

Effectiveness analysis and optimization pathways of teacher intervention strategies in AI-driven language learning environments: a review study

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Abstract: Deep AI-language teaching integration makes teacher intervention vital to learning outcomes. Focusing on oral English proficiency among middle school students, this systematic review explores teacher-AI collaborative intervention. Though AI delivers personalized oral practice and instant feedback, it fails to sustain learners' motivation and offer tailored cognitive guidance, necessitating teachers to serve as data analysts and emotional supporters. Existing challenges involve inadequate teacher AI literacy, inflexible intervention tactics, vague human-machine responsibilities and defective training systems. Proposed optimizations include systematic AI literacy training, a dynamic collaborative framework with clear role boundaries, interpretable AI combined with humanistic instruction, and individualized intervention schemes. The study provides theoretical and practical support for reconciling large-scale personalized intelligent teaching with humanistic care in middle school oral classes.

Keywords: AI-driven language learning; teacher intervention; human-machine collaboration; middle school oral teaching; oral expression ability

1 Introduction

AI transforms traditional language teaching by delivering frequent oral practice, real-time feedback and diverse dialogue scenarios, yet reshapes teachers' core roles. AI excels at standardized personalized learning, yet it cannot replace teachers' emotional scaffolding and higher-order cognitive guidance. This complementary relationship between AI and human teachers needs to be clarified through empirical research [1]. In NLP-based conversational learning, teachers' balance between machine and human feedback directly shapes learners' metacognitive abilities [2]. Studies indicate that when AI handles 60% of repetitive tutoring tasks, teachers can focus on advanced-thinking coaching, boosting learning transfer by 28%, although its cross-cultural validity requires further testing [3]. Existing research fails to match teacher intervention tactics with AI functions and neglects variables like intervention timing and frequency, leading to two practical extremes: over-reliance on AI or underutilization of intelligent tools. This paper addresses two core questions:

- (1) What teacher-AI collaboration modes exist for middle school oral teaching and their features?
- (2) How does such collaboration affect students' oral learning outcomes, and how to optimize teacher intervention?

Combining cognitive load theory and social constructivism, this study constructs a balanced teacher-AI collaborative intervention model.

2 Literature collection & review

2.1 Literature retrieval

Keywords covered AI-assisted language learning, teacher intervention, middle school oral expression, human-machine collaboration, learning effectiveness. Databases included CNKI, Wanfang, VIP, Web of Science, Scopus, ERIC, covering 2018–2025. Screening criteria: AI language teaching + middle school subjects + oral ability cultivation + peer-reviewed papers/theses. Thirteen valid core papers were retained after deduplication and relevance screening.

2.2 Research gaps in existing literature

- (1) Few targeted studies on the unique cognitive and emotional traits of middle-school students in oral English learning;
- (2) Vague definitions of teacher-AI collaboration models specific to middle school oral English, unclear role boundaries between teachers, students and AI;
- (3) Underexplored key influencing factors of oral performance under human-machine collaboration, weak feasible optimization schemes;
- (4) One-sided research perspectives (focusing merely on technology or the teacher's role), lacking integrated multi-subject systematic analysis.

3 Core concept: definition & features of teacher-AI collaboration model

3.1 Definition

The teacher-AI collaboration model for middle school oral teaching is a synergistic interactive system targeting pronunciation accuracy, flexible sentence use and logical expression. Teachers, students and AI leverage respective strengths to achieve dynamic interaction and clear responsibility division, rather than superficial technical assistance [4-5].

3.2 Core roles of three parties

- (1) Teachers: Teaching designers guiding rational AI use; data interpreters mining cognitive barriers behind AI learning data; emotional supporters easing speaking anxiety and cultivating cross-cultural thinking; supervisors integrating AI tools with curriculum objectives.
- (2) Students: Active practitioners finishing high-frequency AI oral drills; self-regulated learners adjusting strategies based on AI and teacher feedback; cognitive builders forming personalized oral learning habits under dual guidance [6].
- (3) AI: Customized drill generator with instant pronunciation/grammar feedback; anytime conversational practice partner simulating real-life dialogues; real-time data recorder tracking practice duration, error frequency and fluency, supplying data evidence for teacher intervention [7]. It features adaptive learning and transparent feedback logic.

4 Current status & key challenges

Research has moved beyond the mere application of AI tools toward examining intervention effectiveness. Intelligent platforms turn teachers from knowledge transmitters into data analysts and learning guides, whose intervention focuses on metacognitive ability cultivation via learning analytics [8]. However, prominent obstacles remain:

- (1) Teachers lack integrated AI and data literacy training, unable to convert learning data into targeted teaching decisions;
- (2) Inflexible universal intervention plans fail to match students' varied oral proficiency, cognitive styles and psychological states; over-dependence on AI automated feedback weakens humanistic emotional support;
- (3) Blurred boundaries of human-machine responsibility risk reducing teachers to passive supporting roles, limiting

instructional creativity;

- (4) Ethical risks involve student oral- data privacy concerns and ambiguous accountability for learning outcomes.

5 Development trends & optimization solutions

5.1 General trends

Teacher roles are evolving from knowledge transmitters to learning designers, data interpreters and emotional communicators [9]. AI cannot replace teachers' advantages in motivating learners and fostering high-order thinking [10]. Future intervention systems will be real-time and adaptive, adjusting strategies based on real-time learning data to build a mutually optimized teacher-intelligent environment ecosystem, with teachers' professional judgment as the core guarantee of effective oral teaching [11]. Successful intervention requires teachers to possess data-driven pedagogical judgment and interpret AI-generated student learning portraits [12]. Integrating strategic teaching and self-regulated learning can foster learners' metacognitive strategies within AI-personalized environments. New core competencies for teachers include data interpretation, rational screening of AI tools and data-based instructional decision-making [13].

5.2 Targeted optimization pathways

- (1) Upgrade teacher training: Develop systematic courses covering AI operation, data interpretation and human-machine collaborative instructional design to improve teachers' digital pedagogy literacy;
- (2) Build mutually-empowering human-machine mechanisms: AI undertakes repetitive data processing and standardized oral practice; teachers intervene at critical learning nodes with emotional comfort and high-level cognitive coaching;
- (3) Boost AI interpretability: Optimize transparent, operable data analysis interfaces for teachers to diagnose students' problems accurately;
- (4) Design differentiated-personalized intervention programmes: Provide tailored guidance for students with poor pronunciation, weak logical expression or speaking anxiety.

6 Conclusion

Effective teacher-led intervention combines AI's systematic strengths with teachers' humanistic pedagogy. Since AI cannot perceive learners' emotions, cognitive barriers or cultural contexts, teachers are redefined as learning facilitators, mentors and emotional caregivers rather than its substitutes. By decoding AI learning data, teachers can detect algorithm-ignored learning obstacles and deliver targeted tutoring. The refined human-machine collaboration model integrates teaching experience and data analysis to boost oral learning performance.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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