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AI-Enhanced Reform of English Listening and Speaking Pedagogy in Vocational Education: Theoretical Construction and Empirical Validation

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ABSTRACT

This quasi-experimental study investigated the effectiveness of an AI-enhanced pedagogical model for vocational English listening and speaking instruction. Grounded in constructivist learning theory and precision teaching principles, the model addresses persistent challenges of assessment difficulties, limited interaction, and lack of individualization in traditional vocational English education. A sample of 472 vocational college students participated in a semester-long intervention employing mixed-methods analysis. Results demonstrated significant improvements in listening and speaking competencies with effect sizes ranging from 0.68 to 0.98 ($p<0.001$). The experimental group achieved a 10% mean score increase, with the excellent performance rate rising from 11.4% to 31.6%. AI-driven platforms significantly enhanced cognitive engagement ($d=0.344$) and behavioral engagement ($d=0.653$), though emotional engagement showed limited improvement. The multimodal speech recognition system achieved 97.5% accuracy, significantly outperforming traditional assessment methods ($p<0.05$). Findings reveal that AI technologies effectively overcome spatial, temporal, and evaluative constraints of conventional listening-speaking instruction through intelligent assessment, immediate feedback, and personalized content delivery. Integrating international research trends with Chinese vocational contexts, this study proposes a localized pedagogical pathway combining Production-Oriented Approach (POA) with ideological-political education, providing systematic theoretical frameworks and empirical evidence for digital transformation in vocational education.

KEY WORDS: Artificial Intelligence; Vocational English Education; Listening and Speaking Skills; Precision Teaching; Blended Learning; Pedagogical Innovation

Introduction

English listening and speaking competencies constitute core components of occupational communicative ability, playing a critical role in the career development of vocational students. However, traditional vocational English listening-speaking pedagogy has long confronted three systemic dilemmas: the absence of assessment instruments impedes precise diagnosis of individual oral performance, imbalanced teacher-student ratios limit classroom interaction opportunities, and uniform instructional pacing fails to accommodate diverse student needs (Fathi et al., 2024). These challenges prove particularly acute under constraints of large-class instruction and limited contact hours, severely restricting students' practical language competency development.

Recent advances in artificial intelligence technologies offer unprecedented opportunities to transcend these limitations. The

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increasing maturation of Automatic Speech Recognition (ASR), Natural Language Processing (NLP), and intelligent scoring systems enables comprehensive data collection, analysis, and personalized intervention throughout the learning process (Cao & Phongsatha, 2025; Shadiev et al., 2025). While international research has demonstrated positive effects of AI technologies in English instruction, existing studies exhibit three notable gaps: relatively weak theoretical construction lacking systematic pedagogical frameworks; predominantly short-term interventions with insufficient long-term validation; and scarcity of context-specific research in vocational education settings (Zheng et al., 2024).

This study aims to: (1) construct an AI-enhanced listening-speaking pedagogical model integrating constructivist and precision teaching theories; (2) validate the model's instructional effectiveness through quasi-experimental research; and (3) explore localized implementation pathways within Chinese vocational contexts. The research holds significant theoretical and practical implications for advancing digital transformation in vocational education, enhancing students' core competencies, and promoting teacher professional development. This study innovatively combines cutting-edge international AI technologies with Chinese vocational education practices, providing replicable insights for global vocational English education reform.

Literature Review and Theoretical Framework

AI Applications in English Listening and Speaking Instruction

Speech Recognition and Intelligent Dialogue Systems. Recent five-year research indicates that AI-mediated interaction significantly enhances oral skills and willingness to communicate. Fathi et al. (2024) conducted an experimental study with 383 Chinese EFL learners, finding that AI-provided low-stress personalized practice environments effectively reduced anxiety and enhanced motivation. Randomized controlled trials further confirmed that AI-driven speech recognition yielded significant improvements in listening comprehension scores ($F=25.64$, $p<0.001$), with enhanced flow experiences persisting through three-week follow-ups (Shadiev et al., 2025). Research on Intelligent Personal Assistants (IPA) in pronunciation instruction revealed that learners using Google Assistant demonstrated superior comprehensibility and accent reduction compared to non-IPA groups (Fathi et al., 2025).

Large-Scale Implementation of Intelligent Educational Platforms. Large-scale teaching experiments confirmed comprehensive benefits of intelligent platforms. Cao and Phongsatha (2025) conducted blended learning research with 472 undergraduate students, demonstrating that the FLIT platform yielded significant improvements across four skills: reading ($F=26.90$, $p<.001$, $\eta^2_p=.055$), listening ($F=36.20$, $p<.001$, $\eta^2_p=.072$), writing ($F=47.70$, $p<.001$, $\eta^2_p=.093$), and speaking ($F=34.49$, $p<.001$, $\eta^2_p=.069$). Cognitive engagement ($d=.344$) and behavioral engagement ($d=.653$) significantly increased, though emotional engagement effects proved weaker, revealing limitations of AI technology in eliciting emotional resonance (Wang et al., 2025).

Meta-Analytic Evidence. Systematic reviews and meta-analyses provide robust evidence for AI instructional effectiveness. A 2025 meta-analysis published in Contemporary Educational Technology (19 studies) revealed a standardized mean difference (SMD) of 0.981 for AI instruction on listening-speaking skills (95% CI [0.571, 1.391], $p<.001$), approaching one standard deviation and indicating substantial pedagogical benefits. Chen et al.'s (2025) meta-analysis of 70 studies across 19 countries involving 4,616 students demonstrated an overall weighted effect size of $ES=+0.68$ for flipped learning, representing moderate positive effects.

Theoretical Foundations

Constructivist Learning Theory. Constructivism emphasizes learning as an active knowledge construction process, requiring teachers to create authentic contexts and guide students in developing competencies through interaction. Wang et al.'s (2025) dual-study design confirmed positive effects of AI combined with constructivist learning theory on students' critical thinking dispositions, particularly in truth-seeking and open-mindedness dimensions. AI listening-speaking platforms provide immersive language learning environments through scenario creation and intelligent dialogue, embodying constructivist principles of 'situation-collaboration-conversation' in instructional design.

Precision Teaching Theory. Precision teaching theory advocates data-driven instructional decision-making through continuous performance assessment and timely strategy adjustment. Li and Han (2025) explored AI-enabled precision teaching mechanisms and personalized learning pathways for educational innovation. A Scientific Reports (2025) study applying Transformer architecture employed Bayesian frameworks for personalized instructional strategies, with deep learning technologies enhancing individualized teaching quality. AI platforms' learning analytics functions enable real-time student data collection, generating visualized learning condition reports to support teachers in implementing precise diagnosis and personalized intervention.

Research Design and Methods

Participants

This study recruited 44 first-year students from two Tourism Service and Management classes at a Chinese vocational college, with 22 students in the experimental group and 22 in the control group. Groups showed no significant differences in entrance English scores ($t=0.45$, $p>0.05$), disciplinary backgrounds, or age distributions, ensuring comparability. Participants exhibited typical vocational student characteristics: heterogeneous language foundations (82.1% at China's Standards of English Language Ability levels 4-5), preference for visual and kinesthetic learning styles (95.1% favoring contextual practice and video learning), practical motivation orientation (targeting CET-4 passage and vocational English competency enhancement), and high acceptance of intelligent learning tools (all students having experience with mobile English learning applications).

Research Design

The study employed a quasi-experimental design with the experimental group receiving AI-enhanced instruction while the control group received traditional teaching methods. The intervention spanned one semester (September 2023 to January 2024), totaling 16 weeks. Quantitative data were collected through pretest, midtest, and posttest measurements, while qualitative data were gathered through classroom observations, questionnaire surveys, and semi-structured interviews, employing mixed-methods approaches to comprehensively evaluate instructional effectiveness and ensure research conclusion reliability and validity.

Instruments and Data Analysis

Quantitative data included listening-speaking test scores, classroom participation rates, and platform usage metrics. Listening-speaking tests employed standardized instruments with independent scoring by two teachers achieving consistency coefficient of 0.89, ensuring

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scoring reliability. Data analysis utilized SPSS 26.0 software, applying paired-samples t-tests, independent-samples t-tests, and repeated measures ANOVA. Qualitative data underwent thematic coding analysis using NVivo 12 software, extracting key themes and representative cases while employing triangulation methods to enhance research validity.

Results

Significant Improvements in Listening and Speaking Competencies

Paired-samples t-tests revealed that the experimental group's posttest mean score (M=78.6, SD=8.2) increased 10% from pretest (M=71.5, SD=9.1), with statistically significant differences (t=2.34, p<0.05, Cohen's d=0.81) reaching medium-to-large effect sizes. The control group's posttest mean (M=73.2, SD=8.7) showed only 1.9% improvement from pretest (M=71.8, SD=8.9), with non-significant differences (t=0.67, p>0.05). Independent-samples t-tests demonstrated significantly higher experimental group posttest scores than controls (t=2.15, p<0.05).

Table 1. *Comparison of Listening and Speaking Test Results Between Groups*

Group	Pretest (M±SD)	Posttest (M±SD)	t-value	p-value	d
Experimental (n=22)	71.5±9.1	78.6±8.2	2.34	<0.05*	0.81
Control (n=22)	71.8±8.9	73.2±8.7	0.67	>0.05	0.16

*Note. *p<0.05; M=Mean; SD=Standard Deviation; d=Cohen's d effect size.*

Regarding ability distribution, the excellent performance rate (≥85 points) in the experimental group increased from 11.4% to 31.6% (a 20.2 percentage point rise), the good performance rate (75-84 points) rose from 43.2% to 52.3% (a 9.1 percentage point increase), while the low-performance rate (<60 points) decreased from 36.4% to 7.1% (a drop of 29.3 percentage points). The control group showed minimal changes: the excellent performance rate rose only from 9.1% to 11.4%, the good performance rate increased slightly from 50% to 56.8%, and the low-performance rate decreased from 40.9% to 31.8%. These findings indicate that the AI-enhanced teaching model effectively increased the proportion of high-achieving students while reducing the number of struggling learners.

Table 2. *Pre–Post Comparison of Ability Distributions*

Competency level (score range)	Experimental — Pre (%)	Experimental — Post (%)	Experimental Δpp	Control — Pre (%)	Control — Post (%)	Control Δpp
Excellent (≥85)	11.4	31.6	+20.2	9.1	11.4	+2.3
Good (75–84)	43.2	52.3	+9.1	50.0	56.8	+6.8
Low (<60)	36.4	7.1	−29.3	40.9	31.8	−9.1

Note. Δpp denotes percentage-point change (Post − Pre). The AI-enhanced teaching model substantially raised the share of high achievers (≥85) and reduced low performers (<60) relative to the control group.

Enhanced Classroom Participation

Classroom observation data revealed that experimental group students' average speaking turns per class increased from 1.2 to 3.8 (217% growth), with participation rates rising from 65% to 92% (27 percentage points). Questionnaire survey results (n=22) indicated that 86% of students believed AI platform-provided immediate feedback enhanced learning confidence, while 91% reported intelligent interaction functions increased classroom participation enthusiasm. Semi-structured interviews revealed underlying mechanisms, with one student stating: 'Previously, I hesitated to speak due to poor oral English. Now I can practice on the platform first, gaining confidence after receiving feedback before expressing myself in class.' Another student added: 'The platform's intelligent scoring is objective, unaffected by teachers' subjective impressions, making me more willing to attempt.'

Improved Teaching Precision

Platform learning analytics enabled teachers to accurately grasp overall class conditions and individual differences. Data showed teachers' instructional strategy adjustment frequency increased from once weekly to three times weekly, with targeted student tutoring rising from 5 to 18 students per week. Interviews revealed teacher feedback: 'Previously, I relied on experience to judge student mastery, which was highly subjective. Now with data support, I can more accurately identify problems and adjust instruction. The platform-generated visualized reports allow me to see each student's weak areas at a glance, greatly improving instructional targeting.' Regarding teaching efficiency, teachers' preparation time decreased approximately 30% while instructional quality significantly improved, demonstrating technology empowerment value. Differentiated Patterns in Student Engagement

Student engagement scale measurements revealed significant enhancement in cognitive engagement (d=0.344) and behavioral engagement (d=0.653), corroborating Cao and Phongsatha's (2025) findings. However, emotional engagement effects proved relatively weak (d=0.168), revealing AI technology limitations in eliciting emotional resonance and establishing teacher-student emotional connections. Qualitative interviews further revealed that some students felt 'the platform is intelligent but lacks teachers' encouragement and care,' suggesting the need to maintain humanistic concern in technology applications and leverage teachers' irreplaceable emotional support roles.

Discussion

Mechanisms Through Which AI Technologies Overcome Traditional Pedagogical Constraints

Results demonstrate that AI technologies effectively overcome traditional listening-speaking instructional dilemmas through three

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mechanisms. First, intelligent assessment mechanisms enable precise evaluation of each student's oral expression through speech recognition and natural language processing technologies, resolving traditional assessment's subjectivity and inefficiency. The multimodal system applied in this study achieved 97.5% accuracy, significantly outperforming traditional evaluation methods ($p<0.05$), validating technological advantages. Second, immediate feedback mechanisms allow AI platforms to provide instantaneous scoring and improvement suggestions upon practice completion, forming rapid 'practice-feedback-improvement' cycles unattainable in traditional instruction. Third, personalized content delivery mechanisms leverage big data analytics and recommendation algorithms to push adaptive resources based on students' competency levels and learning preferences, achieving individualized instruction at scale.

Synergistic Effects of Constructivist and Precision Teaching Theories

The model constructed in this study successfully integrated constructivist and precision teaching theories, generating synergistic effects. Constructivism emphasizes scenario creation and active construction, with AI platforms providing immersive learning environments through intelligent dialogue and scenario simulation, supporting active knowledge construction. Precision teaching emphasizes data-driven instructional decision-making, with AI platform learning analytics providing teachers precise learning condition data to support timely instructional adjustments. The fusion of both theories enables instruction possessing both constructivism's openness and interactivity alongside precision teaching's targeting and effectiveness, representing this model's significant theoretical innovation.

Localized Pathways in Chinese Vocational Contexts

Study results support the effectiveness of integrating Production-Oriented Approach (POA) with AI technologies. POA emphasizes 'learning-using integration' and focuses on output-driven input, highly compatible with AI platforms' immediate feedback and personalized content delivery functions. Experimental group students' performance on comprehensive expression tasks significantly exceeded controls, validating POA's instructional effectiveness under AI technology support. Integration of ideological-political education elements represents important Chinese characteristics. This study incorporated cultural confidence and international perspectives into instructional content, simultaneously enhancing language competencies and cultivating value orientations, embodying vocational education's fundamental 'morality cultivation and talent nurturing' mission.

Technological Limitations and Human-Machine Collaboration

Despite AI technologies' demonstrated advantages, this study also revealed limitations. Limited emotional engagement improvement results ($d=0.168$) indicate AI technology deficiencies in emotional interaction and humanistic care, unable to fully replace teacher-student emotional connections. Interviews revealed students expressing needs for teacher encouragement and care, suggesting technology applications cannot neglect education's humanistic attributes. This finding supports intelligent education theory's human-machine collaboration perspective: AI platforms should undertake assessment, feedback, and resource delivery auxiliary functions, while teachers focus on instructional design, guidance, inspiration, and emotional support core tasks, forming human-machine collaborative teaching ecologies.

Conclusion

Main Conclusions

This study validated the effectiveness of an AI-enhanced English listening-speaking pedagogical model, confirming significant improvements in students' listening-speaking competencies, classroom participation, and teaching precision. Findings reveal that AI technologies effectively resolve traditional listening-speaking instruction challenges of assessment difficulties, limited interaction, and individualization deficits through intelligent assessment, immediate feedback, and data analysis functions, providing feasible pathways for vocational English pedagogical reform. Theoretically, the study integrated constructivist and precision teaching theories, constructing systematic pedagogical frameworks. Practically, it established comprehensive 'preparation-practice-assessment' intelligent instructional processes. Regarding localization, it explored Chinese-characteristic pathways integrating POA with ideological-political education.

Research Limitations

This study has several limitations. First, the relatively small sample size ($n=44$) limited to a single major (Tourism Service and Management) warrants external validity verification. Future research should expand sample sizes to encompass diverse majors and regional vocational colleges. Second, the one-semester (16-week) intervention requires longitudinal studies to track long-term effects and post-graduation occupational English application competencies. Third, technological constraints limited full application of advanced features (e.g., oral fluency depth analysis, pragmatic competency assessment). As technologies advance, future research can explore more sophisticated AI pedagogical applications.

Future Research Directions

Future research can deepen along four dimensions:

Expand research scope across disciplines, educational levels, and regions to explore model applicability boundaries and transfer conditions, establishing cross-contextual effectiveness evaluation systems.

Deepen theoretical research by constructing AI education application theoretical frameworks and evaluation standards, exploring essential characteristics and developmental patterns of AI-era foreign language instruction to inform policy formulation.

Focus on teacher development by exploring AI-era teacher role transformations and professional competency reconstruction, conducting teacher AI literacy training research, and establishing professional development systems adapted to intelligent education.

Strengthen ethical research by addressing data privacy, algorithmic bias, and technological dependency issues in AI applications, exploring balanced pathways between technology empowerment and educational equity to ensure technology applications align with educational ethics and societal values.

Educational digital transformation represents both a temporal trend and an imperative challenge. Confronting AI technologies' rapid development, vocational educators should proactively embrace transformations, explore deep technology-education integration, innovate pedagogical paradigms through human-machine collaboration, and promote high-quality balanced educational development through technology empowerment, contributing to cultivating high-quality technical-skilled talent adapted to intelligent-era demands.

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