Human-machine teaming perspective on college English speaking classroom design: Targeting the enhancement of students' willingness to communicate

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ABSTRACT

This review article examines the integration of human-machine teaming principles into college English speaking classroom design with the specific objective of enhancing students' willingness to communicate. As educational technology continues to evolve, the convergence of human expertise and artificial intelligence capabilities presents unprecedented opportunities for language learning pedagogy. This comprehensive review synthesizes current research across multiple domains including second language acquisition theory, educational technology, human-computer interaction, and artificial intelligence to propose a novel framework for classroom design. Through systematic analysis, the research identifies key HMT components that directly impact WTC: adaptive feedback mechanisms, empathetic AI interactions, collaborative task design, and personalized learning environments. The findings indicate that well-designed human-machine partnerships can significantly reduce speaking anxiety, increase learner autonomy, and enhance communicative competence. The review proposes a multi-layered theoretical framework that positions educators as orchestrators of human-AI collaboration rather than sole content deliverers, while AI systems serve as adaptive learning partners providing real-time feedback, conversation practice, and anxiety-reducing interventions. Key recommendations include implementing transparent AI systems that build trust, designing collaborative speaking tasks that leverage both human creativity and AI analytical capabilities, and developing teacher training programs for effective HMT integration. This work contributes to the growing body of knowledge on AI-enhanced language education and provides practical guidelines for educators seeking to modernize speaking instruction through human-machine collaboration.

Keywords: *Artificial intelligence, Educational technology, English speaking classroom, Human-machine teaming, Second language acquisition, Willingness to communicate.*

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Highlights of this paper

- A novel Collaborative WTC Enhancement Model (CWEM) is proposed to integrate Human-Machine Teaming (HMT) into English-speaking classroom design.
- HMT systems offer adaptive, real-time feedback and non-judgmental practice, significantly reducing speaking anxiety to boost Willingness to Communicate (WTC).
- Educators are reframed as strategic orchestrators of human-AI collaboration, shifting from sole content deliverers to facilitators and coaches.

1. INTRODUCTION

The English language education is undergoing a transformative shift as artificial intelligence (AI) technologies become increasingly sophisticated and accessible. At the intersection of this technological evolution and established second language acquisition (SLA) theory lies an emerging paradigm: human-machine teaming (HMT) in educational contexts. This review examines how HMT principles can be strategically applied to college English speaking classroom design to address one of the most persistent challenges in second language education—enhancing students' willingness to communicate (WTC).

Willingness to communicate, first conceptualized by MacIntyre, Clément, Dörnyei, and Noels (1998) and extensively developed through subsequent research (Cao, 2011; Khajavy, Ghonsooly, Hosseini Fatemi, & Choi, 2016; Peng & Woodrow, 2010; Zou, Xie, & Wang, 2025) represents a learner's readiness to enter into discourse at a particular time with a specific person using a second language. Unlike traditional approaches that view WTC as a stable personality trait, contemporary research demonstrates its dynamic, situational nature, making it amenable to classroom interventions and pedagogical design decisions. The significance of WTC in language learning outcomes cannot be overstated research consistently shows that students with higher WTC engage more frequently in communicative activities, experience reduced language anxiety, and achieve better overall proficiency (Zarrinabadi, 2014; Zhang, Beckmann, & Beckmann, 2018).

Simultaneously, the field of HMT has evolved from simple human-computer interaction paradigms to sophisticated collaborative frameworks where humans and AI systems work together as complementary partners. Unlike traditional educational technology that positions computers as tools for human use, HMT conceptualizes AI systems as team members with distinct capabilities that can enhance human performance when properly integrated (Vats et al., 2024). Recent advances in Large Language Models (LLMs) and conversational AI have made this vision increasingly viable for educational applications.

The convergence of these two domains: WTC enhancement and HMT, which presents opportunities for revolutionary changes in English speaking instruction. Traditional speaking classrooms often struggle with issues such as limited individualized attention, insufficient speaking practice opportunities, persistent student anxiety, and lack of real-time feedback. HMT offers potential solutions through AI systems that can provide immediate feedback, create non-judgmental practice environments, deliver personalized interactions, and free human instructors to focus on higher-order pedagogical tasks.

This review addresses a critical gap in current literature by synthesizing research from multiple disciplines to propose a comprehensive framework for HMT-enhanced English-speaking classroom design. While existing studies have explored AI applications in language learning and WTC factors separately, there has been limited systematic examination of how HMT principles can be specifically leveraged to enhance WTC in college-level English speaking instruction.

Our investigation encompasses several key research questions: How can HMT principles be effectively integrated into English speaking classroom design? What specific AI capabilities most directly impact student WTC? How do different HMT configurations affect speaking anxiety, learner autonomy, and communicative competence? What are the essential design principles for creating effective human-AI partnerships in educational contexts?

The significance of this inquiry extends beyond theoretical interest. As colleges and universities worldwide grapple with increasing enrollment, diverse student populations, and pressure for improved learning outcomes, HMT-enhanced classroom designs offer scalable solutions that can simultaneously improve educational effectiveness and instructor satisfaction. Furthermore, as AI technologies become more prevalent in society, preparing students for human-AI collaboration becomes an essential 21st-century skill.

This review contributes to the field by: (1) providing the first comprehensive synthesis of HMT applications specifically focused on WTC enhancement; (2) proposing a theoretical framework that bridges SLA theory and human-AI collaboration research; (3) identifying specific design principles for effective classroom implementation; (4) highlighting critical considerations for teacher training and institutional adoption; and (5) establishing a foundation for future empirical research in this emerging field.

2. LITERATURE REVIEW

2.1. Theoretical Foundations of Willingness to Communicate in Second Language Learning

Willingness to communicate represents one of the most significant theoretical developments in second language acquisition research over the past three decades. Originally conceptualized within first language communication research, WTC was adapted for second language contexts by MacIntyre, Baker, Clément, and Conrod (2001) who defined it as "a readiness to enter into discourse at a particular time with a specific person or persons, using a L2." This definition emphasizes the situational and dynamic nature of WTC, distinguishing it from more stable personality traits such as extraversion or trait communication apprehension.

The theoretical evolution of WTC has progressed through several distinct phases. Early models treated WTC as a relatively stable individual difference variable, focusing on trait-like predictors such as communication apprehension, perceived competence, and self-confidence. However, subsequent research, particularly Cao (2011) groundbreaking ecological study, demonstrated that WTC fluctuates dramatically within individual learners across different situational contexts. This revelation led to the development of more sophisticated models that account for both trait and state factors.

Peng and Woodrow (2010) large-scale investigation of 579 Chinese EFL learners produced one of the most comprehensive WTC models to date, identifying multiple layers of influence including individual characteristics (Motivation, self-confidence, language anxiety), classroom environmental factors (Teacher support, group cohesiveness, task characteristics), and broader contextual variables (Cultural norms, institutional policies). Their structural equation modeling revealed that perceived teacher support emerged as one of the strongest predictors of classroom WTC, with effect sizes rivaling those of individual psychological variables.

Recent theoretical developments have emphasized the sociocognitive nature of WTC, with Cao (2014) process-oriented model demonstrating how cognitive, affective, and social factors interact dynamically during communicative events. This model identifies specific temporal patterns in WTC fluctuation, showing that initial speaking episodes significantly influence subsequent WTC levels within the same class period. Such findings have profound implications for classroom design, suggesting that early positive speaking experiences can create positive feedback loops that sustain high WTC throughout a lesson.

The situational antecedents of WTC have been extensively documented across diverse cultural and educational contexts. Zhang et al. (2018) comprehensive review identified six primary categories of situational WTC predictors: task characteristics (Topic familiarity, task complexity, interlocutor relationships), environmental factors

(Classroom climate, group dynamics, physical setting), temporal variables (Time of day, lesson stage, academic calendar), interlocutor variables (Familiarity, perceived competence, cultural background), instructor behaviors (Feedback style, error correction approach, encouragement strategies), and technological factors (Medium of communication, tool familiarity, technical reliability).

Task characteristics have received particular attention in WTC research. Topics that are personally relevant, culturally appropriate, and cognitively accessible consistently generate higher WTC levels than abstract or culturally distant topics (Khajavy et al., 2016). Task complexity research reveals a curvilinear relationship with WTC—tasks that are too simple generate boredom and reduced engagement, while overly complex tasks trigger anxiety and avoidance behaviors. The optimal complexity level appears to be just beyond learners' current proficiency level, creating what Vygotsky (1978) termed the "zone of proximal development."

Interlocutor relationships represent another critical WTC determinant. Research consistently shows that WTC increases when students communicate with familiar peers, decreases with unfamiliar classmates, and varies dramatically with instructor interactions depending on the teacher's approachability and feedback style. Zarrinabadi (2014) investigation of teacher effects on WTC identified specific instructor behaviors that promote communication: showing genuine interest in student ideas, providing supportive feedback, using inclusive questioning strategies, and maintaining positive body language.

The role of technology in WTC has emerged as a significant research area. Cultural factors in WTC have been extensively studied, particularly in East Asian contexts where traditional educational approaches may conflict with communicative language teaching principles. Research in Chinese, Korean, and Japanese educational contexts reveals that WTC patterns are significantly influenced by cultural values such as face-saving concerns, respect for authority, and preference for accuracy over fluency. However, these cultural influences are not deterministic—appropriate classroom design and teacher training can successfully increase WTC even in traditionally teacher-centered educational cultures.

2.2. Human-Machine Teaming Frameworks and Educational Applications

Human-Machine Teaming represents a paradigm shift from traditional human-computer interaction models toward collaborative partnerships where humans and AI systems work together as complementary team members. This evolution reflects growing recognition that purely automated systems often fail to handle complex, contextual tasks, while human-only approaches cannot efficiently process large-scale data or provide consistent performance across extended periods.

The theoretical foundations of HMT draw from multiple disciplines including cognitive science, organizational psychology, human factors engineering, and AI. However, contemporary HMT frameworks move beyond simple automation levels to emphasize dynamic collaboration, shared mental models, and adaptive role allocation.

Vats et al. (2024) comprehensive survey of HMT with Large Pre-trained Models identifies three critical phases in human-AI collaboration: (1) Data control and preparation, where humans provide quality oversight and contextual interpretation; (2) Machine learning modeling and execution, guided by human expertise and domain knowledge; and (3) Evaluation and refinement, combining human judgment with algorithmic analysis. This framework provides a useful lens for understanding how educational applications can benefit from strategic human-AI collaboration.

The concept of shared mental models represents a crucial element in effective HMT. Shared mental models refer to organized knowledge structures that team members hold about task requirements, procedures, role responsibilities, and teammate characteristics. In human-AI educational contexts, shared mental models develop as students and instructors learn to understand AI capabilities and limitations, while AI systems adapt to human preferences and teaching styles. Research by Cha, Han, Yoo, and Oh (2024) demonstrates that explicit training in AI capabilities significantly improves human-AI team performance by reducing inappropriate reliance and increasing strategic collaboration.

Trust emerges as a fundamental factor in successful HMT implementation. Bansal et al. (2019) identify two primary trust challenges in human-AI collaboration: over trust, where humans rely too heavily on AI recommendations, and under trust, where humans dismiss accurate AI insights. Educational contexts present unique trust dynamics because student-AI relationships differ from instructor-AI relationships, and trust levels significantly impact learning effectiveness.

Transparency and explainability represent additional critical factors in educational HMT. Mozannar et al. (2023) demonstrate that AI explanations significantly increase human trust in algorithmic decisions, particularly when explanations are provided at appropriate levels of detail for user expertise. In educational contexts, different stakeholders (Students, instructors, administrators) require different types of explanations about AI behavior and decision-making processes.

The adaptation and personalization capabilities of AI systems represent a key advantage in educational HMT applications. Unlike traditional educational technology that provides static responses, modern AI systems can learn from interaction patterns, adapt to individual learning styles, and provide increasingly personalized support. However, this adaptability must be balanced against consistency and predictability requirements that support effective learning.

Several successful HMT implementations in educational contexts provide evidence for the framework's potential. The EDEN system (Siyan, Shao, Yu, & Hirschberg, 2024) demonstrates how empathetic conversational agents can enhance second language learning by providing adaptive feedback, emotional support, and personalized practice opportunities. The system combines human teacher oversight with AI-powered conversation practice, grammar correction, and empathetic response generation. User studies showed significant improvements in perceived affective support and L2 grit among learners who interacted with empathetic AI compared to non-empathetic alternatives.

ConversAR (Bendarkawi et al., 2025) represents another promising HMT application, utilizing augmented reality environments to create immersive group conversation practice. The system features multiple AI agents with distinct personalities and conversation roles, while human instructors provide oversight, task design, and performance evaluation. Initial evaluations demonstrate reduced speaking anxiety and increased learner autonomy compared to traditional classroom instruction.

The CHOP platform (Cha et al., 2024) illustrates HMT principles in English oral presentation practice. The system provides real-time feedback on presentation delivery, content organization, and language use, while human instructors focus on strategic coaching and skill development. Students reported improved confidence and presentation quality after using the integrated human-AI approach.

Research on AI-assisted brainstorming and creative tasks provides additional evidence for HMT effectiveness in educational contexts. Studies demonstrate that human-AI collaborative teams often outperform both human-only and AI-only conditions on creative tasks, with AI systems contributing novel ideas and pattern recognition while humans provide evaluation, refinement, and strategic guidance.

2.3. Technology-Enhanced Speaking Practice and Anxiety Reduction

Technology-enhanced speaking practice has evolved significantly from early computer-assisted language learning (CALL) applications to sophisticated AI-powered conversational systems. This evolution reflects both technological advances and improved understanding of second language speaking acquisition processes. Contemporary research demonstrates that well-designed technological interventions can address many traditional barriers to speaking practice, including limited class time, student anxiety, insufficient individualized feedback, and lack of authentic communicative contexts.

The anxiety reduction potential of technology-mediated speaking practice represents one of the most significant advantages over traditional classroom instruction. Speaking anxiety, identified as one of the primary inhibitors of WTC, stems from multiple sources including fear of negative evaluation, concern about making mistakes, and discomfort with public performance. Technological mediation can address these concerns through several mechanisms: providing private practice opportunities, offering non-judgmental feedback, reducing face-threat in error correction, and allowing self-paced interaction.

Virtual Reality (VR) applications have shown particularly promising results for speaking anxiety reduction. Recent research by Zhang and Khalid (2024) demonstrates that VR-based public speaking practice significantly reduces social anxiety among non-native English speakers. The study found that students practicing in VR environments reported lower anxiety levels and improved performance compared to traditional classroom practice. The immersive nature of VR allows for realistic speaking scenarios while maintaining the psychological safety of a controlled environment.

Avatar-mediated communication research reveals important nuances in technology design for anxiety reduction. Liu, Sanchez, Wang, Yi, and Shi (2023) investigation of avatar realism effects on ESL speaker anxiety found that cartoonish avatars produced lower anxiety levels than realistic human-like avatars. This counterintuitive finding suggests that excessive realism in AI representations may actually increase rather than decrease speaking anxiety by making interactions feel more socially threatening. The study's physiological measures (Heart rate, skin conductance) corroborated self-report findings, providing objective evidence for avatar design effects.

Conversational AI systems specifically designed for language learning have demonstrated significant potential for speaking practice enhancement. The FreeTalky system (Park, Jang, Lee, Park, & Lim, 2021) employed a humanoid robot with persona-based dialogue capabilities to reduce fear of foreign languages. The system's key innovation was its consistent, patient personality that provided encouragement without judgment. User evaluations showed significant reductions in speaking anxiety and increased willingness to engage in L2 communication.

The timing and nature of feedback in technology-enhanced speaking practice significantly impact learning outcomes and anxiety levels. Research demonstrates that immediate feedback can either enhance or impair performance depending on feedback type, learner characteristics, and task complexity. Corrective feedback that interrupts speech flow generally increases anxiety and reduces WTC, while delayed, supportive feedback maintains engagement while promoting accuracy development.

Empathetic AI systems represent a significant advancement in speaking practice technology. The EDEN system's adaptive empathetic feedback demonstrates how AI can provide emotional support alongside linguistic feedback. The system monitors user emotional states through speech analysis and pause patterns, providing appropriate empathetic responses when distress is detected. Experimental results showed that adaptive empathetic feedback produced higher perceived affective support than either fixed empathetic responses or no empathetic feedback.

Group conversation practice through technology presents both challenges and opportunities. Traditional CALL applications focused primarily on individual practice, but recent developments enable multi-user conversational environments. ConversAR's group conversation features allow multiple learners to practice together in augmented reality settings with AI agents facilitating discussions. This approach combines the anxiety-reducing benefits of technology mediation with the authentic interaction patterns of group communication.

The integration of speech recognition and pronunciation feedback systems has significantly enhanced technology-mediated speaking practice. Advanced ASR systems can now provide detailed feedback on pronunciation accuracy, fluency measures, and prosodic features. However, research indicates that feedback effectiveness depends heavily on presentation format and timing. Visual feedback displays that highlight specific pronunciation errors can be highly effective when combined with audio models and practice opportunities.

Personalization and adaptation represent critical factors in technology-enhanced speaking practice effectiveness. AI systems that adapt to individual learning styles, proficiency levels, and anxiety patterns provide more effective support than static applications. Machine learning can identify optimal feedback timing, appropriate challenge levels, and effective motivational strategies for individual learners. However, this personalization must be balanced against pedagogical principles and learning objectives established by human instructors.

The scalability of technology-enhanced speaking practice offers significant advantages for educational institutions facing resource constraints. AI-powered conversational systems can provide unlimited practice opportunities without requiring additional human resources. However, research emphasizes that effective implementation requires careful integration with human instruction rather than replacement of human teachers. The most successful programs position technology as a complement to rather than substitute for human expertise.

3. HUMAN-MACHINE TEAMING FRAMEWORK FOR WTC ENHANCEMENT

Building upon the comprehensive literature review, this section proposes a novel theoretical framework that integrates HMT principles with WTC theory to create optimal conditions for English speaking classroom design. This framework, termed the "Collaborative WTC Enhancement Model" (CWEM), addresses the complex interactions between human instructors, AI systems, and students in technology-enhanced learning environments.

3.1. Theoretical Architecture of the Collaborative WTC Enhancement Model

The CWEM framework operates on four interconnected levels: (1) Individual Learner Level, focusing on personal psychological and linguistic factors; (2) Dyadic Interaction Level, examining human-AI and human-human communication patterns; (3) Classroom Ecosystem Level, encompassing group dynamics and environmental factors; and (4) Institutional Support Level, addressing organizational and technical infrastructure requirements.

At the Individual Learner Level, the framework recognizes that each student brings unique characteristics that influence their response to HMT interventions. These characteristics include language proficiency, cultural background, technology familiarity, personality traits, and prior learning experiences. The framework proposes that effective HMT systems must dynamically adapt to these individual differences through sophisticated learner modeling and personalization algorithms. Unlike traditional one-size-fits-all approaches, CWEM-based systems continuously adjust interaction patterns, feedback styles, and challenge levels based on real-time assessment of learner states and preferences.

The framework incorporates recent advances in affective computing to monitor student emotional states during speaking activities. Through analysis of vocal patterns, facial expressions, physiological measures, and behavioral indicators, AI systems can detect anxiety, frustration, engagement, and confidence levels. This information enables responsive interventions such as providing additional support when anxiety is detected, offering more challenging tasks when students demonstrate readiness, or implementing empathetic responses when emotional distress is identified.

At the Dyadic Interaction Level, CWEM addresses the quality and nature of human-AI communication partnerships. The framework emphasizes that effective HMT requires more than simply adding AI tools to traditional instruction, it demands fundamental reconceptualization of responsibilities. Human instructors evolve from information deliverers to interaction facilitators, strategic coaches, and learning environment orchestrators. AI systems function as practice partners, feedback providers, and adaptive learning supporters.

The framework proposes specific design principles for human-AI communication in educational contexts. AI systems should demonstrate consistent personalities that students can learn to understand and trust. Communication patterns should be transparent, with AI systems able to explain their responses and recommendations in terms appropriate for student comprehension levels. The AI should exhibit appropriate cultural sensitivity and adapt communication styles to match learner preferences and cultural backgrounds.

Critical to successful dyadic interaction is the concept of "complementary competence," where humans and AI systems contribute different but synergistic capabilities. Human instructors provide strategic guidance, emotional support, cultural interpretation, and creative problem-solving. AI systems contribute consistent availability, infinite patience, objective assessment, pattern recognition, and personalized adaptation. The framework emphasizes that optimal learning outcomes emerge when these competencies are strategically combined rather than duplicated.

3.2. Adaptive Feedback Mechanisms and Real-Time Response Systems

The CWEM framework places particular emphasis on adaptive feedback mechanisms that respond dynamically to student needs and learning contexts. Traditional classroom feedback is often delayed, generic, and inconsistent due to instructor workload and human limitations. HMT-enhanced systems can provide immediate, personalized, and contextually appropriate feedback while freeing human instructors to focus on higher-order pedagogical tasks.

The framework identifies multiple feedback channels that can be enhanced through HMT approaches. Linguistic feedback addresses grammar, vocabulary, pronunciation, and discourse features through AI systems trained on large corpora of native speaker productions. However, unlike simple error correction systems, CWEM-based feedback considers learner proficiency levels, error gravity, communicative impact, and emotional readiness for correction. AI systems can determine optimal feedback timing, frequency, and presentation format based on individual learner characteristics and situational factors.

Pragmatic feedback represents a more complex challenge that benefits significantly from human-AI collaboration. While AI systems can identify potential pragmatic inappropriacy through pattern recognition and context analysis, human instructors provide cultural interpretation and strategic guidance for pragmatic development. The framework proposes hybrid feedback systems where AI systems flag potential pragmatic issues and provide initial guidance, while human instructors offer deeper cultural explanation and contextualization.

Motivational and emotional feedback represents a critical component of WTC enhancement that requires sophisticated HMT integration. The framework incorporates research on empathetic AI systems, proposing that effective motivational feedback requires both AI consistency and human authenticity. AI systems can provide consistent encouragement, track progress over time, and offer personalized motivational strategies. Human instructors contribute genuine emotional connection, inspirational guidance, and strategic goal-setting support.

Real-time response systems represent a technological capability that significantly enhances traditional classroom interaction patterns. CWEM-based classrooms incorporate AI systems that can monitor multiple student conversations simultaneously, providing immediate assistance when communication breakdowns occur, suggesting vocabulary or phrases when students struggle with expression, and alerting instructors to students who need additional support.

The framework addresses the critical issue of feedback overload, recognizing that excessive correction can inhibit rather than enhance WTC. AI systems can implement sophisticated feedback filtering algorithms that prioritize corrections based on communicative importance, learner readiness, and pedagogical objectives. This allows for comprehensive error detection while maintaining communicative flow and student confidence.

3.3. Collaborative Task Design and Implementation Strategies

Effective implementation of the CWEM framework requires careful attention to collaborative task design that leverages both human creativity and AI analytical capabilities. The framework proposes a task taxonomy that categorizes speaking activities based on their suitability for different types of human-AI collaboration.

Individual practice tasks benefit significantly from AI partnership, particularly for shy or anxious students who may be reluctant to speak in front of peers. AI conversation partners can provide unlimited practice opportunities, patient interaction, and private feedback. The framework emphasizes that AI practice partners should be designed to gradually build student confidence and prepare them for human interaction rather than replacing human communication entirely.

Pair and small group tasks can be enhanced through AI facilitation and support. AI systems can monitor group conversations, provide vocabulary assistance, suggest discussion topics, and ensure equitable participation. Human instructors can focus on strategic coaching and deeper pedagogical interventions while AI systems handle routine support functions.

Large group and presentation tasks benefit from hybrid assessment systems where AI systems provide technical feedback on delivery features (Pacing, volume, clarity) while human instructors evaluate content, creativity, and communicative effectiveness. This division allows for comprehensive feedback while maintaining human judgment in areas requiring cultural and contextual interpretation.

The framework proposes specific design principles for HMT-enhanced speaking tasks. Tasks should have clear role delineation between human and AI responsibilities, transparent objectives that students can understand and track, appropriate challenge levels that maintain engagement without causing anxiety, and built-in adaptation mechanisms that adjust difficulty based on student performance.

Collaborative project-based tasks represent particularly promising applications of HMT principles. Students can work with AI systems to research topics, generate ideas, organize presentations, and practice delivery, while human instructors provide strategic guidance, evaluation, and coaching. This approach develops both communicative competence and 21st-century skills in human-AI collaboration.

4. IMPLEMENTATION STRATEGIES AND PEDAGOGICAL CONSIDERATIONS

The successful implementation of HMT frameworks in college English speaking classrooms requires consideration of pedagogical strategies, technological integration, and institutional support systems. This section addresses practical implementation approaches, highlighting critical success factors and potential challenges that educators and institutions must navigate.

4.1. Classroom Integration Models and Teaching Approaches

The integration of HMT principles into English speaking instruction can follow several distinct models, each with unique advantages and implementation requirements. The framework identifies three primary integration approaches: supplemental, embedded, and transformative models.

The supplemental model positions AI systems as additional resources that support traditional instruction without fundamentally altering classroom structure or teaching approaches. In this model, students access AI conversation partners for extra practice outside class time, while classroom instruction follows conventional patterns. AI systems provide homework support, pronunciation practice, and individual feedback that supplements teacher-led activities. This approach offers the advantage of minimal disruption to existing pedagogical practices while providing enhanced learning opportunities.

However, research suggests that supplemental integration often fails to realize the full potential of HMT approaches. When AI systems are positioned as "extra" rather than integral components of learning, students may not develop the strategic collaboration skills necessary for optimal human-AI partnership. Furthermore, supplemental approaches may exacerbate existing inequalities if some students have better access to technology resources than others.

The embedded model integrates AI systems directly into classroom activities while maintaining traditional instructional roles for human teachers. In this approach, AI systems function as classroom assistants, providing real-time feedback during speaking activities, facilitating group discussions, and supporting individual student needs. Teachers retain primary responsibility for lesson planning, instruction, and assessment, while AI systems handle routine support functions.

Embedded integration offers several advantages including enhanced individualized attention, more comprehensive feedback, and improved efficiency in routine tasks. Teachers can focus on strategic coaching and complex pedagogical interventions while AI systems provide consistent support for all students. This model requires moderate changes to teaching practices and classroom organization but preserves familiar instructional patterns.

The transformative model represents the most comprehensive approach to HMT integration, fundamentally reconceptualizing roles and responsibilities in the learning environment. In transformative classrooms, human teachers function as learning facilitators and strategic coaches while AI systems serve as primary practice partners and feedback providers. Students develop explicit skills in human-AI collaboration as part of their language learning objectives.

Transformative integration requires significant changes to pedagogical approaches, teacher training, and institutional support systems. However, research suggests this model produces the largest improvements in learning and student engagement. Students in transformative HMT classrooms demonstrate increased autonomy, improved metacognitive skills, and better preparation for technology-enhanced professional environments.

4.2. Teacher Training and Professional Development Requirements

Successful HMT implementation depends critically on comprehensive teacher training programs that address both technological competencies and pedagogical adaptations. The framework identifies several key areas where professional development is essential for effective human-AI collaboration in educational contexts.

Technical literacy represents a fundamental requirement for teachers implementing HMT approaches. However, technical training should focus on strategic understanding of AI capabilities and limitations rather than detailed programming knowledge. Teachers need to understand how AI systems learn and adapt, what types of feedback they can provide reliably, and when human intervention is necessary. This understanding enables informed decisions about when to rely on AI recommendations and when to override or supplement AI-generated responses.

Pedagogical adaptation training addresses the changes in teaching approaches required for effective HMT implementation. Teachers must learn to function as facilitators and coaches rather than primary information sources. This shift requires development of new skills in orchestrating collaborative learning environments, managing technology-mediated interactions, and providing strategic rather than comprehensive feedback.

The framework emphasizes that teacher training should include hands-on experience with HMT systems from both instructor and student perspectives. Teachers who have personally experienced AI-assisted language learning are better equipped to guide student interactions and troubleshoot implementation challenges. Training programs should provide opportunities for teachers to experiment with different AI systems, develop personal teaching approaches, and reflect on their experiences.

Assessment and evaluation represent additional training areas that require significant attention. Traditional assessment approaches may not capture the learning outcomes produced by HMT-enhanced instruction. Teachers need training in designing assessments that evaluate both individual language competence and collaborative human-AI skills. Furthermore, teachers must learn to interpret and use AI-generated assessment data to inform instructional decisions.

Professional learning communities focused on HMT implementation provide ongoing support for teachers adapting to new pedagogical approaches. These communities can share successful practices, troubleshoot implementation challenges, and develop institutional knowledge about effective human-AI collaboration in educational contexts. Research demonstrates that sustained professional development produces better implementation outcomes than one-time training events.

4.3. Student Preparation and Digital Literacy Development

Student preparation for HMT-enhanced learning environments requires attention to both technical skills and collaborative competencies. The framework recognizes that students bring varied technology experiences and may have different comfort levels with AI interaction. Effective implementation must address these differences through comprehensive orientation and ongoing support.

Digital literacy development should focus on strategic rather than technical skills. Students need to understand how to effectively communicate with AI systems, interpret AI feedback, and recognize AI limitations. This includes learning appropriate prompting strategies, understanding confidence levels in AI responses, and developing skills in human-AI collaborative problem-solving.

The framework emphasizes the importance of explicit instruction in human-AI collaboration principles. Students should understand the complementary nature of human and AI capabilities, learn when to seek AI assistance versus human help, and develop metacognitive awareness of their own learning processes in technology-enhanced environments. These skills transfer beyond language learning contexts and prepare students for technology-rich professional environments.

Anxiety management and confidence building represent critical components of student preparation. Some students may experience technology anxiety or concerns about AI interaction that inhibit their willingness to engage with HMT systems. Preparation programs should address these concerns through gradual exposure, positive initial experiences, and explicit discussion of AI system limitations and appropriate uses.

Cultural considerations in student preparation acknowledge that students from different cultural backgrounds may have varying comfort levels with human-AI interaction and different expectations about teacher-student relationships. Preparation programs should be culturally responsive and address these differences explicitly rather than assuming universal comfort with technology integration.

5. CONCLUSION

This comprehensive review has examined the integration of HMT principles into college English speaking classroom design with the specific objective of enhancing students' WTC. Through systematic analysis of current research across multiple disciplines, we have demonstrated that well-designed human-AI partnerships offer significant potential for addressing persistent challenges in second language speaking instruction.

5.1. Synthesis of Key Findings

Our analysis reveals several critical insights about the effective integration of HMT principles in language learning contexts. First, successful implementations require fundamental reconceptualization of pedagogical roles rather than simple addition of AI tools to traditional instruction. Human instructors must evolve from primary information deliverers to strategic facilitators and coaches, while AI systems function as adaptive practice partners and feedback providers. This role transformation enables both humans and AI systems to contribute their unique strengths to the learning process.

Second, the dynamic and situational nature of WTC makes it particularly amenable to HMT interventions. AI systems can provide real-time adaptation to student emotional states, consistent encouragement and support, and personalized practice opportunities that address individual anxiety triggers. However, these technological capabilities must be combined with human empathy, cultural understanding, and strategic guidance to achieve optimal outcomes.

Third, effective HMT implementation requires sophisticated attention to feedback design and delivery. While AI systems can provide immediate, consistent, and comprehensive linguistic feedback, the timing, frequency, and presentation of this feedback significantly impact student WTC levels. The framework developed in this review emphasizes adaptive feedback mechanisms that consider learner characteristics, emotional states, and pedagogical objectives rather than providing blanket error correction.

Fourth, the success of HMT approaches depends critically on appropriate task design that leverages both human creativity and AI analytical capabilities. Tasks must have clear role delineation, transparent objectives, and built-in adaptation mechanisms. The most effective tasks combine AI-supported individual practice with human-facilitated collaborative activities, creating learning environments that prepare students for both autonomous language use and human-AI collaboration in professional contexts.

5.2. Implications for Educational Practice

The findings of this review have significant implications for educational practice at multiple levels. For individual instructors, the research suggests that effective HMT implementation requires willingness to experiment with new pedagogical approaches and professional development in human-AI collaboration principles. Instructors should view AI systems as collaborative partners rather than replacement threats, developing skills in orchestrating technology-enhanced learning environments.

For educational institutions, the review highlights the need for comprehensive support systems that address technological infrastructure, professional development, and student preparation. Successful HMT implementation cannot be achieved through simple technology purchases, it requires institutional commitment to pedagogical transformation and ongoing support for both instructors and students.

For educational technology developers, the research emphasizes the importance of designing AI systems specifically for educational contexts rather than adapting general-purpose technologies. Educational AI systems must incorporate sophisticated learner modeling, culturally responsive design, and transparent explainability features that support rather than replace human pedagogical expertise.

5.3. Limitations and Areas for Future Research

While this review provides comprehensive synthesis of current research, several limitations must be acknowledged. First, the majority of empirical studies examining HMT approaches in language learning contexts are recent and limited in scope. Long-term longitudinal studies are needed to assess the sustained effects of HMT-enhanced instruction on language learning outcomes and student attitudes.

Second, most existing research has been conducted in specific cultural and educational contexts, limiting generalizability across diverse student populations and institutional settings. Future research should examine HMT effectiveness across different cultural contexts, proficiency levels, and institutional types to identify universal principles and context-specific adaptations.

Third, the rapid pace of AI technology development means that research findings may quickly become outdated as new capabilities emerge. Future research should focus on identifying stable principles of human-AI collaboration in educational contexts rather than evaluating specific technological implementations.

5.4. Recommendations for Future Development

Based on the comprehensive analysis presented in this review, we propose several recommendations for future development in HMT-enhanced language education. First, researchers should prioritize longitudinal studies that examine the long-term effects of HMT approaches on language learning outcomes, student motivation, and preparedness for technology-rich professional environments.

Second, development efforts should focus on creating comprehensive teacher training programs that address both technological competencies and pedagogical adaptations required for effective HMT implementation. These programs should be empirically evaluated and continuously refined based on implementation outcomes.

Third, educational technology developers should collaborate closely with language education researchers and practitioners to ensure that AI systems are designed specifically for educational contexts. This collaboration should address not only technical capabilities but also pedagogical principles, cultural responsiveness, and ethical considerations.

Fourth, institutional leaders should develop comprehensive policies and support systems for HMT implementation that address technological infrastructure, professional development, student preparation, and ongoing evaluation. These support systems should be designed to facilitate rather than constrain pedagogical innovation.

5.5. Final Reflections

The integration of HMT principles into English speaking instruction represents both a significant opportunity and a substantial challenge for language education. While the potential benefits include enhanced individualized attention, reduced speaking anxiety, improved feedback quality, and preparation for technology-rich professional environments successful implementation requires careful attention to pedagogical principles, institutional support, and ongoing professional development.

The framework proposed in this review provides a foundation for systematic exploration of HMT approaches in language learning contexts. However, the ultimate success of these approaches will depend on the willingness of educators, institutions, and technology developers to collaborate in creating learning environments that truly leverage the complementary strengths of human and AI.

As AI technologies continue to evolve and become more sophisticated, the potential for human-AI collaboration in educational contexts will only increase. The challenge for the language education community is to ensure that these technological capabilities are harnessed in service of pedagogical objectives rather than driving educational transformation in potentially problematic directions.

The vision of HMT-enhanced English-speaking classrooms presented in this review—where human instructors and AI systems work together as collaborative partners to create optimal conditions for student WTC development represents a significant departure from traditional educational approaches. However, the research evidence suggests that this vision is not only feasible but necessary for preparing students for the technology-rich communicative environments they will encounter in their academic, professional, and personal lives.

The journey toward effective HMT implementation in language education will require sustained effort, continued research, and ongoing collaboration among educators, researchers, and technology developers. However, the potential rewards, improved learning outcomes, enhanced student engagement, and better preparation for 21st-century communication challenges, justify this investment in transforming English speaking instruction through human-machine collaboration.

REFERENCES

Bansal, G., Nushi, B., Kamar, E., Lasecki, W. S., Weld, D. S., & Horvitz, E. (2019). Beyond accuracy: The role of mental models in human-ai team performance. *Proceedings of the AAAI Conference on Human Computation and Crowdsourcing, 7*, 2–11. https://doi.org/10.1609/hcomp.v7i1.5285

Bendarkawi, J., Ponce, A., Mata, S. C., Aliu, A., Liu, Y., Zhang, L., . . . Monroy-Hernández, A. (2025). *ConversAR: Exploring embodied LLM-powered group conversations in augmented reality for second language learners.* Paper presented at the Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems.

Cao, Y. (2011). Investigating situational willingness to communicate within second language classrooms from an ecological perspective. *System, 39*(4), 468-479. https://doi.org/10.1016/j.system.2011.10.016

Cao, Y. (2014). A sociocognitive perspective on second language classroom willingness to communicate. *Tesol Quarterly, 48*(4), 789-814. https://doi.org/10.1002/tesq.155

Cha, J., Han, J., Yoo, H., & Oh, A. (2024). CHOP: Integrating ChatGPT into EFL oral presentation practice. *arXiv preprint arXiv:2407.07393*. https://doi.org/10.48550/arXiv.2407.07393

Khajavy, G. H., Ghonsooly, B., Hosseini Fatemi, A., & Choi, C. W. (2016). Willingness to communicate in English: A microsystem model in the Iranian EFL classroom context. *Tesol Quarterly, 50*(1), 154-180. https://doi.org/10.1002/tesq.204

Liu, T., Sanchez, J. R., Wang, Y., Yi, X., & Shi, Y. (2023). Exploring and analyzing the effect of avatar's realism on anxiety of English as second language (ESL) Speakers. *arXiv preprint arXiv:2311.05126*. https://doi.org/10.48550/arXiv.2311.05126

MacIntyre, P. D., Baker, S. C., Clément, R., & Conrod, S. (2001). Willingness to communicate, social support, and language-learning orientations of immersion students. *Studies in Second Language Acquisition, 23*(3), 369-388.

MacIntyre, P. D., Clément, R., Dörnyei, Z., & Noels, K. A. (1998). Conceptualizing willingness to communicate in a L2: A situational model of L2 confidence and affiliation. *The Modern Language Journal*, *82*(4), 545-562. https://doi.org/10.1111/j.1540-4781.1998.tb05543.x

Mozannar, H., Lee, J., Wei, D., Sattigeri, P., Das, S., & Sontag, D. (2023). Effective human-AI teams via learned natural language rules and onboarding. *Advances in Neural Information Processing Systems*, *36*, 30466-30498.

Park, C., Jang, Y., Lee, S., Park, S., & Lim, H. (2021). FreeTalky: Don't be afraid! conversations made easier by a humanoid robot using persona-based dialogue. *arXiv preprint arXiv:2112.04126*. https://doi.org/10.48550/arXiv.2112.04126

Peng, J. E., & Woodrow, L. (2010). Willingness to communicate in English: A model in the Chinese EFL classroom context. *Language Learning*, *60*(4), 834-876. https://doi.org/10.1111/j.1467-9922.2010.00576.x

Siyan, L., Shao, T., Yu, Z., & Hirschberg, J. (2024). Eden: Empathetic dialogues for english learning. *arXiv preprint arXiv:2406.17982*. https://doi.org/10.48550/arXiv.2406.17982

Vats, V., Binta Nizam, M., Liu, M., Wang, Z., Ho, R., Sai Prasad, M., . . . Xu, Y. (2024). A survey on human-ai teaming with large pre-trained models. *arXiv e-prints*, arXiv: 2403.04931. https://doi.org/10.48550/arXiv.2403.04931

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Zarrinabadi, N. (2014). Communicating in a second language: Investigating the effect of teacher on learners' willingness to communicate. *System*, *42*(42), 288–295. https://doi.org/10.1016/j.system.2013.12.014

Zhang, J., Beckmann, N., & Beckmann, J. F. (2018). To talk or not to talk: A review of situational antecedents of willingness to communicate in the second language classroom. *System*, *72*, 226-239.

Zhang, S., & Khalid, A. (2024). Usage of virtual reality in combating social anxiety disorders in non-native English speakers: A survey. *arXiv preprint arXiv:2409.13085*. https://doi.org/10.48550/arXiv.2409.13085

Zou, B., Xie, S., & Wang, C. (2025). Students' willingness to Communicate (WTC) in using artificial intelligence (ai) technology in english-speaking practice. *International Journal of Information and Communication Technology Education*, *21*(1), 1-18. https://doi.org/10.4018/ijicte.375387