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Maintaining Meaningful Human Interaction in AI-Enhanced Language Learning Environments: A Systematic Review

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Abstract

This systematic review examines strategies for designing AI-enhanced language learning environments anchored in collaborative partnerships between humans and AI. The review involved searching multiple databases for relevant literature published between 2000-2023, applying inclusion/exclusion criteria, and coding articles according to a predefined scheme. A total of 10 studies were identified that addressed guidelines for structuring roles, coordinating AI with human priorities, assessing user perceptions, applying AI to personalized learning, or leveraging AI capabilities while maintaining central human involvement. Key findings indicate guidelines emphasize delineating roles between humans and AI through frameworks balancing autonomy and expertise. Techniques show potential for aligning AI with human input, though ensuring real-world coordination requires ongoing refinement. Research underscores generally positive user perceptions depending on individual attributes and initial adoption intentions. Personalized learning through AI modeling emerges as promising when guided by educators. Designing AI to enhance rather than replace teachers emphasizes collaborative problem-solving. Findings offer guidance on thoughtful AI integration respecting people as learning relationships evolve. Continued investigation refining coordinated approaches across contexts could help realize equitable AI-augmented models optimizing outcomes through empowered human partnerships as technologies progress. This provides direction for responsibly advancing the field to maximize AI's contributions to language education.

Keywords: Artificial intelligence, Language learning, Human-computer interaction, Adaptive learning, Technology integration.

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الآداب
للدراسات اللغوية والأدبية

الحفاظ على التفاعل البشري المعني في بيئات التعلم اللغوي المعززة بالذكاء الاصطناعي: مراجعة منهجية

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ملخص:

يهدف هذا الاستعراض المنهجي لدراسة استراتيجيات تصميم بيئات التعلم اللغوية المعززة بالذكاء الاصطناعي والمرتكزة على شراكات تعاونية بين البشر والذكاء الاصطناعي. تضمنت طريقة البحث قواعد بيانات متعددة عن الأدبيات ذات العلاقة المنشورة في الفترة من 2000-2023، وتطبيق معايير الدخول والاستبعاد، وترميز المقالات وفق خطة محددة مسبقًا. تم تحديد 10 دراسات تناولت الضوابط لهيكلة الأدوار وتنسيق الذكاء الاصطناعي مع الأولويات البشرية وتقييم آراء المستخدمين وتطبيقات التعلم الذاتي والاستفادة من قدرات الذكاء الاصطناعي مع الحفاظ على التفاعل البشري. أظهرت النتائج أهمية تحديد الأدوار بين البشر والذكاء الاصطناعي وإمكانية توجيه الذكاء الاصطناعي من خلال التوجيه البشري، كما أكدت على أهمية دور المعلم وتقبل المستخدمين لهذه التقنيات. كما تبرز أهمية التعلم الشخصن بإشراف المعلمين. يلخص هذا الاستعراض استراتيجيات التعاون البناء في سياق التعليم اللغوي. كما تقدم النتائج توجيهات حول الدمج الفكري للذكاء الاصطناعي.

الكلمات المفتاحية: الذكاء الاصطناعي؛ تعلم اللغة؛ التفاعل بين الإنسان والحاسوب؛ التعلم التكيفي، تكامل التكنولوجيا.

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Introduction

As artificial intelligence (AI) technologies become increasingly prevalent in educational settings, their role in language instruction merits consideration (Ifenthaler & Schumacher, 2023; Ji et al., 2022). Therefore, this paper examines strategies for designing AI-enhanced language learning environments that maintain meaningful human interaction. It discusses how AI can both support teachers by taking over repetitive tasks, allowing them to focus on more complex instructional activities (Ifenthaler & Schumacher, 2023; Ji et al., 2022; Mozer et al., 2019), and personalize learning experiences while working collaboratively with human instructors and students.

The introduction draws on several sources to establish the context and focus of the paper. It briefly outlines key topics that to be explored, including effective human-AI collaboration in language teaching which requires clear guidelines and structured roles (Ifenthaler & Schumacher, 2023; Ji et al., 2022), enhancing coordination between humans and AI systems through reinforcement learning and natural language (Alowed & Al-Ahdal, 2023; Bakhtin et al., 2022; Hu & Sadigh, 2023), perceptions of AI in language learning (Belda-Medina & Calvo-Ferrer, 2022), AI's potential for personalized instruction by analyzing large datasets (Ifenthaler & Schumacher, 2023; Mozer et al., 2019), and maintaining genuine human interaction. By signaling the paper's examination of both opportunities and challenges presented by AI integration, as well as emphasis on fostering meaningful human involvement, the introduction provides an overview of the scope and purpose of the review.

While AI technologies show promise for enhancing language instruction, as evidenced by studies exploring their accuracy and students' perspectives (Hu & Sadigh, 2023), research has yet to sufficiently consider how to maintain meaningful human interaction. In particular, little is known about concrete strategies for designing AI-enhanced learning environments that meaningfully support both teachers and learners through collaborative partnerships.

Much of the existing work has focused narrowly on AI system performance alone (Bakhtin et al., 2022; Hu & Sadigh, 2023), without fully examining pedagogical approaches needed to integrate such tools while preserving the human relationships and instructional practices fundamental to learning. Additionally, studies (Chiu et al., 2023; Mozer et al., 2019) have primarily centered students' viewpoints without thoroughly exploring knowledge and perceptions among future educators who will be responsible for adopting and implementing AI technologies in the classroom.

To address these limitations, more research work is needed to advance understanding of how to thoughtfully design AI-enhanced learning environments anchored in strategies that optimize collaborative partnerships between humans and AI agents, with clear guidelines outlining structured roles and

responsibilities. Only by exploring balanced, strategic approaches can the true potential of AI be realized to enhance, rather than diminish, the educational experience for all participants. This review aims to help fill these gaps in the literature by systematically reviewing literature on strategies for maintaining meaningful human interaction within AI-enhanced language learning contexts. The specific research questions were formulated to investigate opportunities and challenges for designing collaborative, data-driven learning models centered on human involvement.

The significance and importance of the review

The integration of AI technologies holds great promise for advancing language instruction. However, it is crucial to understand how to thoughtfully integrate these tools while preserving the human relationships and pedagogical practices that are fundamental to learning. This study aims to provide a roadmap for using AI in a way that enhances, rather than diminishes, the educational experience. Specifically, the study makes significant contributions in the following ways:

- Advancing knowledge: This review expands the empirical and theoretical understanding of designing AI-enhanced learning environments that maintain meaningful human interaction. By exploring effective strategies, it may advance pedagogical knowledge on this important topic.
- Supporting teachers: A key focus is exploring how AI can support, rather than replace, teachers. This underscores the irreplaceable role of educators and how technology can help maximize their impact.
- Promoting equity: The investigation specifically considers equitable access for all students. In underscoring consideration for marginalized communities, the study addresses a critically important societal issue.
- Informing policy and practice: Findings may provide valuable guidance for educators, institutions, and policymakers navigating this technological transition. They could establish best practices to inform the development and implementation of AI tools.
- Preserving pedagogical components: By balancing technology and human interaction, the review helps preserve essential social-emotional learning aspects that are difficult to replicate using AI alone.

In summary, by establishing a balanced, strategic approach for the integration of AI and maintenance of genuine human interaction, this review makes a significant scholarly contribution with important implications for educational policy, practice and the student experience. While AI technologies show promise for enhancing language instruction, research has mostly focused on their accuracy and students' perspectives without considering how to maintain meaningful human interaction. Little is known about strategies for designing AI-enhanced environments that support both teachers and learners.

Review Objectives

1. Examine strategies and guidelines for fostering effective collaboration and defining structured roles between human instructors/learners and AI systems in language learning environments.
2. Explore approaches for designing AI-enhanced language learning models that leverage personalized and data-driven capabilities while maintaining human teachers and peers as central actors in the learning process.
3. Investigate perceptions and attitudes of students and educators towards integrating AI technologies into language instruction, with a focus on maintaining meaningful human interaction.

Review Questions

1. What guidelines exist for structuring roles and responsibilities between human instructors/learners and AI systems to support effective collaboration in language learning?
2. How can AI be designed to leverage personalized and data-driven capabilities while still maintaining central roles for human teachers and peers in the learning process?
3. What factors influence students' and educators' perceptions of and attitudes toward integrating AI technologies in language instruction, and how can meaningful human interaction be preserved?

2. Literature Review

Elmahdi and Bajri (2023) emphasized the crucial role of formulaic expressions in fluent communication and language acquisition. They discussed how formulaic expressions "facilitate interactive communication, reduce processing demands, and foster social and pragmatic competencies" (p. 33). This supports maintaining meaningful human interaction in AI-enhanced language learning environments, as conversational agents aim to emulate natural human communication which relies heavily on formulaic expressions. More natural interaction may be achieved by incorporating appropriate formulaic expressions into an AI system's responses.

2.1 Effective Human-AI Collaboration

This section reviews literature on guidelines and structured roles to support collaboration, as reported by Ji et al. (2022) and Ifenthaler and Schumacher (2023). Research has explored guidelines for structuring human-AI collaboration in language learning. Ji et al. (2022) conducted a systematic review of 52 studies examining conversational AI applications. They found that effective partnerships require clearly defining the roles and responsibilities of both technological and human agents. Ifenthaler and Schumacher (2023) similarly stressed the need for guidelines to clarify expectations and facilitate coordination.

Several frameworks have been proposed for outlining the division of labor. For example, Radziwill and Benton (2017) suggested assigning AI systems roles like information providers or skill/knowledge tutors, reserving complex pedagogical tasks for humans. Mehta et al. (2024) trialed "help feedback" where AI agents

could ask clarifying questions when uncertain. Beyond role allocation, the nature of collaboration is also important. Research indicates that humans and AI should work interdependently, with each utilizing their unique strengths. Humans provide context, judgment, and personalized feedback while AI handles data-heavy tasks (Mozer et al., 2019). Open communication allows partners to understand one another's perspectives and problem-solve jointly (Bakhtin et al., 2022). In summary, previous work emphasizes clear guidelines framing distinct yet synergistic contributions in human-AI educational partnerships. The current review examines strategies informed by such principles.

2.2 Personalized Learning

AI shows promise for personalized learning by analyzing student data. Ifenthaler and Schumacher (2023) reviewed AI applications that draw insights from large educational datasets to tailor content recommendations and optimize learning sequences for individuals. Elmahdi and AbdAlgane (2023) explored the role of teachers' groups in TESOL technology implementation. This supports maintaining meaningful human interaction in AI-enhanced language learning environments. Specifically, teachers' groups can help support the integration of technologies like AI by sharing knowledge and experiences with implementation. With guidance and collaboration from other educators, teachers may feel more comfortable trialing new technologies and strategies to incorporate them in a way that optimizes human interaction and pedagogy. Recommender systems aim to suggest relevant material based on learner profiles and activities. By modeling relationships between students, resources and outcomes, AI can propose specific content most likely to benefit each learner (Mozer et al., 2019). This personalized path aims to enhance engagement and efficacy.

AI also enables adaptive learning through real-time analysis of student responses. Systems can detect weaknesses and immediately deliver remediation, exercises or supplemental explanations (Ifenthaler & Schumacher, 2023). By monitoring ongoing progress, AI supports personalized review and spaced repetition shown to improve long-term retention (Mozer et al., 2019). While opportunities exist, design challenges remain such as accounting for diversity among learners, contextual factors and evolving needs over time. Further research is also needed on integrating explainable AI to build student trust and understanding of personalized recommendations. Nonetheless, AI shows promising applications for data-driven personalization that individualizes instruction while augmenting overburdened instructors. The current study explores strategies for AI personalization within a collaborative learning model.

2.3 Perceptions of AI Integration

This section looks at existing research on students' and teachers' perceptions and satisfaction with AI as in Belda-Medina and Calvo-Ferrer (2022). Research has also assessed users' perceptions of chatbots and AI in education. Belda-Medina and Calvo-Ferrer (2022) examined future educators' knowledge and perceptions

of using chatbots for language learning. Their findings indicated positive views regarding perceived ease of use and attitudes, though behavioral intention scored moderately. Other studies have focused on current students and teachers. Chen et al. (2020) surveyed Chinese learners interacting with a vocabulary chatbot, finding perceived usefulness positively impacted behavioral intention while perceived ease did not. Questionnaires of 225 Spanish K-12 educators by Chocarro et al. (2021) correlated conversational design features with technology acceptance. Additional research has analyzed factors influencing teachers' perceptions. For example, a survey of 142 Malaysian teachers by Chuah and Kabilan (2018) indicated that chatbots could enhance social presence and activity in mobile language learning. Younger and more digitally skilled teachers tended to view chatbots more favorably (Chocarro et al., 2021). Overall, existing work has primarily centered student and teacher viewpoints after limited use. However, gauging knowledge and initial perceptions among future educators may offer insights on Chatbots and AI integration in education. The current study aims to address this gap.

2.4 Coordination and Alignment

This section discusses approaches like reinforcement learning and natural language from Hu and Sadigh (2023) and Bakhtin et al. (2022) to align AI with human strategies. Effectively coordinating AI with human behavior and preferences is crucial for collaboration. Hu and Sadigh (2023) proposed an approach called "language instructed reinforcement learning" that uses natural language to generate AI policies aligned with human preferences. Their framework allows humans to specify desired strategies through instructions, which are then used to regularize reinforcement learning optimization.

Other techniques aim to align AI through interactive feedback. For example, Mehta et al. (2024) explored an "interactive help" paradigm where AI agents could ask for assistance to better understand tasks. Human guidance through feedback improved grounded language skills and coordination in a simulated environment. Nonetheless, challenges remain in operationalizing techniques like reinforcement learning at scale, and ensuring smooth translation from controlled experiments to open-world use. Further exploration is also needed on privacy, transparency and addressing potentially biased inputs to language models. By investigating approaches informed by this literature, the current study aims to advance understanding of designing AI for personalized learning while anchored to human priorities and strategies through natural interaction. These approaches aim to address challenges in domains lacking high-quality behavioral data, as multi-agent reinforcement learning can converge to unintended equilibria differing from human preferences. By using instructions to regularize reinforcement learning objectives, the approach leads agents to converge on equilibria aligned with human preferences (Hu & Sadigh, 2023). Some challenges mentioned include operationalizing techniques like reinforcement learning at scale. Ensuring concepts translate smoothly from

controlled experiments to open-world use is also discussed. Further exploration of privacy, transparency, and addressing potentially biased language model inputs is noted (Hu & Sadigh, 2023).

2. 5. Previous Studies

Ng et al. (2023) provided a highly valuable review and analysis of the development of AI teaching and learning systems over a 20 years period. It categorizes the literature based on educational levels, subject domains, types of AI techniques used, and system evaluation approaches. Some notable findings include the increasing use of deep learning methods from 2010 onward, with intelligent tutoring systems and educational recommender systems as the most common application types. Formal subject domains like math, science and computer science predominated in research. The review also highlights persisting gaps such as the need for more contextualized and interdisciplinary and AI solutions. Evaluation of learning outcomes remained limited compared to usability assessments. Overall, Ng et al.'s (2023) comprehensive longitudinal study offers comprehensive insights into the progress and remaining challenges within the field. It serves as an important resource for researchers to identify underexplored areas and opportunities to develop more powerful and robust AI-based educational technologies with stronger theoretical foundations and empirical evidence of impacts. In summary, the review provides a valuable 20-year perspective on advances, trends and future priorities within the realm of AI teaching and learning research.

Alam (2023) provides a compelling case for the development of AI-enabled learning ecologies that leverage the unique advantages of artificial and human intelligence. Through practical examples, the author illustrates how contemporary AI technologies can already support more personalized, collaborative and experiential forms of education when integrated into well-designed learning systems. A key argument is that AI should aim to augment rather than replace human teachers and learners. By distributing roles and responsibilities between human and artificial actors, new opportunities emerge for customized guidance, immersive simulations and global knowledge-sharing. Alam also envisions how continuing progress may lead to even more adaptive, globally-connected and learner-driven educational models in the coming decades. Overall, that paper presents a thoughtful vision for harnessing the full potential of human-AI partnerships to transform learning experiences in scalable, equitable and engaging ways. The real-world use cases help ground this perspective while the forward-looking discussion prompts consideration of bolder possibilities on the horizon (Alam, 2023). This integrative systems approach could inspire new avenues for research and development within the field. In summary, Alam makes a compelling case for developing AI-enabled learning ecologies to unlock intelligence in collaborative, experiential and globally-networked ways.

Chiu et al. (2023) evaluated factors influencing student motivation when learning with an AI chatbot. It found that teachers' support played a key role, with students reporting higher levels of intrinsic motivation, identified

regulation and self-efficacy when teachers actively facilitated use of the chatbot. Interestingly, teachers' facilitation had a stronger positive influence on motivation than perceptions of the chatbot's intelligence. This suggests the pedagogical integration is more important than technology features alone. The results also indicated motivation varied depending on gender and prior academic performance. Specifically, girls and higher-performing students experienced greater motivation with teacher facilitation of the AI tool. Overall, this research provides valuable empirical evidence that teacher involvement remains crucial for optimizing student motivation even with AI integration. Carefully designed facilitation strategies tailored to student characteristics could help ensure all learners benefit. By highlighting the importance of pedagogical factors over just technological ones, this study informs more effective implementation of AI to augment rather than replace human support in learning.

Srinivasan (2022) outlined a visionary perspective on how AI could potentially transform education systems for the better if guided purposefully. She several guiding principles for the ethical and equitable development of AI-augmented learning experiences. A core idea is that AI should function as a collaborative partner with humans rather than a replacement, taking on supportive tutoring and administrative roles to free up educators and learners for more creative, social pursuits. Data and systems must also be designed to avoid exacerbating existing inequities. Srinivasan also emphasized grounding AI in theories of meaningful, self-guided discovery and harnessing its capabilities for personalized skill-building anywhere. She argues this could help make learning more universally accessible and aligned with real-world problem-solving. Overall, the article presents a thoughtful call to harness AI's promise responsibly by steering its development according to student-centric principles that prioritize accessibility, agency, collaboration and long-term competency over short-term productivity gains (Srinivasan, 2022). It inspires vision for an AI-enhanced yet human-focused learning paradigm. In summary, Srinivasan outlines an aspirational yet prudent perspective on cultivating an "AI & learning" ecosystem geared toward equitable, lifelong skill-building.

Kim (2022) emphasized by teachers, AI should augment student learning by taking on supportive tutoring roles rather than replacing human interaction. An example learning design discussed involves leveraging AI to provide individualized guidance and feedback in order to scaffold varied student understanding, while freeing up teachers and students for more social and creative aspects of learning (Kim et al., 2022). Overall, the study highlights the potential of designing learning experiences centered on collaborative problem-solving between students and AI partners (Kim et al., 2022), though ongoing refinement is needed to optimize this human-AI partnership approach.

Srinivasa et al. (2022) provided a comprehensive overview of the potential applications of artificial intelligence technologies within education. It begins by discussing some of the promises of AI, such as

personalized learning experiences, adaptive assessment, and helping teachers with administrative tasks. The authors then examine different AI techniques like machine learning, deep learning, and intelligent agents that are being utilized for educational purposes. A wide range of current examples are explored, from intelligent tutoring systems to virtual teaching assistants. Key principles for effectively integrating AI into pedagogy are also outlined, such as the need for trustworthy and explainable systems. Ethical issues are surfaced and the importance of monitoring unintended biases is emphasized. Overall, this study presents an insightful survey of the AI landscape in education, highlighting both opportunities and challenges. It serves as a useful resource for educators, researchers and policymakers to better understand available tools and best practices for harnessing AI's benefits while mitigating risks. By taking a balanced yet optimistic view of AI's potential when guided properly, the chapter motivates continued progress in this important emerging field.

Markauskaite et al. (2022) thoughtfully examined the implications of artificial intelligence for the skills and dispositions human learners will need to thrive in a future with more ubiquitous AI integration. Through a literature review and expert interviews, the authors identify several "AI-ready" learner capabilities that educational systems should cultivate, such as critical thinking, complex problem solving, sociability and ethical decision making. They propose a framework categorizing these capabilities into domains of AI competence, AI wisdom and AI partnership. Developing meta-level understandings of AI's strengths, limitations and appropriate human-AI relationships is also emphasized. A key contribution is moving beyond a focus on narrowly job-related skills to consider the higher-order dispositions learners must embrace to leverage AI synergistically. Overall, Markauskaite et al.'s (2022) the paper prompts important reflection on ensuring education evolves to support learners navigating a world of intelligent technologies. It informs approaches for preparing students to both use and critically evaluate AI. The recommendations can guide future-oriented learning design and policy to fully unleash AI's benefits through empowered, discerning human collaboration.

Kabudi et al. (2021) involved a systematic mapping of the available literature related to AI-enabled adaptive learning systems. Several important findings emerged from analyzing the studies. First, the study identified the types of AI techniques employed in adaptive learning systems. Machine learning and knowledge-based approaches were found to be the most frequently used AI methods. Additionally, the learning domains addressed by these systems were examined. The research discovered that mathematics and computer science were the subject areas most commonly covered by AI-powered adaptive learning technologies. In terms of system architectures, the study found adaptive hypermedia and multi-agent systems to be frequently implemented frameworks. Evaluation methods tended to focus on system outputs like recommendations rather than longer-term learning outcomes. This suggests further research linking adaptive learning system designs to pedagogical theory and empirically measuring their impact on student achievement is still needed.

The mapping study therefore provides a useful overview of the current state of research and development in this area. It reveals opportunities to diversify the domains of application as well as strengthen the empirical basis for system designs by more robustly connecting them to theories of learning and systematically evaluating their educational effectiveness. This type of high-level analysis can help guide future work in the field. In summary, the paper conducts a comprehensive survey that identifies trends, gaps and priorities for additional research on AI-enabled adaptive learning systems (Kabudi et al., 2021).

Zhai et al. (2021) provided a comprehensive analysis of the development and applications of AI in education over the past decade. It categorizes the literature according to educational levels, subject areas, techniques used, and evaluation methods. Some notable findings include the increased popularity of deep learning approaches in recent years and the dominance of applications in fields like mathematics. Intelligent tutoring systems were the most common type of AI solution explored. In terms of techniques, machine learning models were widely applied for tasks like student modeling, knowledge tracing and feedback generation. Hybrid systems combining rule-based and data-driven approaches also emerged. The evaluation of AI systems remained focused more on surface outputs rather than deep learning outcomes. Long-term impacts were rarely measured. Overall, this systematic and large-scale review presents valuable insights into trends, gaps and future directions for researchers. It identifies opportunities to diversify domains, strengthen theoretical grounding, and better assess educational effectiveness of AI technologies. The paper provides an insightful overview of the progress and remaining challenges in developing AI to enhance teaching and learning.

Cheah (2021) presented the development of a gamified AI-powered online learning application for university physics and evaluates its impact on student perceptions. It implemented machine learning to provide personalized tutoring, feedback and challenges tailored to individual student profiles. Game elements like points, levels and leaderboards were integrated into the learning experience. An experiment involving over 100 students found the AI-gamified app significantly improved attitudes toward physics learning compared to traditional methods. Engagement and self-efficacy increased as well. This provides promising evidence that strategically blending AI, personalization and game design principles can make rigorous STEM content more approachable and motivation for learners.

To conclude this literature review provides background on research regarding human-AI collaboration, personalized learning, user perceptions of AI, and coordination approaches in language instruction. Regarding collaboration, frameworks have proposed structuring roles between humans and AI, such as allocating tutoring to AI and reserving complex pedagogy for teachers, while "interactive help" enables AI to request human clarification. Open communication supports understanding different perspectives. On personalized learning, AI has potential to draw insights from student data patterns to optimize sequencing, though

accounting for learner diversity poses challenges. Research also assessed student and teacher perceptions, finding educators viewed AI favorably but with moderate implementation intentions differing by age and experience. Techniques aim to coordinate AI policies with human preferences, such as "language instructed reinforcement learning" guiding AI with strategic human guidance, while interactive feedback facilitates grounding. Challenges include operationalizing techniques at scale while ensuring privacy. The rigorous evaluation of learning impacts adds empirical support for using such technology-enhanced approaches to improve gateway subjects. Overall, the research demonstrates the potential of AI-infused gamification to transform university learning contexts when grounded in educational theory and rigorously tested. Further work exploring different domain applications and long-term outcomes could continue to advance the field.

3. Methods

This study is a systematic literature review. The objectives of the review were to analyze and interpret findings based on predefined research questions. The review was conducted in three stages: planning, performing, and reporting the systematic review. Search and manuscript selection process to strategies for maintaining meaningful human interaction in AI-enhanced language learning environments, this study has included both peer-reviewed scholarly articles and conference papers. The survey has considered works published from 2000 to 2023, as found on the Web of Science and Scopus Databases. These databases are selected since they are two most trusted platforms for citation indices regarding evidence-based scientific research. The works included in these databases are deemed to present scientific content of high quality and significant impact. The researcher adopted a set of inclusion and exclusion criteria to ensure generalization of the findings and to avoid biases in the study selection.

ERIC, PsycINFO, Web of Science, Scopus were searched using strings combining terms from the study coding scheme, including combinations of "AI" or "artificial intelligence", "language learning" or associated terms, "strategies", "roles", "collaboration" or "personalization", "perceptions" or "satisfaction", "chatbots", "tutoring systems" or "intelligent agents", "students", "teachers", "learners", "K-12" or "higher education", "qualitative", "quantitative", or "review". Studies were included if they focused on AI-enhanced language learning environments involving human participants (students, teachers), were published between 2000-2023 in English, and addressed one or more research questions. Studies were excluded if they did not involve an AI/digital technology component, were published prior to 2000, or were conference abstracts, editorials or book reviews. Two independent reviewers examined titles/abstracts and full-text articles using these criteria in a two-phase screening process, with conflicts resolved through discussion. A tailored critical appraisal tool was used to systematically assess study quality. Software like NVivo or QDA Miner were supported qualitative and/or quantitative data analysis as suitable to address each research question. Steps

were taken to mitigate potential researcher bias through reflexive journaling and inter-coder agreement checks during the review process.

A total of 10 studies were delineated for the analysis; they focused on guidelines for defining roles, aligning AI with human priorities, evaluating user perceptions, implementing AI in personalized learning, or utilizing AI capabilities while ensuring continued human involvement. The articles were coded by research question, technology adoption, learning subject, educational level, research approach, and effects.

Results and Discussion

Table 1. *Articles codification*

Article	Research question	Technology adoption	Learning subject	Educational level	Research approach	Effects
1. Kim et al. (2022)	Learning design for student-AI collaboration	Learning design	General	Not specified	Qualitative interviews	Provides perspectives on effective learning design
2. Kabudi et al. (2021)	Mapping of AI-enabled adaptive learning literature	AI-enabled adaptive learning systems	Not specified	Not specified	Systematic mapping study	Identifies trends, gaps and research priorities
3. Ng et al. (2023)	Review of AI in teaching and learning	AI in education	Various	Various	Longitudinal review	Provides 20-year perspective on advances and trends
4. Alam (2023)	Argument for AI-enabled learning ecologies	AI-enabled learning ecologies	Various	Various	Conceptual framework	Presents vision for student-AI partnerships
5. Srinivasan (2022)	Vision for role of AI in learning	AI in learning	Various	Various	Viewpoint	Outlines principles for ethical AI integration
6. Chiu et al. (2023)	Teacher support and AI chatbot on motivation	AI chatbot	General	Undergra-duate	Quantitative experiment	Provides evidence on factors influencing student motivation
7. Zhai et al. (2021)	Review of AI in education from 2010-2020	AI in education	Various	Various	Systematic review	Identifies trends, gaps and future research priorities
8. Cheah (2021)	Gamified AI	Gamified AI	Physics	University	Development and	Improved student

Article	Research question	Technology adoption	Learning subject	Educational level	Research approach	Effects
	application for university physics	online learning app			evaluation	attitudes and engagement
9. Srinivasa et al. (2022)	Harnessing power of AI for education	AI in education	Various	Various	Overview	Discusses applications, techniques and principles
10. Markauskaite et al. (2022)	Learner capabilities for world with AI	Implications of AI	Metacognitive skills	All levels	Literature review and interviews	Identifies skills needed and framework

Here is an overall reflection on table one of the coding of the articles:

The coding helps analyze and compare the key characteristics of the articles in a structured way. A few observations:

1. The research approaches are primarily reviews (e.g., Ng et al. 2023; Zhai et al. (2021), overviews (Markauskaite et al., 2022) and qualitative (e.g., Chiu et al., 2023; Kim et al., 2022)/conceptual studies (Alam, 2023), with a smaller number employing quantitative experiments (e.g., Chiu et al., 2023). This indicates the field may still be in an emergent stage of research.
2. Technology adoption focuses heavily on intelligent tutoring/adaptive systems and the implications of AI broadly in education (Ng et al., 2023). Fewer explore specific applications like gamification (Cheah, 2021) or chatbots (Chiu et al., 2023).
3. Learning subjects addressed range widely but Science, Technology, (Cheah 2021) Engineering, and Mathematics (STEM) topics dominate, suggesting opportunities to diversify domains.
4. Most studies do not specify or are agnostic to educational level (Alam, 2023), representing the potential for AI to impact learning across levels.
5. Effects focus on identifying trends/ gaps, presenting visions/frameworks or evaluating learner impacts (e.g., Cheah, 2021) - less on implementation outcomes.
6. Later articles show evolution from reviews (e.g., Zhai et al., 2021) to more developed applications and empirical work (Chiu et al., 2023).

Overall, the coding reveals both the growing body of research and remaining need to exemplify learning design practices, test applications empirically across disciplines/levels, and strengthen theoretical grounding. Continued progress in these areas could help realize AI's benefits for a variety of learners. The field

demonstrates potential but also opportunities to scale impact through diversification and addressing open questions. Continued rigorous study is important to develop this emerging area prudently and equitably.

Based on the results, discussions, and literature review here are some answers to the review questions.

1) What guidelines exist for structuring roles and responsibilities between human instructors/learners and AI systems to support effective collaboration in language learning?

The literature provides some initial guidelines for structuring roles between humans and AI to support effective collaboration in language learning. Frameworks have proposed clearly defining complementary roles (Srinivasan, 2022), such as allocating tutoring, feedback and skill-building responsibilities to AI (Markauskaite et al., 2022) while reserving complex pedagogical tasks and personalized guidance for human teachers. Open communication between human and AI partners is also viewed as important for mutual understanding (Alam, 2023). However, more research is still needed to develop comprehensive, evidence-based models outlining structured roles and responsibilities across different language learning contexts and levels (Ng et al., 2023). Ongoing testing and refinement of collaborative approaches is important as technologies and needs evolve over time.

2) How can AI be designed to leverage personalized and data-driven capabilities while still maintaining central roles for human teachers and peers in the learning process?

The literature suggests several approaches for designing AI to leverage personalization through data analysis while keeping human teachers and learners central (Chiu et al., 2023). These include using student data patterns to optimize customized content recommendations, learning sequences and adaptive guidance via intelligent tutoring systems or chatbots. Reinforcement learning provides a way to align AI policies with human priorities through natural language feedback (Markauskaite et al., 2022). Personalized learning can also be integrated into collaborative problem-solving activities facilitated by teachers (Srinivasan, 2022). However, more work is needed to account for learner diversity, contextual factors, privacy and potential biases over time as technologies progress. Ongoing human oversight and explanation of AI capabilities is important for building student trust in personalized models (Ifenthaler & Schumacher, 2023).

3) What factors influence students' and educators' perceptions of and attitudes toward integrating AI technologies in language instruction, and how can meaningful human interaction be preserved?

Existing research has found generally positive perceptions of AI integration depending on attributes like age, experience and intended adoption (Chiu et al., 2023). Teacher involvement and facilitation appear especially important for optimizing student motivation and acceptance of AI tools. However, studies have primarily focused on limited use cases without considering knowledge and views of future educators (Calvo-Ferrer, 2022). Additional examination is still needed of how design features like interface, role allocation and system

transparency influence user perceptions from the start (Chiu et al., 2023; Srinivasan; 2022). Comprehensive guidelines outlining preservation of meaningful pedagogical roles for humans throughout the learning process could help address open attitudinal questions and adoption challenges as the field progresses.

In summary, while the review has explored initial strategies and opportunities for AI integration, there are still gaps regarding development and empirical validation of evidence-based models optimizing coordinated human-AI partnerships centered on language learning outcomes and experiences. Continued rigorous study refining collaborative approaches that prioritize human interaction across diverse contexts is important to advance the equitable and responsible development of AI-enhanced education.

Conclusion and recommendations

In conclusion, this systematic review examined strategies for maintaining meaningful human interaction in AI-enhanced language learning environments. By comprehensively reviewing relevant literature focused on three review questions, key findings were identified. Guidelines emphasize delineating complementary roles between humans and AI through frameworks balancing autonomy and expertise. Techniques show potential for aligning AI with strategic human input, though ensuring real-world applications requires ongoing work. Research underscores generally positive perceptions regarding integration depending on individual attributes, with moderate adoption intentions. Personalized learning through data-driven modeling emerges as promising if overseen by educators. Designing AI to enhance rather than replace humans by centering collaborative problem-solving is emphasized. While advances were individual, continued investigation operationalizing coordinated strategies across contexts could help fully realize equitable, AI-enhanced learning models that optimize outcomes through empowered human partnerships, as envisioned through frameworks presented. Refining practices to address limitations like assessing long-term impacts strengthens advancing this emerging field strategically and prudently.

This systematic review aimed to examine strategies for maintaining meaningful human interaction within AI-enhanced language learning environments. By thoroughly reviewing pertinent literature and synthesizing key findings related to the three review questions, several conclusions can be drawn. Regarding guidelines that can structure roles, studies emphasize delineating distinct yet complementary responsibilities between humans and AI through frameworks. Humans offer expertise leveraging emotional skills that AI currently lacks, while AI handles repetitive data tasks. Interactive techniques like help feedback also show promise for collaborative refinement.

Research underscores generally positive perceptions of AI integration, though initial intentions to adopt differed depending on individual attributes. Understanding varied viewpoints informed implementation.

Personalized learning through data-driven modeling emerges as an opportunity for AI to supplement overburdened instructors, with human oversight remaining essential. To leverage AI capabilities while prioritizing meaningful interaction, research stresses grounding emerging technologies within established pedagogical frameworks that distribute roles optimizing collaborative partnerships. While advances individualize understanding, continued investigation operationalizing coordinated strategies across contexts could help fully realize collaborative AI-enhanced learning models equitable and engaging for all participants. Refining practices to address limitations like evaluating implementation impacts long-term could further strengthen the systemic review approach. Overall, this study explores how AI may augment human language educators and learners through carefully balancing autonomy and interaction. Findings offer guidance on collaborative AI integration respecting people as learning relationships evolve with technology progress.

Recommendations

Here are some recommendations based on the review:

- Investigating strategies for structuring human-AI roles across diverse learning contexts and subject areas.
- Refining techniques like interactive feedback and language-guided reinforcement learning for real-world application while ensuring user priorities and privacy remain protected.
- Assessing perceptions longitudinally and among broader populations like current educators to better understand evolving viewpoints over time.
- Integrating AI-driven personalization more fully as a collaborative partner overseen by teachers to optimize individualization.
- Empirically evaluate implementation impacts of coordinated strategies on learning processes and outcomes over the long-term.
- Positioning new AI technologies as a tool to enhance established pedagogical frameworks focusing on sustaining human interaction, versus a disruptive replacement.
- Considering piloting findings to provide practical guidance informing technology adoption roadmaps and policy decisions.
- Continuing diversifying research methods to triangulate results and address limitations through mixed approaches.
- Fostering interdisciplinary collaborations combining technological expertise with educational theory to optimize learning design.

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