

Constructing a Teacher–Student–AI Agent Collaborative Teaching Model for Vocational ESP: A Symbiotic Theory Approach to Chaoxing AI Agent Integration

Xiaoli Hu

Jiangsu Maritime Institute, Nanjing 211170, Jiangsu, China

Abstract: *The rapid advancement of generative artificial intelligence has created new possibilities for reconstructing teaching relationships in vocational English for Specific Purposes (ESP), yet existing research remains largely confined to theoretical frameworks without platform-based empirical validation. This conceptual and design-oriented paper proposes a “Teacher–Student–AI Agent” (TSA) collaborative teaching model for vocational ESP, grounded in symbiotic theory and implemented through the Chaoxing AI Agent platform. The paper addresses two critical gaps: the lack of operational models for TSA collaboration within specific smart teaching platforms, and the insufficient integration of AI agents into vocational ESP instruction, particularly in cruise service English. Drawing upon symbiotic theory and human–AI collaboration research, the study repositions the AI agent not as a passive tool but as a “digital collaborator” capable of diagnosis, interaction, and evaluation. It analyzes the four core functions of the Chaoxing AI Agent—AI Teaching Assistant, Customized AI Agent, AI Practice, and AI Learning Analytics—and maps them onto the teaching needs of cruise service English. On this basis, the paper constructs a three-subject, four-stage collaborative model comprising three subjects (teacher, student, AI agent) and four stages (pre-class diagnosis, in-class interaction, post-class evaluation, and continuous optimization). A key contribution is the design of an AI-empowered cruise service scenario bank covering at least eight typical workplace tasks. The paper also discusses design principles, role division, interaction logic, and transferability to other vocational ESP courses, providing a theoretical and practical blueprint for reconstructing teaching relationships in the digital intelligence era.*

Keywords: Teacher–Student–AI Agent collaboration; Symbiotic theory; Chaoxing AI Agent; Vocational ESP; Cruise service English; Teaching model construction.

1. INTRODUCTION

The digital transformation of vocational education has entered a new phase characterized by the deep integration of artificial intelligence into teaching and learning processes. In China, the Ministry of Education has explicitly called for reconstructing the “teacher–machine–student” collaborative teaching relationship in vocational education and for enhancing teachers' AI teaching competence (Li, 2026). Within this policy context, the question of how to operationalize AI-empowered collaborative teaching models in specific subject areas—particularly in vocational English for Specific Purposes (ESP)—has become increasingly urgent.

Vocational ESP instruction faces persistent challenges that AI technologies are uniquely positioned to address. Cruise service English, as a representative vocational ESP course, requires students to master not only specialized vocabulary and expressions but also the communicative competence needed in authentic workplace scenarios—boarding service, cabin management, dining communication, and emergency response. Traditional classroom instruction struggles to simulate these high-fidelity professional contexts, resulting in a persistent gap between language learning and workplace application (Wang, 2025). While virtual reality and simulation technologies have been explored as partial solutions, they often require substantial infrastructure investment and lack the adaptive, personalized feedback capabilities that AI systems can provide.

The emergence of AI agents—intelligent systems capable of autonomous perception, reasoning, and action—offers new possibilities for addressing these challenges. Unlike earlier AI tools that functioned as passive assistants, AI agents can engage in dynamic, context-aware interactions, adapt to individual learner needs, and provide real-time diagnostic feedback. The Chaoxing AI Agent platform, developed by Beijing Century Superstar, represents one of the most widely deployed AI teaching platforms in Chinese higher vocational institutions, offering four integrated functions: AI Teaching Assistant, Customized AI Agent, AI Practice, and AI Learning Analytics. However, systematic research on how these functions can be effectively integrated into vocational ESP

teaching remains scarce.

This paper addresses this gap by proposing a Teacher–Student–AI Agent (TSA) collaborative teaching model for vocational ESP, grounded in symbiotic theory and operationalized through the Chaoxing AI Agent platform. The paper pursues three objectives: (1) to establish the theoretical foundations of TSA collaboration by drawing upon symbiotic theory and human–AI collaboration research; (2) to analyze the functional characteristics of the Chaoxing AI Agent and map them onto the pedagogical needs of cruise service English; and (3) to construct an operational TSA model with clear role division, interaction logic, and scenario-based design. The proposed model is intended to serve as a blueprint for vocational ESP instruction in the digital intelligence era and to provide a transferable framework for other ESP contexts.

2. LITERATURE REVIEW

2.1 Symbiotic Theory and Human–AI Collaboration in Education

Symbiotic theory, originating in biology to describe mutually beneficial relationships between different organisms, has been increasingly applied to educational contexts to conceptualize the relationship between human actors and technological systems. In its educational adaptation, symbiotic theory posits that effective learning environments emerge from interdependent, co-existing relationships between humans and AI, where each party contributes distinct capabilities that enhance the overall system (Wang & Lee, 2026).

Recent scholarship has advanced symbiotic theory as a framework for understanding human–AI collaboration in language education. Wang and Lee (2026) conducted a 16-week digital storytelling study with EFL learners, demonstrating that “symbiotic learning”—a form of human–AI collaboration characterized by iterative prompting, revision, and refinement of AI outputs—fosters agency, personalization, creativity, and critical decision-making. Their findings suggest that learners who engage in symbiotic relationships with AI develop not merely technical skills but also the critical awareness necessary for responsible AI engagement. This perspective challenges the instrumental view of AI as a mere tool, positioning it instead as a reflective partner in the learning process.

In the context of college English teaching, a symbiotic human–machine collaborative model has been empirically tested over a 12-week period, with results indicating significant improvements in students' English grades, enhanced teacher professional development, and the initial construction of a mutually beneficial teaching ecosystem among teachers, students, and intelligent machines. This study provides preliminary evidence that symbiotic relationships in language education can yield measurable pedagogical benefits.

However, existing research on symbiotic learning has primarily focused on general English contexts and has not adequately addressed the specific requirements of vocational ESP, where the integration of professional scenarios and workplace communication tasks introduces additional complexity.

2.2 AI Agents in Language Education: From Tools to Collaborators

The evolution of AI in language education has progressed from simple computer-assisted language learning (CALL) systems to sophisticated AI agents capable of autonomous interaction and adaptive response. Recent systematic reviews have documented this trajectory. Lee et al. (2026) examined 49 empirical studies on generative AI in language classrooms published between 2023 and 2024, identifying diverse roles that GenAI plays: feedback provider, learning tutor, cognitive stimulator, interaction facilitator, and conversation partner. Their review also highlighted persistent challenges, including content quality issues, overreliance, pedagogical limitations, and concerns over academic integrity.

The concept of the “AI agent” represents a further evolution beyond generative AI tools. While generative AI systems like ChatGPT respond to prompts, AI agents are designed to perceive their environment, make autonomous decisions, and take actions to achieve specific goals. In educational contexts, this means AI agents can proactively diagnose learner needs, adapt instructional strategies, and provide continuous support without explicit prompting. Research on human–agent interaction in education has identified both the potential and the challenges of this approach, noting that current research focuses predominantly on virtual agents in one-to-one learning scenarios, with significant gaps in understanding dynamic human–AI interaction processes and higher-order thinking development.

In the Chinese context, the integration of AI agents into vocational English teaching has begun to attract attention. Studies have explored AI-empowered listening and speaking pedagogy in vocational education, demonstrating that AI technologies can overcome spatial, temporal, and evaluative constraints of conventional instruction through intelligent assessment. Research on human–AI collaboration in vocational writing has proposed a theoretical framework combining second language acquisition, socio-constructivist learning, and adaptive learning environments, identifying personalization, contextualization, and digital feedback as core dimensions.

Despite these advances, a critical gap persists: existing research has not systematically examined how AI agents integrated into specific smart teaching platforms—such as the Chaoxing platform—can be operationalized within a collaborative teaching model for vocational ESP. The Chaoxing platform's AI Agent functions represent a distinctive configuration that has not been adequately studied in the context of vocational language education.

2.3 Vocational ESP and the Challenge of Scenario-Based Instruction

Vocational ESP instruction is distinguished by its emphasis on preparing learners for specific workplace communication contexts. In cruise service English, for example, learners must develop competence in handling guest inquiries, resolving complaints, providing safety information, and managing service interactions—all in English and often under time pressure. Research on maritime and cruise ESP has demonstrated that authentic workplace genres, disciplinary literacy, and specialized registers require instructional approaches that go beyond general English teaching methodologies (Wang, 2025).

The “Three-Chains, Four-Dimensions, Five-Contexts” teaching model developed for workplace communication English in Chinese vocational colleges represents an integrated approach that combines ESP, value education, and AI-enhanced pedagogy. This model demonstrates that vocational ESP instruction benefits from systematic integration of professional scenarios, language skills, and technological support. However, the model remains at the theoretical construction stage and has not been operationalized through a specific AI agent platform.

The Chaoxing AI Agent platform offers distinctive affordances for vocational ESP instruction. Its AI Practice function includes scenario dialogue and oral training capabilities that can be customized to specific professional contexts. The Customized AI Agent function allows instructors to configure intelligent agents with domain-specific knowledge and interaction logic. The AI Learning Analytics function provides behavioral data that can inform instructional adjustments. Together, these functions create the technical conditions for implementing a symbiotic TSA model in vocational ESP.

3. THEORETICAL FRAMEWORK

3.1 Symbiotic Theory as the Foundational Lens

The TSA collaborative teaching model is grounded in symbiotic theory, which provides a conceptual vocabulary for understanding the interdependent relationships among teachers, students, and AI agents. In this framework, symbiosis is not merely co-existence but a relationship of mutual benefit in which each party contributes distinct capabilities that enhance the overall system's functioning (Wang & Lee, 2026).

Applied to the TSA model, symbiotic theory yields three foundational principles:

Complementarity. The teacher, student, and AI agent each possess distinct capabilities that complement one another. The teacher brings pedagogical expertise, contextual judgment, and ethical guidance. The student brings active engagement, reflective capacity, and learning motivation. The AI agent brings computational power, data processing capability, and consistency in assessment. Effective collaboration requires recognizing and leveraging these complementary strengths rather than attempting to replace human capabilities with technological ones.

Interdependence. The three parties operate in an interdependent relationship where the effectiveness of each depends on the others. The AI agent's diagnostic capabilities are meaningless without the teacher's pedagogical interpretation and the student's engagement. The teacher's instructional design is enhanced by the AI agent's data analytics. The student's learning is enriched by both the teacher's guidance and the AI agent's personalized support.

Emergence. The TSA system as a whole produces educational outcomes that exceed the sum of individual contributions. The symbiotic relationship generates new pedagogical possibilities—such as personalized

scenario-based practice at scale, real-time diagnostic feedback integrated into instruction, and data-informed teaching adjustments—that would be impossible to achieve through any single actor operating alone.

3.2 The “Digital Collaborator” Conceptualization of the AI Agent

A distinctive contribution of this framework is the conceptualization of the AI agent not as a passive tool or an autonomous tutor but as a “digital collaborator.” This conceptualization draws upon recent scholarship on human–AI collaboration that positions AI as an active participant in the learning process rather than merely an instrument for content delivery (Sun, 2025).

The digital collaborator role encompasses three functions:

Diagnostic collaborator. The AI agent continuously monitors learner behavior, performance, and engagement, generating diagnostic information that informs both teacher decision-making and student self-regulation. In cruise service English, this includes tracking oral practice performance, identifying persistent pronunciation or fluency issues, and detecting patterns of engagement or disengagement.

Interactive collaborator. The AI agent engages students in scenario-based dialogue and interactive practice, providing immediate feedback and adaptive responses. Unlike scripted dialogue systems, the AI agent can adjust the complexity, focus, and pace of interaction based on learner responses, creating a form of personalized practice that would be impractical for teachers to provide individually.

Evaluative collaborator. The AI agent provides objective, consistent assessment of learner performance, complementing teacher evaluation with data-driven scoring. In the context of cruise service English, the AI agent can assess oral fluency, pronunciation accuracy, and the appropriate use of professional expressions, providing feedback that is both immediate and consistent.

3.3 The Three-Subject, Four-Stage Structural Model

The TSA model is structured as a three-subject, four-stage system. The three subjects are the teacher, the student, and the AI agent, each with distinct roles and responsibilities. The four stages define the temporal flow of collaborative interaction across the instructional cycle.

Three Subjects:

Teacher. The teacher serves as the pedagogical designer, scenario curator, and ethical guide. The teacher designs the overall instructional flow, configures the AI agent with appropriate content and interaction logic, curates the professional scenarios that form the basis for AI practice, and provides the contextual interpretation and ethical guidance that AI systems cannot replicate. Importantly, the teacher’s role is not diminished but transformed—from primary information deliverer to learning architect and facilitator.

Student. The student serves as the active learner, reflective practitioner, and feedback provider. The student engages with AI-mediated practice, reflects on AI-generated feedback, and provides input on the effectiveness and relevance of AI interactions. The student’s role includes developing the critical AI literacy needed to evaluate AI outputs and use them productively.

AI Agent. The AI agent serves as the diagnostic, interactive, and evaluative collaborator, operating within the parameters established by the teacher and responding adaptively to student needs.

Four Stages:

Pre-class Diagnosis. The AI agent analyzes student baseline performance, identifies individual strengths and weaknesses, and generates diagnostic profiles that inform instructional planning. The teacher uses these profiles to adjust content focus and anticipate areas requiring additional support.

In-class Interaction. The teacher facilitates classroom activities, introduces scenarios, and guides reflection. The AI agent supports in-class practice through scenario dialogue and provides real-time feedback to students. The teacher monitors AI-student interactions and intervenes when additional explanation or guidance is needed.

Post-class Evaluation. The AI agent provides summative assessment of student performance, generating detailed profiles that document development over time. The teacher reviews AI-generated evaluations, adds contextual interpretation, and integrates AI assessments with classroom observations.

Continuous Optimization. Based on data from the previous stages, the teacher adjusts instructional design, the AI agent is refined with updated content and interaction patterns, and the student receives personalized recommendations for further practice. This stage feeds back into the pre-class diagnosis of the next cycle, creating a continuous improvement loop.

4. CHAOXING AI AGENT FUNCTIONS AND THEIR PEDAGOGICAL MAPPING

4.1 Analysis of the Four Core Functions

The Chaoxing AI Agent platform integrates four core functions that collectively enable the TSA collaborative model:

AI Teaching Assistant. This function provides real-time question-answering, personalized resource recommendation, and learning path guidance. In the TSA model, the AI Teaching Assistant operates as a continuous support mechanism, addressing student questions that arise during independent practice and recommending resources tailored to individual needs. The function reduces the teacher's burden of routine inquiry response while ensuring that students receive timely support.

Customized AI Agent. This function enables the configuration of domain-specific intelligent agents with customized knowledge bases, interaction scripts, and response patterns. For cruise service English, this function allows instructors to create a "Cruise English Virtual Mentor" that embodies professional knowledge, appropriate register, and service-oriented communication norms. The customized agent can engage students in role-play scenarios, simulate guest interactions, and provide contextually appropriate feedback.

AI Practice. This function includes scenario dialogue, oral training, and automated scoring. Scenario dialogue enables students to practice workplace conversations in a controlled, repeatable environment. Oral training provides structured practice with immediate feedback on fluency, pronunciation, and grammatical accuracy. Automated scoring generates objective performance data that supplements teacher evaluation. The AI Practice function is the primary mechanism through which students develop and refine their professional communication skills.

AI Learning Analytics. This function provides learning profiles, classroom participation monitoring, and performance prediction. Learning profiles aggregate data from multiple sources to create multidimensional representations of student development. Participation monitoring tracks engagement patterns and identifies students at risk of disengagement. Performance prediction uses behavioral and performance data to forecast learning outcomes, enabling proactive intervention.

4.2 Mapping AI Functions to Cruise Service English Teaching Needs

The four AI functions map onto the specific pedagogical needs of cruise service English instruction:

Table 1: Specific Pedagogical Needs of Cruise Service English Instruction

AI Function	Pedagogical Need	Application in Cruise Service English
AI Teaching Assistant	Continuous support for professional vocabulary and expressions	Real-time assistance with cruise-specific terminology, service phrases, and safety vocabulary
Customized AI Agent	Domain-specific interaction practice	Role-play scenarios with a "Cruise English Virtual Mentor" embodying service standards
AI Practice	Scenario-based oral communication training	Boarding welcome dialogues, cabin service inquiries, dining communication, emergency instructions
AI Learning Analytics	Progress monitoring and diagnostic feedback	Tracking development in fluency, accuracy, and professional register; identifying areas for targeted practice

This mapping ensures that the AI functions are not applied generically but are specifically adapted to the

communicative requirements of cruise service contexts.

4.3 Scenario Bank Design: From Workplace Tasks to AI Practice Tasks

A key output of the TSA model design is the development of a scenario bank that translates authentic cruise service workplace tasks into AI-practiceable dialogue scenarios. The scenario bank is organized around the following design principles:

Authenticity. Scenarios are derived from actual workplace communication tasks identified through industry consultation and needs analysis. Each scenario reflects the communicative purposes, participant roles, and contextual constraints of real cruise service interactions.

Progressive complexity. Scenarios are sequenced from simple transactional exchanges to complex problem-solving interactions, allowing for differentiated practice and gradual skill development.

Integrated professional content. Each scenario embeds professional vocabulary, service norms, and industry knowledge within the language practice, ensuring that language learning is inseparable from professional competence development.

Reflective elements. Scenarios include prompts that encourage students to reflect on their communicative choices, consider alternative approaches, and connect practice to professional standards.

The scenario bank includes at least eight workplace tasks spanning the cruise service cycle: boarding welcome and document verification, cabin facility introduction and guest inquiry response, dining service and special dietary requirement handling, entertainment and activity explanation, emergency broadcast and evacuation guidance, complaint handling and service recovery, disembarkation assistance and farewell, and cross-departmental coordination communication.

5. MODEL IMPLEMENTATION AND OPERATIONAL GUIDELINES

5.1 Role Division and Interaction Protocols

The successful implementation of the TSA model requires clear role division and interaction protocols. Table 2 summarizes the responsibilities and interaction patterns for each subject across the four stages.

Table 2: Role Division Across the Four Stages

Stage	Teacher Role	Student Role	AI Agent Role
Pre-class Diagnosis	Review AI-generated profiles; adjust instructional focus	Complete baseline practice; review diagnostic feedback	Generate diagnostic profiles; identify strengths and weaknesses
In-class Interaction	Facilitate activities; introduce scenarios; guide reflection	Engage in scenario practice; respond to AI feedback	Provide interactive practice; deliver real-time feedback
Post-class Evaluation	Interpret AI assessments; integrate with observations	Review AI evaluation; reflect on development	Generate summative assessment; document progress
Continuous Optimization	Adjust design; refine AI configuration	Act on recommendations; pursue targeted practice	Provide updated practice; generate new recommendations

The interaction protocols specify that the AI agent operates within parameters established by the teacher, that teacher intervention takes precedence when pedagogical judgment indicates, and that student reflection is integrated into all stages to ensure that AI-mediated practice contributes to deeper learning rather than superficial engagement.

5.2 Teacher AI Competence Requirements

The TSA model places new demands on teacher competence. Beyond traditional pedagogical skills, teachers must develop:

AI configuration competence. The ability to configure the Customized AI Agent with appropriate content, interaction scripts, and assessment criteria.

Data interpretation competence. The ability to interpret AI-generated learning analytics and translate them into pedagogical action.

AI-student interaction monitoring competence. The ability to monitor AI-student interactions and intervene when necessary to ensure productive learning.

Ethical and critical AI competence. The ability to guide students in critically evaluating AI outputs and using AI responsibly.

These competence requirements align with the framework for vocational teachers' AI teaching competence developed by Li et al. (2026), which includes dimensions of AI knowledge, AI application, AI evaluation, and AI ethics.

5.3 Transferability to Other Vocational ESP Contexts

While the TSA model has been designed with cruise service English as the initial application context, its structure and principles are transferable to other vocational ESP domains. The transferability derives from three design features:

Modular scenario architecture. The scenario bank is organized as discrete, self-contained modules that can be adapted for different professional contexts by substituting domain-specific tasks and content.

Platform-agnostic role structure. The three-subject, four-stage structure is defined conceptually and can be implemented through other AI platforms with similar functional capabilities.

Principled integration logic. The mapping of AI functions to pedagogical needs follows a generalizable logic that can be applied across ESP domains, from maritime English to medical English to business English.

6. DISCUSSION

6.1 Theoretical Contributions

This paper makes three theoretical contributions. First, it advances symbiotic theory in educational technology by demonstrating its applicability to a specific, operational teaching model rather than remaining at the level of general principle. By articulating the mechanisms of complementarity, interdependence, and emergence within the TSA framework, the paper provides a more precise theoretical vocabulary for understanding human–AI collaboration in language education.

Second, the paper contributes to research on AI agents in education by moving beyond the “tool versus tutor” dichotomy that has characterized much previous discussion. The “digital collaborator” conceptualization offers a third position that recognizes the agent’s active role while maintaining human pedagogical authority.

Third, the paper addresses the gap in vocational ESP research on AI integration. While AI-empowered language teaching has received substantial attention in general English contexts, vocational ESP—with its distinctive emphasis on workplace scenarios and professional communication—has been comparatively neglected. The TSA model provides a framework that is specifically attuned to the requirements of vocational ESP.

6.2 Practical Implications

For vocational college teachers, the paper provides a concrete operational model that can be implemented using the Chaoxing platform, which is already widely deployed in Chinese higher vocational institutions. The four-stage structure and the role division framework offer clear guidance for integrating AI agents into existing teaching practices without requiring wholesale pedagogical transformation.

For institutional administrators, the paper demonstrates how existing platform investments can be leveraged to enhance vocational ESP instruction. The TSA model does not require acquiring new technologies but rather reconfiguring existing AI functions within a coherent pedagogical framework.

For platform developers, the analysis of Chaoxing AI Agent functions and their pedagogical mapping provides feedback on current capabilities and identifies areas where further development—such as more sophisticated scenario customization or more granular learning analytics—would enhance educational value.

6.3 Limitations and Future Research

The paper is conceptual and design-oriented, and the proposed TSA model requires empirical validation through classroom implementation. Future research should: conduct quasi-experimental studies to assess the model's effects on oral proficiency, learning motivation, and professional communication competence; develop and validate instruments for measuring teacher AI competence within the TSA framework; explore the transferability of the model to other vocational ESP domains; investigate the ethical dimensions of AI agent use in vocational education, including issues of data privacy, algorithmic bias, and the appropriate boundaries of AI involvement in assessment; examine the long-term sustainability of the TSA model, including the workload implications for teachers and the technical support requirements for institutions

7. CONCLUSION

This paper has proposed a Teacher–Student–AI Agent collaborative teaching model for vocational ESP, grounded in symbiotic theory and operationalized through the Chaoxing AI Agent platform. The model repositions the AI agent as a “digital collaborator” with diagnostic, interactive, and evaluative functions, operating within a three-subject, four-stage structure that integrates AI functions into the full instructional cycle. The paper has analyzed the four core functions of the Chaoxing AI Agent—AI Teaching Assistant, Customized AI Agent, AI Practice, and AI Learning Analytics—and mapped them onto the specific pedagogical needs of cruise service English instruction. A scenario bank design framework has been proposed, organized around principles of authenticity, progressive complexity, integrated professional content, and reflective elements.

The TSA model represents a practical pathway for reconstructing teaching relationships in vocational English education, transforming AI from a peripheral tool into an integrated collaborator within a symbiotic pedagogical ecosystem. While empirical validation remains necessary, the model provides a theoretically grounded and practically implementable blueprint for vocational ESP instruction in the digital intelligence era, with potential for transferability across vocational ESP domains.

ACKNOWLEDGMENTS

This research is a phased achievement of the 2026 National Joint Conference of Presidents of Higher Vocational Colleges project “Research on the Teacher–Student–Machine Collaborative Teaching Model for Higher Vocational Industry English Based on AI Agents” (Project No. XLH202632).

REFERENCES

- [1] Lee, S., Choe, H., Zou, D., & Jeon, J. (2026). Generative AI (GenAI) in the language classroom: A systematic review. *Interactive Learning Environments*, 34(1), 335–359. <https://doi.org/10.1080/10494820.2025.2498537>
- [2] Li, F. (2026). Innovation and practice of database teaching in higher vocational education under the Teacher-AI-Student tripartite synergistic framework. In *Proceedings of the 2026 5th International Conference on Humanities, Wisdom Education and Service Management* (pp. 1–8). Atlantis Press. https://doi.org/10.2991/978-2-38476-593-5_26
- [3] Wang, F.-Y., & Lee, S.-Y. (2026). Symbiotic learning: Developing multiliteracies in human-AI collaboration. *Pedagogies: An International Journal*, 21(2), 329–352. <https://doi.org/10.1080/1554480X.2025.2606234>
- [4] Wang, J. (2025). Large-language-model-supported BOPPPS teaching for maritime ESP: A quasi-experimental study in a Chinese vocational college. In *Proceedings of the 2025 3rd International Conference on Information Education and Artificial Intelligence* (pp. 1–7). ACM. <https://doi.org/10.1145/3799457.3799635>