced learning, low-anxiety experimentation, and confidence enhancement. This finding is broadly consistent with previous IDLE research, which has emphasized learner autonomy, interest-driven participation, and self-directed engagement as key features of IDLE (Ko, 2026; Yang et al., 2026). However, the present study further indicates that learner agency in AI-mediated IDLE is not simply an internal attribute of the student. Instead, it is activated and sustained through AI's capacity to provide immediate responses, personalized guidance, and emotionally safer spaces for practice. In particular, students were able to turn vague learning intentions into concrete tasks, repeat difficult content without embarrassment, and reinterpret mistakes as manageable learning problems. This suggests that AI makes autonomy more operational and affectively supportive, allowing learners to exercise greater control over both the cognitive and emotional conditions of their IDLE.

Second, the technological affordances reveal how AI changes the material and functional structure of IDLE. Previous studies of IDLE have often focused on learners' access to existing online resources, such as videos, websites, social media, dictionaries, and language learning applications (Lee & Dressman, 2018; Soyoof et al., 2026). In such contexts, learners usually search, select, consume, and occasionally interact with available materials. By contrast, the present study shows that AI enables a more generative and adaptive form of informal learning. Through immediate feedback, language scaffolding, multimodal resource expansion, and adaptive practice design, students could produce learning materials that were closely aligned with their current goals, levels, errors, and interests. This finding extends prior understandings of IDLE by showing that digital resources are no longer only pre-existing objects to be accessed. In AI-mediated IDLE, resources can be dynamically generated, modified, and reorganized through learner-tool interaction, making informal learning more responsive to situated and changing learning needs.

Third, the interactional affordances identified in this study highlight the role of AI

in creating new spaces for English communication beyond the classroom. Previous IDLE research has often associated interaction with online communities, peer communication, social networking platforms, or authentic contact with English users (Lee, 2026; Zainuddin & Yunus, 2022). While these forms of interaction remain important, the present findings suggest that AI introduces a different type of interactional space, one that is simulated, repeatable, adjustable, and relatively low-pressure. Students used AI to conduct simulated conversations, negotiate meaning through follow-up questions, compare alternative expressions, and rehearse real communicative situations. This does not mean that AI can replace authentic human interaction. Rather, AI appears to serve as a preparatory and supportive interactional environment, especially for students who lack regular access to English-speaking interlocutors or feel anxious in real communication. Therefore, AI-mediated IDLE may help bridge the gap between private language practice and public communicative participation.

Fourth, the institutional affordances show that AI can connect IDLE with formal educational contexts. A common distinction in IDLE research is between classroom-based learning and out-of-class digital learning, with the latter often understood as more autonomous, voluntary, and learner-directed (Lee, 2026; Lee & Lee, 2021). The present study complicates this distinction by showing that AI-mediated IDLE does not necessarily operate outside institutional learning. Instead, students used AI to extend classroom content, supplement teacher feedback, and support coursework-related tasks. These practices suggest that AI can blur the boundary between formal and informal learning by allowing classroom topics, assignments, feedback needs, and academic communication tasks to continue beyond scheduled instructional time. Importantly, students did not simply use AI as a substitute for teachers. Rather, they treated it as a supplementary resource that could make institutional learning more continuous, accessible, and manageable. This finding points to a more connected ecology of English learning in which classroom instruction and informal AI use mutually reinforce each other.

Fifth, the developmental affordances indicate that AI-mediated IDLE has temporal significance for students' evolving learning practices. Much previous research on AI-supported language learning has focused on immediate outcomes, user perceptions, learning engagement, or the effectiveness of specific tools (Wang et al., 2025; Wang et al., 2026). The present study adds a developmental perspective by showing that students' use of AI changed over time. Participants gradually developed learning routines, became more strategic in prompting and comparing outputs, and learned to evaluate AI-generated responses more critically. These findings suggest that AI-mediated IDLE is not only a context for practicing English, but also a site where students develop digital learning habits, strategic competence, and AI literacy. In this process, learners move from occasional and task-driven AI use toward more reflective and self-regulated engagement. Therefore, the value of AI in IDLE lies not only in its immediate support for language learning, but also in its potential to shape learners' longer-term capacity to manage technology-rich learning environments.

Theoretically, this study makes three contributions. First, it extends IDLE research by reframing AI as an affordance-generating resource rather than a neutral tool or supplementary application. This reframing helps explain how AI expands what learners can do in IDLE, including setting goals, receiving feedback, generating materials, practicing interaction, and developing learning strategies. Second, the

study enriches the application of ecological systems theory in language learning research. Instead of mechanically applying ecological levels, it translates the ecological perspective into five affordance dimensions that better capture students' lived experiences of AI-mediated IDLE. Third, the study contributes to AI-supported language learning research by shifting attention from whether AI is effective to how AI creates learning possibilities within situated ecologies. This shift is important because it foregrounds the relational nature of AI affordances, showing that the value of AI emerges through interactions among learners, tools, tasks, institutional expectations, and developmental processes.

The findings also offer several practical implications. For students, AI-mediated IDLE should be approached as a strategic and reflective learning practice rather than a convenient shortcut. Learners need to develop the ability to set clear goals, provide useful prompts, compare alternative outputs, verify uncertain information, and adapt AI support to their own learning needs. For teachers, AI can be incorporated into pedagogical guidance as an extension of classroom learning. Rather than simply warning students against AI use, teachers can help them understand when AI feedback is useful, how to evaluate AI-generated language, and how to combine AI support with teacher feedback and peer interaction. For institutions, the findings suggest the need to provide clearer support for responsible out-of-class AI use, including AI literacy training, academic integrity guidance, and resources for IDLE. Such support would help students benefit from AI affordances while developing critical, ethical, and sustainable practices in AI-mediated IDLE.

Conclusion

This study explored how AI affords university students' IDLE from an ecological systems perspective. Based on semi-structured interviews with 20 university students, the findings revealed that AI supports IDLE through five interconnected affordance dimensions: learner, technological, interactional, institutional, and developmental affordances. At the learner level, AI supported personalized goal pursuit, self-paced learning, low-anxiety experimentation, and confidence enhancement. At the technological level, AI provided immediate feedback, generative scaffolding, multimodal resources, and adaptive practice. At the interactional and institutional levels, AI created simulated communicative spaces, supported meaning negotiation, extended classroom learning, supplemented teacher feedback, and assisted coursework. At the developmental level, AI helped students form learning routines, use AI more strategically, and develop critical AI literacy. Overall, the study shows that AI should not be viewed merely as a tool for language assistance, but as an affordance-generating resource that reshapes students' IDLE ecology.

Despite these contributions, this study has several limitations that point to future research directions. First, the study was based on a relatively small sample of 20 university students, which limits the generalizability of the findings to broader learner populations, educational levels, and sociocultural contexts. Future studies could include larger and more diverse samples, such as secondary school students, postgraduate students, or learners from different countries. Second, the study relied mainly on self-reported interview data, which may not fully capture students' actual AI-mediated IDLE practices. Future research could combine interviews with learning logs, screen recordings, digital trace data, or classroom and out-of-class observations.

Third, this study adopted a qualitative and cross-sectional design. Longitudinal or mixed-methods studies could further examine how AI affordances develop over time and how they influence learners' language development, autonomy, engagement, and AI literacy. Such research would provide a more comprehensive understanding of AI-mediated IDLE in evolving digital learning ecologies.

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Institutional Review Board Statement:

Ethical review and approval were waived for this study according to the Measures for Ethical Review of Life Science and Medical Research Involving Humans (Article 32, Chapter 3; https://www.gov.cn/zhengce/zhengceku/2023-02/28/content_5743658.htm (accessed on 20 March 2025) . In addition, this study does not involve intervention and it is low risk.

Informed Consent Statement:

Written informed consents were obtained from all subjects involved in this study.

Data Availability Statement:

The data presented in this study are available on request from the corresponding author due to restrictions (privacy, legal or ethical reasons).

Conflicts of Interest:

The authors declare no conflicts of interest.

References

Ali, A. (2026). AI-enhanced informal digital learning of English: Effects on EFL students' cognitive, non-cognitive and oral proficiency skills. *Australasian Journal of Educational Technology, 42*(1), 18-37. https://doi.org/10.14742/ajet.10506

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design.* Harvard University Press.

Crompton, H., Edmett, A., Ichaporia, N., & Burke, D. (2024). AI and English language teaching: Affordances and challenges. *British Journal of Educational Technology, 55*(6), 2503-2529. https://doi.org/10.1111/bjet.13460

Guan, L., Li, S., & Gu, M. M. (2024). AI in informal digital English learning: A meta-analysis of its effectiveness on proficiency, motivation, and self-regulation. *Computers and Education: Artificial Intelligence, 7*, 100323. https://doi.org/10.1016/j.caeai.2024.100323

Guo, S., Wong, R., & Lee, J. S. (2026). From sporadic to sustained: facilitating AI-mediated informal digital learning of English (AI-IDLE) speaking practice

through a teacher support framework. *Innovation in Language Learning and Teaching,* 1–20. https://doi.org/10.1080/17501229.2026.2642395

Guo, X., & Lee, J. S. (2023). A systematic review of informal digital learning of English: An ecological systems theory perspective. *System, 117*, 103097. https://doi.org/10.1016/j.system.2023.103097

Huynh, T. V. (2025). Relationship between students' informal digital learning of English and willingness to communicate: Insights from the vietnamese EFL context. *Computer-Assisted Language Learning Electronic Journal, 26*(7), 295-319.

Ko, H. (2026). Bridging digital learning competence and academic achievement: The roles of informal digital learning and metacognitive self-regulation. *Journal of Intelligence, 14*(2), 31. https://doi.org/10.3390/jintelligence14020031

Lee, J. S. (2026). *Informal digital learning of English.* Cambridge University Press.

Lee, J. S., & Dressman, M. (2018). When IDLE hands make an English workshop: Informal digital learning of English and language proficiency. *Tesol Quarterly, 52*(2), 435-445. https://www.jstor.org/stable/44986999

Lee, J. S., & Lee, K. (2021). The role of informal digital learning of English and L2 motivational self system in foreign language enjoyment. *British Journal of Educational Technology, 52*(1), 358-373. https://doi.org/10.1111/bjet.12955

Lee, T., & Cho, V. (2025). Enhancing language learning through generative artificial intelligence in blended learning: An empirical study on productive and receptive of informal digital learning English. *Journal of Educational Technology Systems, 53*(3), 143-169. https://doi.org/10.1177/00472395241266454

Lee, Y. J., Parrila, R., & Colenbrander, D. (2026). Adopt, adapt, or reject? Analysing student-AI interaction in university curriculum-aligned writing tasks. *Applied Language Sciences, 2*(1). https://doi.org/10.65553/ALS.260102

Liu, G. L., & Hossain, M. K. (2026). What Predicts (AI-Mediated) Informal Digital Learning of English in the Global South? The Case of Rural Bangladeshi Students. *Journal of Computer Assisted Learning, 42*(2), e70196. https://doi.org/10.1002/jcal.70196

Liu, G. L., Darvin, R., & Ma, C. (2025). Exploring AI-mediated informal digital learning of English (AI-IDLE): a mixed-method investigation of Chinese EFL learners' AI adoption and experiences. *Computer Assisted Language Learning, 38*(7), 1632–1660. https://doi.org/10.1080/09588221.2024.2310288

Liu, G., & Ma, C. (2024). Measuring EFL learners' use of ChatGPT in informal digital learning of English based on the technology acceptance model. *Innovation in Language Learning and Teaching, 18*(2), 125–138. https://doi.org/10.1080/17501229.2023.2240316

Liu, H. (2026). Parental AI Investment Behaviours and AI-Mediated Informal Digital Learning of English: The Chain Mediating Role of Children's Perceived AI Value and Effort Expectancy for AI. *Journal of Computer Assisted Learning, 42*(2), e70198. https://doi.org/10.1002/jcal.70198

Mashhadi, A., Sabrialvar, K., & Jahanifar, M. (2026). Using intelligent personal assistants as conversational partners in informal digital learning of English: revisiting EFL learners' willingness to communicate. *Cogent Education, 13*(1). https://doi.org/10.1080/2331186X.2026.2714640

Namaziandost, E. (2025). Academic motivation, academic buoyancy, and language development in AI-supported learning environments: a SEM analysis of the roles

of digital informal learning and digital competence. *Innovation in Language Learning and Teaching*, 1-22. https://doi.org/10.1080/17501229.2025.2570836

Nguyen, L. T. H., Dinh, H., Dao, T. B. N., & Tran, N. G. (2025). Teachers' perceptions and students' strategies in using AI-mediated informal digital learning for career ESL writing. *Education Sciences, 15*(10), 1414. https://doi.org/10.3390/educsci15101414

Rezai, A., Soyoof, A., & Reynolds, B. L. (2024). Ecological factors affecting students' use of informal digital learning of English: EFL teachers' perceptions. *Teaching and Teacher Education, 145*, 104629. https://doi.org/10.1016/j.tate.2024.104629

Rezai, A., Soyoof, A., & Reynolds, B. L. (2026). Effectiveness of informal digital learning of English on EFL learners' vocabulary knowledge: A mixed-methods investigation. *Computer Assisted Language Learning, 39*(1-2), 1-26. https://doi.org/10.1080/09588221.2024.2350419

Solhi, M., Derakhshan, A., & Azari Noughabi, M. (2026). The potential of AI-driven informal digital learning of English for shaping L2 learners' willingness to communicate and speaking motivation: does L2 grit mediate? *Innovation in Language Learning and Teaching,* 1–20. https://doi.org/10.1080/17501229.2026.2653171

Soyoof, A., Lee, J. S., & Liu, G. L. (2026). Informal digital learning of English (IDLE) as an innovative pedagogy: A catalyst for holistic language development and sustainable global impact. *Journal of Computer Assisted Learning, 42*(3), e70237. https://doi.org/10.1002/jcal.70237

Wang, X., Gao, Y., & Reynolds, B. L. (2026). L2 self-guides, achievement emotions, and engagement in AI-mediated informal digital learning of English: Insights from structural equation modeling and psychological network analysis. The Asia-Pacific Education Researcher, 1-12. https://doi.org/10.1007/s40299-025-01073-y

Wang, X., Gao, Y., Reynolds, B. L., & Wang, Q. (2025). Exploring Chinese EFL learners' beliefs about AI-mediated informal digital learning of English (IDLE): Insights from Q methodology. *Porta Linguarum,* 131-146. https://doi.org/10.30827/portalin

Wang, Y., & Guo, Y. (2026). Investigating the interplay of Chinese English as foreign language learners' growth mindset, enjoyment, adaptability, and engagement in AI-mediated informal digital learning of English. *Journal of Computer Assisted Learning, 42*(1), e70189. https://doi.org/10.1002/jcal.70189

Yang, C., Li, R., & Feng, D. (2026). Chinese Learner Engagement in AI-Mediated Informal Digital Learning of English: A Self-Determination Theory Perspective. *The Asia-Pacific Education Researcher,* 1-12. https://doi.org/10.1007/s40299-026-01132-y

Zainuddin, F. N., & Yunus, M. M. (2022). Sustaining formal and informal English language learning through Social Networking Sites (SNS): A systematic review (2018–2022). *Sustainability, 14*(17), 10852. https://doi.org/10.3390/su141710852

Zhou, X., & Liu, H. (2026). L2 Selves, Control-Value Appraisals, and Engagement in AI-Supported Informal Digital Learning of English: An SEM and fsQCA Approach. *Journal of Intelligence, 14*(7), 127. https://doi.org/10.3390/jintelligence14070127

Zou, M., Soyoof, A., Teng, M. F., & Chen, H. (2025). A skill-specific perspective on AI-mediated informal digital learning of English (AI-IDLE): Examining the

contributing roles of L2 writing motivation and enjoyment. *Language Teaching Research,* 13621688251375547. https://doi.org/10.1177/13621688251375547

Author Bio

Xiaochen Wang is a Ph.D. candidate at Xi'an Jiaotong University. His research interests include informal language learning, teacher education, and linguistic landscapes. His email address is wangxiaochen666666@outlook.com, and his ORCID is 0000-0002-4786-8777.

Yang Gao is a researcher professor in the School of Foreign Studies at Xi'an Jiaotong University. His research interests include language teacher education, particularly teacher beliefs and practices, agency and identity, linguistic landscapes, and language policy and planning. He supervises Ph.D. students specializing in language teacher education. His ORCID is 0000-0001-5888-6033.