From Blended Intelligence to "Dual-Teacher Classrooms": Building and Applying AIGC-Empowered Collaborative Learning Paradigms

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Abstract. This study proposes an AIGC-supported "dual-teacher classroom" collaborative learning paradigm for higher education. The paradigm redefines the dual-teacher model as human-AI collaboration between human teachers and AIGC tools, which integrates dynamic content generation, personalized learning support, and real-time assessment and feedback into three stages: preparation, collaboration, and summary. Teaching practices in several higher education courses show that this model can improve students' knowledge mastery, learning engagement, and critical thinking skills. The study provides a practical framework for applying AIGC to collaborative learning while emphasizing the irreplaceable role of human teachers in guidance, emotional support, and pedagogical judgment.

Keywords: AIGC; dual-teacher classroom; collaborative learning; higher education

1 Introduction

Generative AI is fundamentally reshaping higher education, catalyzing the evolution of traditional "dual-teacher classrooms" into human-AI synergistic models. While AI-Generated Content (AIGC) excels in resource generation and adaptive feedback, human educators remain indispensable for pedagogical and socio-emotional guidance. However, AIGC's systematic integration into group-based collaborative learning remains underexplored. To bridge this gap, this study proposes a three-stage (preparation, collaboration, summary) AIGC-empowered dual-teacher collaborative learning paradigm, empirically evaluating its efficacy in enhancing students' knowledge mastery, engagement, and critical thinking.

2 Literature Review

The "dual-teacher" paradigm has transitioned from traditional human-human instructional divisions [1, 2] to synergistic human-AI collaboration [3]. While Artificial

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Intelligence Generated Content (AIGC) significantly enhances pedagogical efficiency and inquiry depth [4], its inherent risks—such as plagiarism, overreliance, and diminished learner autonomy—necessitate robust instructional design and effective human-AI synergy to unlock its true educational value [5].

Despite extensive research on AI-assisted personalized learning, AIGC's integration into group-based collaborative learning remains underexplored [6]. Because collaborative learning inherently demands complex interaction, negotiation, and shared regulation, AIGC must transcend its role as a mere knowledge repository to become an active collaborative facilitator [7]. Consequently, this study proposes an AIGC-empowered dual-teacher collaborative learning paradigm to evaluate its empirical impact on students' knowledge mastery, engagement, and critical thinking in authentic higher education settings.

3 AIGC-Supported Dual-Teacher Classroom Collaborative Learning Paradigm

3.1 Paradigm Structure

Rooted in human-AI synergy [3], the AIGC-empowered dual-teacher paradigm mitigates instructional bottlenecks in group monitoring and formative assessment. By leveraging AIGC for dynamic resource generation and learning analytics [8], the model seamlessly integrates human pedagogical judgment and emotional intelligence with AI's generative and analytical capabilities. Operationally, this paradigm unfolds across three sequential stages (Figure 1):

Preparation: Teachers formulate instructional objectives while AIGC generates tailored learning materials and cognitive scaffolds.

Collaboration: Students engage in AI-assisted group inquiry, enabling human teachers to focus on higher-order interaction management and complex problem-solving.

Summary: Students present outcomes and engage in iterative revision, driven by multi-dimensional feedback from teachers, peers, and AIG.

3.2 Key Mechanisms

The paradigm is driven by three core mechanisms: dynamic content generation, personalized learning support, and real-time assessment. Specifically, AIGC synthesizes context-specific materials and cognitive scaffolds to enrich collaborative inquiry. Simultaneously, it conducts granular learning analytics on group performance and individual trajectories, delivering adaptive resources that empower human teachers to implement targeted interventions.

Furthermore, while AIGC supplies instantaneous, data-driven formative feedback to refine student outputs, human educators retain the indispensable role of evaluating higher-order reasoning, socio-emotional dynamics, and ethical values [9]. Ultimately, these mechanisms catalyze a paradigm shift from rudimentary AI-assisted instruction to profound human-AI symbiosis, establishing a rigorous division of labor: algorithms

manage resource generation and data analytics, while human teachers orchestrate cognitive direction, classroom interaction, and emotional development.

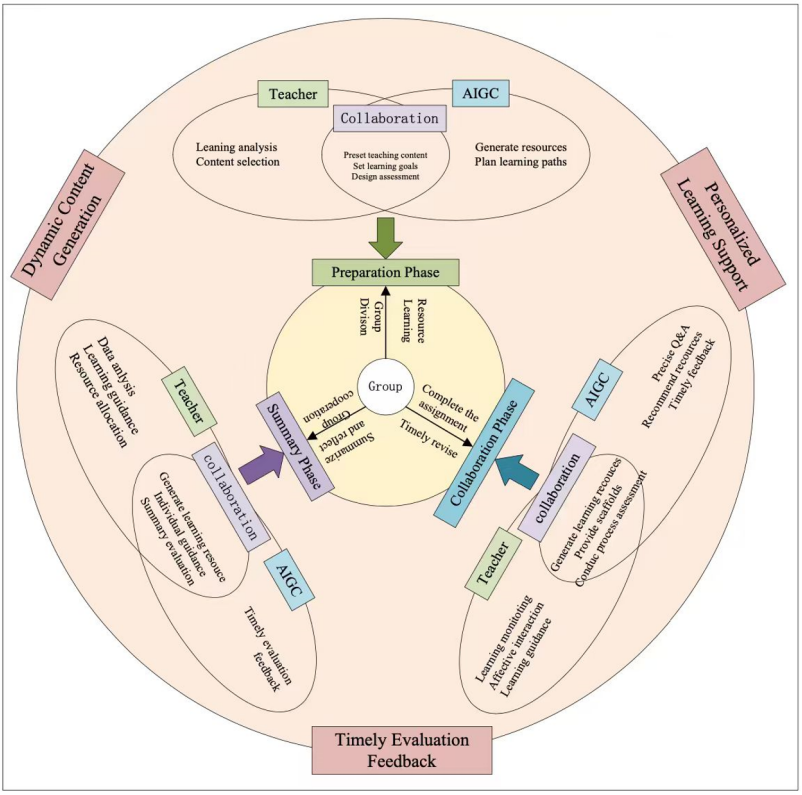

Fig. 1. Collaborative Learning Paradigm for the Dual-Teacher Classroom

4 Application and Effectiveness Analysis of the Paradigm

4.1 Application of the Paradigm

To empirically validate the proposed paradigm, it was implemented across five distinct higher education courses: Supply Chain Case-Based Training, Data Mining in Shipping Finance, Portfolio Management, Statistical Analysis and Application of Integrated Transportation Big Data, and Management Case-Based Training. This selection encompasses diverse educational contexts, spanning undergraduate and graduate levels, international student cohorts, as well as data-driven and case-based pedagogical approaches. Across all settings, the implementation strictly adhered to the aforementioned three-stage human-AI synergistic framework, seamlessly integrating AI-driven analytics with human-led pedagogical regulation to enhance the efficiency and adaptability of collaborative learning.

4.2 Course Design

To reduce repeated descriptions, the course design is summarized in Table 1. Although the five courses differed in teaching content and student groups, they followed the same three-stage implementation logic of the AIGC-supported dual-teacher classroom paradigm.

Table 1. Course Design Based on the AIGC-Supported Dual-Teacher Classroom Paradigm

Course	Target Students	Preparation Stage	Collaboration Stage	Summary Stage
Supply Chain Case-Based Training	Undergraduates	Generate case materials and define supply chain performance analysis tasks	Support case analysis, group discussion, and performance evaluation	Present case analysis results and revise reports based on feedback
Data Mining in Shipping Finance	Undergraduates	Generate financial datasets and introduce data mining tasks	Support data processing, model analysis, and result interpretation	Present analytical results and improve reports based on feedback
Portfolio Management	Undergraduates	Generate market data and investment cases	Support risk assessment, portfolio simulation, and decision-making	Present portfolio designs and optimize investment strategies
Statistical Analysis and Application of Integrated Transportation Big Data	Graduate students	Generate transportation big data cases and datasets	Support statistical analysis, model interpretation, and policy recommendation	Present analysis results and refine policy suggestions
Management Case-Based Training	International students	Generate management cases and background information	Support case discussion, multilingual interpretation, and solution development	Present case solutions and improve analysis through reflection

As shown in Table 1, AIGC provided course-specific support, including case interpretation, material generation, solution refinement, dataset generation, data analysis, model interpretation, and multilingual assistance. Across all courses, human teachers guided learning, evaluated student outputs, and ensured the critical and appropriate use of AIGC-generated content.

4.3 Effectiveness Analysis

To examine the effectiveness of the paradigm, this study conducted a between-group comparison in the Supply Chain Case-Based Training course. Students were randomly

divided into six groups of five; three groups adopted the AIGC-supported dual-teacher classroom collaborative learning paradigm, while the other three received conventional collaborative learning instruction.

The results were evaluated in terms of knowledge mastery, learning engagement, and critical thinking skills. The experimental group outperformed the control group in all three dimensions. Test results showed higher knowledge mastery, questionnaire results indicated stronger learning engagement, and interview results suggested improved critical thinking skills, as students learned to question, compare, and verify AIGC-generated content through inquiry. The application results across the five courses are summarized in Table 2.

Table 2. Analysis of Course Application Results

Course Title	Target Students	Knowledge Mastery	Learning Engagement	Critical Thinking Skills
Supply Chain Case-Based Training	Undergraduates	High	Medium	Medium
Data Mining in Shipping Finance	Undergraduates	Medium	High	Medium
Portfolio Management	Undergraduates	Medium	Medium	High
Statistical Analysis and Applications of Integrated Transportation Big Data	Graduate Students	High	High	High
Management Case-Based Training	International Students	Medium	Medium	Medium

As shown in Table 2, the AIGC-supported dual-teacher classroom paradigm showed positive effects across courses, but outcomes varied by course type and student group. Graduate students benefited most in data-intensive courses, while undergraduates improved more in practice-oriented and decision-making courses. International students also progressed, though language and cultural factors partly limited their engagement and critical thinking. Thus, the paradigm's effectiveness depends on course features, prior knowledge, autonomy, and language background.

5 Conclusions and Suggestions

The practice indicates that the AIGC-supported dual-teacher classroom collaborative learning paradigm can improve students' knowledge mastery, learning engagement, and critical thinking by providing personalized resources, instant feedback, and interactive guidance. However, as the paradigm remains exploratory, future implementation should further clarify the roles of human teachers and AIGC: teachers should emphasize

instructional guidance, emotional support, value judgment, and classroom regulation, while AIGC should support resource generation, immediate feedback, and data-based learning analysis. Meanwhile, teachers' competence in integrating AIGC tools and interpreting learning data should be strengthened to promote more precise human-AI collaboration and the sustainable development of this paradigm.

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