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Review Article

ChatGPT-4o for English language teaching and learning: Features, applications, and future prospects

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Abstract

The recent launch of ChatGPT-4o by OpenAI has attracted considerable attention. This new version of ChatGPT offers a unique technological tool that will definitely have a profound impact on the field of English Language Teaching (ELT). As artificial intelligence has transformed education and other fields, the advent of ChatGPT-4o is poised to lead to further transformation. Drawing on secondary data, this article aims to discuss the role that ChatGPT-4o plays in English language teaching and learning. The article is divided into three main parts, focusing on (a) key features of ChatGPT-4o for ELT, (b) potential applications of ChatGPT-4o in ELT, and (c) future prospects and ethical considerations on ChatGPT-4o. The article concludes with some implications for ELT, particularly for English teachers. It also offers suggestions for future research.

Keywords: ChatGPT-4o; ChatGPT; ELT; features; applications; future prospects

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Introduction

Recent research on the use of Chat Generative Pre-Trained Transformer (ChatGPT) in English language teaching and learning has presented a well-rounded view of the strengths and weaknesses or issues concerning this artificial intelligence (AI) chatbot (Baidoo-Anu & Ansah, 2023; Deng & Lin, 2022; Fitria, 2023; Sok & Heng, 2023). There is a growing recognition of the potential of ChatGPT, particularly in terms of offering immediate, adaptable feedback (Barrot, 2023; Preiksaitis & Rose, 2023; Sol & Heng, 2024) and enhancing interactive, customized learning experiences (Kostka & Toncelli, 2023). However, there is also concern over excessive dependence on this AI technology (Alawida et al., 2023; Sok & Heng, 2023).

While research has highlighted that ChatGPT can greatly enhance students' learning experience by providing ample practice opportunities and instant corrections (Shaikh et al., 2023; Zhang, 2024), this AI tool falls short of replicating the deep understanding and motivational support that human teachers can offer (Ali et al., 2023). There is a consensus that a combination of methods involving both AI and humans is likely to be the most effective approach (Hong, 2023; Kostka & Toncelli, 2023). In this approach, ChatGPT can assist with fundamental language practice while teachers concentrate on developing higher-order skills such as critical thinking and cultural understanding. By utilizing this hybrid approach, learning outcomes can be significantly improved (Baidoo-Anu & Ansah, 2023; Baskara, 2023).

Research on applying generative AI to improve English language teaching and learning has yielded mixed findings. Muthmainnah et al. (2022) showed how AI could improve critical thinking skills through human-computer interaction in English Language Teaching (ELT) contexts, while Yin et al. (2022) discussed the efficiency and benefits of integrating AI and Natural Language Processing (NLP) in English teaching, emphasizing the potential to revolutionize language learning. Earlier research by Ali (2020) examined how AI could simplify language teaching and learning. Liu and Kong (2021) explored how AI could be used to teach collegiate English in a personalized and diverse manner. Singh (2019) found a need to integrate technology into ELT to improve language competency. It was also found that while English as a Foreign Language (EFL) learners recognized the benefits of technology-enhanced teaching, school technological infrastructure and EFL teachers' limited professional experience

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prevented technology integration into daily pedagogical practices (Singh, 2019). Thus, educators could learn how to use AI tools like ChatGPT to improve foundational language practice while acknowledging the importance of human teachers in developing higher-order skills like critical thinking and cultural understanding in ELT.

While AI applications in language education offer numerous advantages, it is crucial to approach their use responsibly and inclusively, taking into account both the benefits and challenges they bring (Tiwari, 2024). For instance, generative AI is important in teaching and learning English, but human instruction is just as important when information and communication technology (ICT) skills and technical means are still an issue, particularly when it comes to fully and effectively incorporating new technology into ELT classrooms (Ironsi, 2024).

As a leading generative AI tool developed by OpenAI, ChatGPT has captured the world's attention since its launch in November 2022 (British Council, 2023; Sol et al., 2024; Wu et al., 2023). Research into the use of ChatGPT, particularly those focusing on the challenges and opportunities of this AI tool, has rapidly grown (see Deng & Lin, 2022; Hong, 2023). There are a few versions of ChatGPT (i.e., ChatGPT3, ChatGPT-3.5, ChatGPT-4, and the recently launched ChatGPT-4o), with different capabilities, offering a range of benefits while also causing some concerns (Alawida et al., 2023; Sok & Heng, 2023).

ChatGP-4o (the letter 'o' stands for 'omni') is the latest version of ChatGPT. It was launched on May 13, 2024, by OpenAI. This new version of the model is apparently faster than its predecessors, programmed to deliver responses in a chatty and occasionally flirtatious tone. Its features include reading and discussing images, translating languages, identifying emotions from visual expressions, and better remembering previous prompts; moreover, it supports smooth conversational flow with no delays between questions and answers (Kleinman, 2024). ChatGPT-4o has demonstrated new capabilities that have the potential to change the world, including the world of ELT (Zau, 2024).

ChatGPT-4o is a natural language processing tool that demonstrates an impressive capacity to comprehend and produce text that closely resembles human language, apparently exhibiting remarkable precision and relevance

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(OpenAI, 2024). This iteration highlights significant improvements, expanding on the intelligence of ChatGPT and GPT-4 by enhancing its speed and extending its capabilities in text, image recognition, vision, and audio (Wiggers, 2024). The user experience seems intuitive, making it easier to work with this AI tool without getting lost in complicated interfaces. While ChatGPT-4o is currently exclusive to ChatGPT Plus members, OpenAI aims to make this advanced AI application accessible to all its users, including those with free accounts (OpenAI, 2024).

While ChatGPT-4o is poised to change the world, this advancement seems to hold significant potential for enhancing both teaching and learning experiences, including in ELT contexts (Diasamidze & Tedoradze, 2024; Liu & Ma, 2024; Sol et al., 2024). Given ChatGPT-4o's significance and potential impact on ELT, this review article aims to discuss key features of this AI tool and examine its applications in ELT. The main objective is to highlight how ChatGPT-4o's features can address common challenges in language education, improve student engagement, and support teachers in delivering more effective instruction. This article also aims to shed light on the transformative potential of AI in the realm of English language teaching and learning.

Key features of ChatGPT-4o for ELT

Compared to previous versions, ChatGPT-4o can better process complicated language inputs in text, audio, and video and rapidly produce natural responses in the same formats (Kleinman, 2024; OpenAI, 2024), making it a highly potential English language teaching and learning tool (see Table 1 for a summary of key features of ChatGPT-4o). OpenAI has enhanced ChatGPT-4o's reasoning ability based on NLP and an upgraded large language model (LLM) (OpenAI, 2024), which has the potential for analyzing grammar, vocabulary, and context. The new ChatGPT model expands upon the capabilities of previous versions by better identifying grammatical errors, explaining grammatical principles, and suggesting improved word choices. This rapid and precise feedback may help students realize their mistakes and learn the language in a similar way to what ChatGPT offers (Preiksaitis & Rose, 2023). The interaction may deepen and improve English comprehension. ChatGPT-4o can also provide personalized and timely help that traditional classrooms cannot, making it a promising AI tool for language acquisition (Law, 2024).

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Currently, ChatGPT-4 provides excellent real-time feedback for language acquisition through voice recognition (Law, 2024), but the latest iteration, ChatGPT-4o, further enhances voice-to-voice speech recognition capabilities (OpenAI, 2024). Real-time feedback can help English learners correct errors, which helps to improve learning and prevent errors. ChatGPT-4o can also swiftly identify spelling, punctuation, and sentence structure errors in writing. Like ChatGPT-4, it can provide students with comments on how to enhance their work (Baskara, 2023; Fitria, 2023). ChatGPT-4o's immediate feedback loop can also help language acquisition by correcting pronunciation, intonation, and fluency during speaking practice, just like the older version of ChatGPT (Young & Shishido, 2023).

Another helpful feature of ChatGPT-4o is related to user customization, memory, and reasonability (OpenAI, 2024), which can be used to enhance teaching and learning. AI's memory function can keep track of previous interactions to ensure continuity and coherence in learning sessions, and its reasoning abilities can help it generate more accurate and contextually relevant responses (OpenAI, 2024). ChatGPT-4o can, for example, tailor its responses and content to each student in accordance with individual students' academic abilities and learning styles. This flexible learning strategy enables students to receive a customized learning experience, such as in dialogues, debates, and interviews.

Interactive content generation is another notable feature of ChatGPT-4o. This feature has the potential to enable the creation of engaging and varied learning materials. Like the previous versions, ChatGPT-4o can generate summaries, outlines, quizzes, conversation prompts, reading passages, and other interactive activities based on file uploads such as PDFs, spreadsheets, images, web links, and video files (OpenAI, 2024). With ChatGPT-4o, students will be able to simulate real-life scenarios, such as ordering food at a restaurant or navigating a travel itinerary with specific locations and maps, providing them with practical language practice. According to Young and Shishido (2023), who studied the potential of ChatGPT in EFL settings, such interactive exercises could not only make learning more enjoyable but also help students apply their language skills in realistic contexts.

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ChatGPT-4o is also ideal for training students in speaking and listening due to its capacity to mimic authentic, human-like conversations, similar to its older versions (Ali et al., 2023). Students may now talk to ChatGPT-4o and get fast feedback and corrections (OpenAI, 2024), which could boost their confidence and fluency in everyday language use. ChatGPT-4o may now role-play different characters in different settings, letting students practice conversational English in a secure and friendly atmosphere, which in turn improves their communication skills and reduces language anxiety (see Toribio, 2023).

ChatGPT-4o can now generate images and modulate many voices in a human-like manner (OpenAI, 2024). This feature can create more opportunities for engaging learning sessions and enhance interaction between learners and AI. ChatGPT-4o can also provide amazing pronunciation practice with multiple voices and languages to help students enhance their listening and speaking abilities. The discourse about the actual world may be extended with visual assistance and smartphone cameras. ChatGPT-4o's robotic, singing, and modulated speech capabilities will also offer unique potential for English language teaching and learning. These qualities may be leveraged to create exciting and diverse audio-learning experiences for different learning styles. As students can appreciate and remember rhymes better by singing them (Good et al., 2015), dramatic and modulated voices generated by ChatGPT-4o will be able to teach speech intonation, emphasis, and emotion. These flexible voice options will make role-playing more dynamic, allowing students to practice English in diverse social and cultural situations.

Research has shown that multilingual approaches, such as translanguaging, could enhance ELT practice because they enable teachers and students to overcome communication barriers, have access to a variety of linguistic resources, and create a more welcoming learning atmosphere for multilingual learners (Diaconu, 2022; Haukås, 2016). With support for more than 50 languages, ChatGPT-4o now has a strong multilingual feature (OpenAI, 2024). The model is able to show off its wide language capabilities and how well it can translate between languages such as English, French, and Italian in real time. Although research on the actual use of this feature in ELT is not available, ChatGPT-4o looks set to contribute to improving the effectiveness of language teaching worldwide by offering translations and materials in native languages.

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The last and perhaps the most promising and future-proof feature of ChatGPT-4o is its video or vision capability. Video cameras can now help ChatGPT-4o recognize things, texts, photos, arithmetic problems, and more (OpenAI, 2024). With this function, ChatGPT-4o will be able to provide new opportunities for English language training and AI tutoring. This new feature will also allow students to practice speaking English in varied circumstances, get immediate feedback, and learn to recognize and react to non-verbal signals in real time, which are essential in daily conversations. ChatGPT-4o's video feature can also simulate real-life conversation (OpenAI, 2024), making it a wonderful tool for teaching and learning English. Therefore, there is no doubt that this feature will let students practice their language abilities in a realistic setting and get instant feedback in live and real-time pronunciation exercises and other practical learning activities. All the key features of ChatGPT-4o are summarized in Table 1.

Table 1. *A summary of key features of ChatGPT-4o for ELT*

No.	Key features of ChatGPT-4o for ELT
1	Analyzing grammar, vocabulary, and context
2	Provide excellent real-time feedback for language acquisition
3	Tailor responses to individual students' academic ability and learning styles
4	Generate summaries, outlines, quizzes, conversation prompts, reading passages, and other interactive activities
5	Mimic authentic, human-like conversations
6	Create more opportunities for engaging learning sessions and enhance interaction between learners and AI
7	Enable teachers and students to overcome communication barriers, provide access to a variety of linguistic resources, and create a more welcoming learning atmosphere for multilingual learners
8	Allow students to practice speaking English in varied circumstances, get immediate feedback, and learn to recognize and react to non-verbal signals in real time

Source: Authors' synthesis of relevant literature

Potential applications of ChatGPT-4o in ELT

ChatGPT-4o has several potential applications in ELT (see Table 2). First, it may be used to improve language practice by offering several tailored dialogues,

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exercises, and activities. It can also generate student-specific practice problems based on students' profiles, interests, and knowledge levels (Zau, 2024). For example, EFL students may practice writing essays on any theme and receive quick comments on grammar, vocabulary, and sentence structure. This will help them write better and comprehend language norms, as evidenced by research on ChatGPT (Baskara, 2023; Fitria, 2023). In addition, ChatGPT-4o can also create realistic conversational practice settings, such as interviews. This feature can be useful for students to engage in verbal communication practices, which can enhance their listening and speaking skills in a similar way to what ChatGPT can do (Ali et al., 2023).

Second, ChatGPT-4o may aid in enhancing personalized learning paths, one of its most transformational uses for teaching and learning. ChatGPT-4o can, for example, determine student strengths and weaknesses and change exercise intensity and concentration by continually analyzing student performance. If a student excels in academic vocabulary but has problems with grammar, this advanced AI tool can challenge them with more difficult vocabulary assignments and provide grammar practice. Previous findings on ChatGPT have shown that students could benefit from this personalized approach when they were challenged and supported to achieve at their own speed (Firat, 2023). In this vein, students can focus primarily on areas for improvement while building their knowledge through personalized learning routes (Shemshack & Spector, 2020).

Third, ChatGPT-4o's prompt feedback can be used to improve learning inside and outside the classroom. Research has shown that students can learn from their mistakes in real-time throughout writing and speaking activities with instant corrections and recommendations (Pashler et al., 2005). In this manner, ChatGPT-4o can swiftly identify grammatical problems and problematic language in students' written projects and propose ways to fix the problems. This rapid feedback can help students realize and address their mistakes before they become habits. This has been demonstrated in a study on ChatGPT (Kusam, 2024). Similarly, ChatGPT-4o can also instantly correct pronunciation problems and improve fluency during conversational practices, helping students enhance their speaking abilities. According to Lee (2009), real-time feedback was found to be helpful in helping students improve their linguistic abilities.

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Fourth, with its advanced features, ChatGPT-4o may be able to encourage and engage students with interactive and varied information. It can generate puzzles, quizzes, and role-playing scenarios, making learning enjoyable and engaging. For English language learning, ChatGPT-4o may mimic a trip itinerary where students must utilize English to navigate. This gives them real-world practice (Zau, 2024). Previous studies on ChatGPT showed that interactive exercises and self-reflection activities could make learning enjoyable and help students apply their information (Firat, 2023; Zhai, 2022). Armed with its new features, ChatGPT-4o will be able to enhance this capability further by creating a more dynamic and engaging learning environment with more sophisticated voices, multilingual abilities, and multiple text genres that could stimulate continual practice and progress for English language learners.

Finally, EFL teachers can use ChatGPT-4o's interactive content generation and human-like conversational simulation features to make learning environments more engaging and motivating for students. ChatGPT-4o is equipped with advanced features that allow it to generate conversational responses based on user input (OpenAI, 2024). This provides a platform for interactive dialogue, which can be useful for learning and teaching purposes, as ChatGPT could offer (Fergus et al., 2023). Research has indicated that using ChatGPT in educational settings could provide many benefits (Atlas, 2023; Qadir, 2022; Sok & Heng, 2023). For example, it could help students with academic and professional writing, provide personalized feedback, and enhance communication dynamics (Atlas, 2023; Qadir, 2022). ChatGPT's ability to imitate human conversations opens up exciting possibilities for language learning. As an updated version of ChatGPT, ChatGPT-4o will provide opportunities for naturalistic learning interactions and personalized learning environments in a similar, if not better, way than what ChatGPT could do (Bekou et al., 2024; Kohnke et al., 2023). All the potential applications of ChatGPT-4o in ELT are summarized in Table 2.

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Table 2. *Potential applications of ChatGPT-4o in ELT*

No.	Potential applications of ChatGPT-4o in ELT
1	Improve language practice
2	Enhance personalized learning paths
3	Improve learning inside and outside the classroom
4	Encourage and engage students with interactive and varied information
5	Make learning environments more engaging and motivating for students

Source: Authors' synthesis of relevant literature

Future prospects of ChatGPT-4o and ethical considerations

Table 3. *Future prospects of ChatGPT-4o and ethical considerations*

No.	Future prospects of ChatGPT-4o and ethical considerations
1	Leveraging generative AI in ELT contexts
2	Providing training on AI integration in ELT
3	Being mindful of AI hallucinations
4	Addressing ethical concerns

Source: Authors' synthesis of relevant literature

As seen in Table, the future prospects of ChatGPT-4o lie in the ability of users to leverage these advanced AI tools for English language teaching and learning, the need to provide training on AI use in ELT, and the need to be mindful of the issue concerning AI hallucinations. There are also important ethical considerations that need to be taken into account when utilizing AI for language teaching and learning purposes. Each of these points is discussed in turn in this section.

Leveraging generative AI in ELT contexts

The implementation of state-of-the-art technologies within educational frameworks is significantly advanced with the incorporation of ChatGPT-4o and similar AI tools into English language instruction (Hang et al., 2022; Law, 2024; Sok & Heng, 2024b). With the ongoing progress in technology that improves their capacity to understand and generate natural language, these tools are progressively gaining utility in educational environments. According to Karataş et al. (2024), these technologies offer individualized skill-level-

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appropriate exercises, personalized content, and immediate feedback to students, which could make a difference in the field of ELT.

In spite of the rapid advancements in technology, the indisputable significance of human educators persists (Ji et al., 2022). Educators can continue to fulfill an indispensable function in nurturing profound cognitive comprehension, emotional astuteness, cultural awareness, and innovative pedagogical approaches. Thorough language acquisition and the development of critical thinking are contingent upon the possession of these qualities (Thornhill-Miller et al., 2023). Teachers can provide emotional support and handle the complex cultural dimensions of language use, which AI generally fails to do. Teachers also have a knack for engaging children, inspiring curiosity, and fostering ethical communication (British Council, 2023). Thus, while AI can expedite data-driven analysis, human instructors will continue to play a crucial role in language teaching, particularly in developing students' language and cultural understanding and abilities.

Providing training on AI integration in ELT

Research conducted by Sol et al. (2024) brought attention to a critical oversight in the use of AI tools for English language learning among EFL university students in Cambodia, as the study found a lack of proper training on how to utilize AI technologies effectively. Although AI-driven applications like Google Translate and Grammarly are widely used, a significant number of students (around 70%) have not been taught how to properly utilize AI. The study suggested providing AI training to students to improve their knowledge and skills on how to use AI effectively (Sol et al., 2024).

The lack of training on the effective use of AI, as reported by Sol et al. (2024), highlights the importance of thorough educational programs that provide learners and educators with the necessary skills to utilize AI technologies properly. Improved training programs would not only increase confidence in using AI tools but would also ensure that the full potential of AI in supporting language learning is realized (Kusmawan, 2023). According to Bingimlas (2009), adequate training plays a crucial role in effectively incorporating technology into educational environments, resulting in enhanced academic achievements. In addition, Pokrivcakova (2019) highlighted the significance of customized AI tool training that covers the technical aspects of these

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applications, as well as the pedagogical strategies for integrating them into language learning curricula. Therefore, it is crucial to promote systematic training programs in order to create an environment that encourages the responsible use of AI tools, thereby improving the language learning and development process.

Being mindful of AI hallucinations in ELT contexts

AI hallucination is a phenomenon that needs immediate attention in the integration of AI into education. This idea describes circumstances where AI systems provide false, misleading, illogical, or incorrect information that seems to be legitimate; however, the term is used as an antonym to faithfulness (being consistent or truthful in the sources) and factuality (based on facts) (Ji et al., 2023). Given how important the reliability and accuracy of the information are in educational settings, these errors might be very detrimental to teachers and students. In particular, Athaluri et al. (2023) investigated the frequency of AI hallucinations in research proposals using an analytical approach in which 178 references mentioned by ChatGPT-4 were checked for correctness. The results showed that many of the references either missed a Digital Object Identifier (DOI) or were not found via conventional internet searches, suggesting possible limits in the AI's capacity to generate trustworthy references for academic use.

To address the AI hallucination issue, Ji et al. (2023) proposed an interactive self-reflection methodology to mitigate such errors, demonstrating through automatic and human evaluations that this approach could significantly reduce hallucination and improve AI performance. In ELT, language learners may experience major setbacks and develop misunderstandings when they are exposed to faulty structures, invented idiomatic phrases, or erroneous use of examples. If AI-generated information is not properly monitored and addressed, it could create a ripple effect that these inaccuracies may become part of learners' knowledge base, therefore strengthening wrong language use. More research attention in this area is, therefore, strongly recommended.

Addressing ethical concerns in ELT contexts

As the use of AI in education has increasingly grown, ethical issues must be addressed (Cotton et al., 2024; Shen et al., 2023; Sok & Heng, 2023). Generative conversational AI systems like ChatGPT could present ethical issues such as plagiarism and cheating (Stahl & Eke, 2024). AI may enhance individualized

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educational experiences, but its effects on human interaction, which is essential to social learning, must be considered (Alawida et al., 2023). A balanced strategy must measure these ethical considerations against AI's advantages, prioritize student well-being, and preserve educational integrity (Parray et al., 2023). To leverage the ethical issues, it is important to raise awareness among teachers, students, and other stakeholders. In this vein, research has recommended diversifying stakeholder participation, holistic risk-benefit analysis, and multi-level policy initiatives (Kostka & Toncelli, 2023; Sok & Heng, 2024a).

Indeed, AI technologies like ChatGPT-4o are set to improve language acquisition with their reasoning skills, personalized content, and scalable interventions (Barrot, 2023; British Council, 2023; Karataş et al., 2024). Therefore, ELT institutions and programs should responsibly integrate these technologies within their instructional systems to enhance English language teaching and learning. With ChatGPT and now ChatGPT-4o, there remain concerns about ethical awareness related to academic integrity, misuse, misinformation, privacy, data security, and biases (Rahman & Watanobe, 2023; Sok & Heng, 2024a). Handling sensitive student data, disinformation, overreliance on AI, and potential biases in instructional materials requires strict ethical rules and regulatory requirements (Ray, 2023; Sok & Heng, 2024a; Wu et al., 2024). In this respect, OpenAI and other companies that develop AI tools must be transparent about how they store text, picture, audio, and video user data (Wu et al., 2024).

Conclusion

ChatGPT-4o's new capabilities, such as dynamic voice, multimedia file uploads, and video/vision features, present a significant opportunity to revolutionize the ELT field. These new abilities can make ChatGPT-4o an excellent tool for providing personalized feedback, interactive learning experiences, and enhanced communication dynamics. To leverage these capabilities of ChatGPT-4o for teaching and learning English, educators can address common challenges in language education, such as providing real-time feedback, tailoring learning paths to individual student needs, and creating engaging learning materials. These features will definitely impact the teaching and learning of the four macro skills (i.e., listening, reading, speaking, and writing skills) in English language learning. However, it is also crucial to

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recognize that while AI tools like ChatGPT or ChatGPT-4o offer tremendous potential, they should complement rather than replace human instructors. The indispensable role of teachers in fostering critical thinking, emotional intelligence, and cultural understanding cannot be overstated. Therefore, a balanced approach that integrates AI technology with human-led instruction is essential to maximize the benefits of both learning and teaching in the ELT (Ironsi, 2024; Sol et al., 2024; Tiwari, 2024).

As ChatGPT and its new versions continue to grow and improve over time, it is imperative to address ethical issues and ensure the responsible use of these technologies in ELT settings. Ethical concerns such as academic integrity, disinformation, misuse, privacy, data security, and potential biases must be carefully managed through stringent guidelines and policy regulations. Transparency and awareness of how AI tools process and store user data are essential factors, along with ongoing training programs to equip educators and learners with the necessary skills to utilize these technologies effectively.

In light of the discussion of the features, applications, and future prospects of ChatGPT-4o that are based on secondary data, it is suggested that empirical research be conducted to examine how ChatGPT-4o can be effectively integrated into English classrooms to enhance teaching and learning. Research into the benefits and concerns regarding the utilization of ChatGPT-4o in education should also be conducted, particularly in contexts, such as Cambodia, that are underrepresented in the international literature. Finally, given the rapid development of AI and its increasingly significant impact on education and research, including in the ELT field, it is imperative to conduct research that investigates (a) how AI tools can be effectively integrated into the classroom to enhance teaching and learning, (b) how AI can be utilized in an ethical and responsible manner, and (c) how AI can be leveraged to enhance research engagement and productivity of academic staff and students.

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