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A Human-AI Collaborative Framework for GenAI-Supported Online Courses in Higher Vocational Education

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Abstract

Generative artificial intelligence provides new paths for the creation of resources, learning interaction, and teaching feedback in online vocational education courses. Given the problems of static resources, lack of professional contexts, and limited personalised support, this paper proposes an instructional design and application framework from the perspective of human-AI collaboration. The framework covers four dimensions of instructional design: objectives, content, organization, and evaluation. It also includes task division, human-AI collaboration, student participation, and data feedback across the pre-class, in-class, and post-class stages. At the application level, the framework links pre-class preparation, in-class collaborative learning, and post-class feedback, with GenAI used for resource generation, scenario support, formative feedback, and learning analysis. The framework also stresses verification of AI-generated content, clear role boundaries, and the use of learning data to support continuous instructional adjustment. Therefore, generative AI should support vocational contexts, learning interaction, and differentiated feedback, while teachers retain responsibility for professional judgment, content reliability, and data security.

Keywords

Generative artificial intelligence; human-AI collaboration; higher vocational education; online learning; instructional design

1. Background

Many existing online courses in higher vocational education are still in a video-lecture format, and although there are some online exercises and homework submission, there is little teacher-student interaction or individualised guidance. Vocational education needs to focus on practical operation and authentic work environments, and a single source of static digital materials cannot present complex job tasks sufficiently (Roslin et al., 2022). Generative artificial intelligence (GenAI) can generate materials, cases and feedback according to instructional tasks and learning needs through its functions of content generation, natural language interaction, scenario simulation and instant feedback, thus providing new avenues for differentiated learning support (Kasneci et al., 2023; Yan et al., 2024). However, the educational value of technology cannot be achieved through technology alone; rather, it requires effective integration into instructional design and a clear division of labour among teachers, students, and AI. The guiding documents indicate that the applications of generative AI should be human-centered and protect teachers' professional responsibilities and learners' autonomy (Miao & Holmes, 2023). Therefore, this paper studies GenAI-supported instructional design in higher vocational online courses from the perspective of human-AI collaboration.

2. Conceptual Foundations

2.1 Educational Technology Characteristics of GenAI

GenAI has capabilities in content generation, interaction, and contextual adaptation, and is not limited to preset resources and rule-based feedback; it can generate learning materials, problem scenarios, cases, and feedback according to instructional tasks and learning needs. In education, it can be used to enhance resource utilisation and offer support for inquiry-based learning, scenario simulation, and formative assessment (Kasneci et al., 2023; Yan et al., 2024).

2.2 Fundamental Characteristics of Online Courses in Higher Vocational Education

The content of instruction connects professional knowledge with work tasks, and activities are focused on operational practice, problem-solving, and experience in authentic or simulated work environments. Online learners have different levels of prior knowledge, self-regulation abilities, and learning speeds; the courses need to provide stable resources and add learning scaffolds, process support, and timely feedback. Research on online learning in vocational education has found that the organisation of practical instruction, teacher-student roles, and learning experience are factors that affect instruction (Roslin et al., 2022).

2.3 Fundamental Logic of Human-AI Collaborative Instruction

Human-AI collaboration does not mean replacing teachers with AI or adding another tool. It involves redistributing tasks and responsibilities. Teachers are responsible for setting goals, selecting materials, organizing activities, making judgments, and adjusting teaching; GenAI helps prepare resources, organizes information and supports interaction, and students learn by asking questions, evaluating materials, applying what they've learned, and reflecting. GenAI applications in vocational education require teachers to combine knowledge of technology, professional expertise, and teaching experience (Willermark & Carlsson, 2026). Therefore, the core of human-AI collaboration is not to increase AI intervention but to establish a collaborative relationship of "teachers' professional judgment - appropriate GenAI support - learner agency" in the design of instructional objectives, content, organization, and assessment. Based on the logic of human-AI collaboration, this paper proposes the framework shown in Figure 1 for GenAI-supported online courses in higher vocational education.

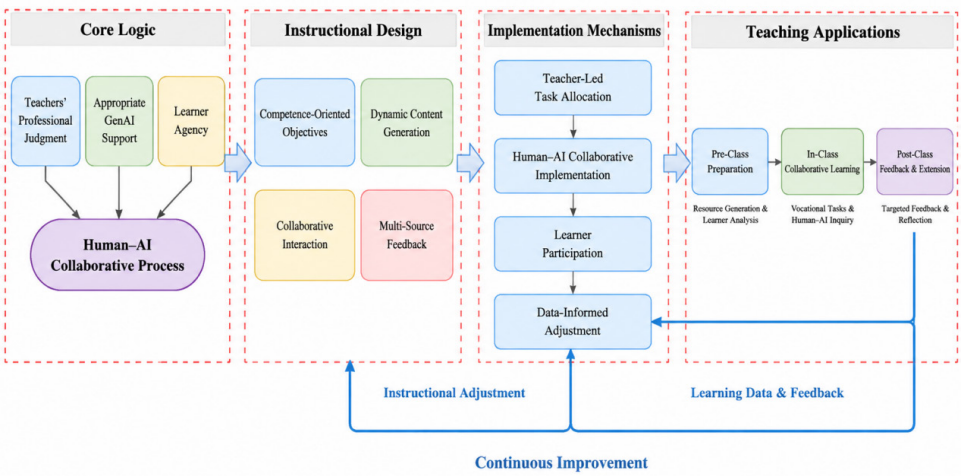

Figure 1. Human-AI Framework for GenAI-Supported Online Courses in Higher Vocational Education.

3. Human-AI Collaborative Instructional Design

3.1 Instructional Objectives: Emphasizing Competence Orientation

From the perspective of human-AI collaboration, the goals of online courses in higher vocational education should be to promote the development of knowledge, vocational ability, and professional qualities, and to determine

whether students can apply acquired knowledge to analyze and solve problems in work scenarios. Teachers should set core objectives based on professional standards, job requirements, and course positioning; then, GenAI can be used to convert competence goals into tasks of different difficulties and complexities, and build scaffolds according to students' foundation levels.

3.2 Instructional Content: Strengthening Resource Generation

GenAI can support the construction of a course structure with "stable core content + dynamically generated content". Teachers establish knowledge and competence frameworks based on course objectives and job tasks, then use GenAI to generate cases, problems, role materials, operational scenarios, and resources to maintain the connection between instructional content and vocational practice. A recent systematic review by Ranuharja et al. (2025) confirms that GenAI significantly enhances vocational instructional material design by supporting personalised learning and automating content creation, while also highlighting the need for digital competency development and ethical frameworks to guide its integration. Generated resources may contain errors, biases, or violations of professional norms (Kasneci et al., 2023), and need to be verified by teachers.

3.3 Instructional Organization: Promoting Collaborative Interaction

The impact of generative AI on online courses will not be to add new tools for providing information; rather, it is likely to change the structure of "resource viewing - exercise completion - assignment submission" into a multi-party interaction system involving teachers, students, and generative AI to tackle real or simulated vocational problems. Teachers can propose vocational tasks, have students use GenAI to gather information and generate solutions, engage in role-playing, and form judgments through comparison, verification, discussion, and revision. AI output should not be treated as the final answer; students should be encouraged to examine, compare, and verify it. Given that excessive reliance may weaken critical thinking (Yan et al., 2024), teachers should engage in probing, correction of deviations, and raising of conceptual understanding to establish an activity chain of "task-driven—human-AI inquiry—peer collaboration—judgment and revision—teacher guidance—reflection and improvement".

3.4 Instructional Evaluation: Emphasizing Multi-Source Feedback

In a human-AI cooperative environment, assessment should consider both learning processes and competence development rather than relying only on final results. Teacher evaluation, student self-assessment, peer assessment, and AI-assisted feedback can be integrated, with task performance, interaction process, work revision, and milestone achievement used as evaluation evidence. Generative AI can be employed to provide low-stakes, formative feedback on common errors and suggest revisions; however, it should not issue a final judgment on complex vocational competencies or high-stakes evaluations. Evaluation thus forms a closed loop of "learning performance—multi-source feedback—student revision—instructional adjustment", enabling feedback to serve student improvement and teachers' decision-making.

4. Mechanisms for Human-AI Collaborative Implementation

4.1 Teacher-Led: Clarifying Instructional Tasks

Teachers are still responsible for the objectives of the course, professional standards, values and judgments, decision-making and final evaluation; repetitive or supporting work, such as resource generation, information organisation, basic Q&A and formative feedback, can be assisted by GenAI. Such task allocation helps keep technology aligned with instructional purposes and allows teachers to focus on learning diagnosis, instructional decisions, and critical guidance (Willermark & Carlsson, 2026; Yang et al., 2026).

4.2 Human-AI Collaboration: Optimizing the Instructional Process

Human-AI cooperation should not have students accept the AI's results directly. Students should consider the results in light of course knowledge, professional norms, and other evidence, and teachers need to intervene through questioning, examples, and corrections. GenAI becomes a tool for analysis, comparison, and verification rather than a source of answers.

4.3 Student Participation: Strengthening Autonomous Learning

The enhancement of online learning by human-AI collaboration depends on students' cognitive engagement and learning agency. GenAI can reduce the cost of information retrieval and routine work, but using the results may eliminate opportunities for problem analysis, evidence evaluation, and problem-solving (Yan et al., 2024). Therefore, students should be encouraged to pose questions, obtain information, use AI and verify the output, explain the reason for prompts, evidence, and solution modifications, identify knowledge gaps, and adjust learning strategies. Technology should be used to reduce the burden of low-value work and not replace learners' thinking and practice.

4.4 Data Feedback: Driving Instructional Improvement

Online learning can generate process data, such as completed tasks, learning progress, and interaction feedback. Teachers can identify the problems and individual differences to adjust the tasks and course resources. Learning data and AI analysis can only provide a basis for instructional judgment; they should not replace teachers' decisions, and principles of purpose limitation, data minimisation, transparency, and security need to be followed (Miao & Holmes, 2023). Accordingly, a feedback loop of "learning activities—process data—assisted analysis—teacher interpretation—instructional adjustment" can be established.

5. GenAI-Supported Instructional Applications

5.1 Pre-Class Preparation: Generating Resources and Analyzing Learning Conditions

Teachers can have GenAI create guidance materials, case backgrounds, knowledge prompts, and tiered exercises according to learning objectives and work tasks, and adjust their difficulty and learning support based on students' previous performance. Teachers can give quick quizzes, collect students' answers and organise training tasks, and use AI to identify general problems. Teachers can provide explanations and examples for students with weaker foundations and more open-ended or challenging tasks for better-prepared students. AI diagnosis is only a reference for teachers' judgments, and generated resources also need to be reviewed by teachers; thus, a pre-class process of "task guidance—resource support—autonomous preparation—learning condition assessment" is formed.

5.2 In-Class Implementation: Collaborative Learning Activities

Teachers organise activities based on typical work tasks or real-life work problems to have students use their professional knowledge, apply GenAI, and cooperate with others to solve problems. Generative AI can take on the roles of vocational clients and managers to generate scenarios and respond in real time through continuous conversation. Based on studies, GenAI-based virtual roles and contextualised scaffolds can be used to simulate work scenarios and provide support for competency training (Ngu et al., 2025). Students need to analyze information, compare solutions, and justify their choices; groups can deepen learning through presentations and peer questioning; teachers are responsible for process observation and critical guidance, forming a learning process of "vocational context—human-AI inquiry—peer collaboration—presentation of outcomes—teacher guidance".

5.3 Post-Class Extension: Providing Targeted Learning Feedback

GenAI can be used to generate exercises, knowledge prompts, and revision suggestions according to the results of tasks, common errors, and work revisions, thus offering timely formative support for students (Yan et al., 2024). Students can experience a cycle of "completing tasks—receiving feedback—evaluating feedback—revising work—further reflection"; teachers focus on reviewing feedback related to professional judgment, vocational standards, and complex competencies, and adjust subsequent resources and tasks according to common problems. Post-class feedback supports individual learning and informs the next round of instructional design.

6. Conclusion

This paper explores GenAI-supported instructional design and application for online courses in higher vocational education from the perspective of human-AI collaboration, establishes a collaborative logic centered on teachers' professional judgment, suitable GenAI support, and learner agency, and puts forward course design approaches across four dimensions: instructional objectives, instructional content, instructional organisation, and instructional

evaluation. Based on this, implementation mechanisms are constructed through task division, process collaboration, student participation, and data feedback, and these are further operationalised in three instructional stages: pre-class, in-class, and post-class.

Meanwhile, GenAI in educational applications still poses risks such as content reliability, learning dependence, and data privacy and governance (Kasneci et al., 2023; Miao & Holmes, 2023). Therefore, future GenAI applications in online courses in higher vocational education should further refine mechanisms for teacher review, student verification, data protection, and responsibility delineation, and empirically test the actual effects of different human-AI collaborative designs in authentic instructional contexts.

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