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Exploration of AIGC-Enabled Teaching Model for "Big Data Platform Construction and Maintenance" Course in Higher Vocational Education

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Abstract: ***In response to the challenges of disconnection between theory and practice, outdated resources, and significant variations in student proficiency in the traditional teaching of Big Data Platform Construction and Maintenance courses in higher vocational education, this paper proposes an AIGC-enabled course teaching model from the perspective of constructivist learning theory. The model deeply integrates AIGC tools into the entire process of "pre-class preparation, in-class guidance, and post-class consolidation," constructing four key dimensions: professional resource generation, personalized learning diagnosis, situated practice support, and iterative professional capability development. Through practical application in actual teaching, results demonstrate that this model effectively enhances students' troubleshooting and cluster maintenance capabilities, with students' final comprehensive scores and willingness for independent learning significantly improved compared to the traditional model. This research provides a practical reference for the human-machine collaborative teaching reform of big data courses in higher vocational education.***

Keywords: AIGC, Big data platform, Construction and maintenance, Teaching model, Human-machine collaboration.

1. INTRODUCTION

In the context of the "Artificial Intelligence +" initiative promoted by China, advancing the digital and intelligent transformation of vocational education teaching models has become an important issue. In March 2025, China's Ministry of Education released the "National Education Digitalization Strategy Action Plan," which clearly states the need to accelerate the deep application of artificial intelligence in education, promote the intelligent upgrading of curricula, textbooks, and teaching systems, integrate artificial intelligence technology throughout all elements and the entire process of education, and unleash and stimulate the transformative potential of artificial intelligence. As higher vocational institutions bear the important responsibility of cultivating high-quality technical and skilled talent for industry, their course teaching should emphasize the cultivation of practical and hands-on abilities.

Big Data Platform Construction and Maintenance is one of the core courses for big data technology and related majors in higher vocational education. Its content closely interfaces with enterprise job requirements, covering Hadoop distributed framework deployment, cluster monitoring and optimization, fault diagnosis, and other complex content, featuring high complexity, strong practicality, and cutting-edge characteristics. It is a key course for cultivating students' operation and maintenance job competencies. However, in actual teaching, this course faces problems such as complex content systems, rapid technology iteration, heavy practical tasks, and high cluster construction costs. Traditional knowledge-imparting teaching methods often result in "armchair strategizing," failing to adapt to operation and maintenance practice scenarios, with pain points including excessive personalized bugs, high tuning and error-correction costs, and low fault recurrence rates, making it difficult to effectively support the dynamic development of students' professional capabilities and meet the demands of enterprises for big data talent cultivation. There is an urgent need for digital and intelligent solutions with strong real-time interaction and personalized adaptation capabilities.

As a cutting-edge direction in current artificial intelligence development, AI-Generated Content (AIGC) technology is developing rapidly. Large models represented by ChatGPT and DeepSeek are profoundly reshaping the education ecosystem [1]. AIGC tools possess powerful capabilities in code generation, scripting, and multi-turn dialogue-based error correction, forming a high degree of alignment with teaching challenges in big data operation and maintenance courses such as environment configuration, exception handling, and parameter tuning. These tools can build upon students' personalized learning data to address gaps in their specialized knowledge, while also providing rich practical cases that transcend professional-grade complexity and match students' cognitive levels [2]. Simultaneously, AIGC opens up more creative development paths for students [3]—for example, encouraging students to continuously converse with the system during autonomous exploration to acquire new debugging approaches. Introducing AIGC into the Big Data Platform Construction and Maintenance course in higher vocational education will help drive the transformation of the teaching model from "knowledge transmission and skill replication" to practical competence development. Based on this, this paper starts from the perspective of constructivist learning theory to explore the design and practical pathways of an AIGC-enabled teaching model for this course.

2. CURRENT SITUATION AND PRACTICAL CHALLENGES OF BIG DATA PLATFORM CONSTRUCTION AND MAINTENANCE COURSE TEACHING FROM A CONSTRUCTIVIST PERSPECTIVE

2.1 Disconnection Between Theory and Practice Leading to Insufficient Construction of Professional Competence

Constructivist learning theory [4] holds that learners' comprehensive abilities are not acquired through external simple indoctrination, but are gradually constructed through autonomous practical exploration, reflection, and knowledge transfer in real or simulated task contexts [5]. This highly aligns with the hands-on teaching requirements of the Big Data Platform Construction and Maintenance course. The course covers core content with strong practical orientation, such as distributed cluster construction, functional testing, and platform performance tuning, demanding high levels of practical application and comprehensive capability from students. However, traditional teaching is dominated by teacher-led theoretical explanations and standardized experimental demonstrations, with students mostly in a state of passive imitation, lacking opportunities for autonomous problem identification, inquiry-based exploration, and trial- and-error practical training. The training of higher-order technical capabilities and troubleshooting logic principles cannot support the effective transfer of course knowledge to practical operations, making it impossible to form a closed loop of professional competence development aligned with big data platform operation and maintenance job requirements.

2.2 Lack of Adaptability in Teaching Resources, Making It Difficult to Meet Students' Individual Professional Development Needs

Students exhibit significant disparities in prerequisite professional knowledge such as computer networks, Linux systems, and programming fundamentals, directly leading to uneven course learning outcomes: some students with better foundations can quickly master cluster deployment and cluster tuning operations, while others with weaker foundations face substantial difficulties in coding, debugging, and tool usage. Existing teaching resources primarily consist of standardized post-class assignments and summative final assessments, lacking dynamic tracking and precise diagnosis throughout students' entire professional learning process, making it impossible to promptly identify student difficulties and implement stratified teaching and personalized guidance.

3. DESIGN OF THE AIGC-ENABLED COURSE TEACHING MODEL

3.1 Reconstruction of Teaching Objectives

Focusing on the core competency requirements of big data platform operation and maintenance positions, and integrating the technological characteristics and application advantages of AIGC, when empowering the Big Data Platform Construction and Maintenance course with AIGC technology, it is essential to achieve an organic integration of technical tools and pedagogical principles, systematically incorporating core elements and modes of thinking cultivated by artificial intelligence into the course teaching objective system, thereby reconstructing the value connotation and pedagogical logic of the course.

The course objectives are primarily restructured across three dimensions—knowledge, skills, and competence: the knowledge dimension focuses on the theoretical system and technical architecture of big data platform construction and operation and maintenance, systematically covering the full-chain knowledge system from foundational principles and system deployment to data collection, storage, processing, and analysis; the skill dimension emphasizes core hands-on competencies such as big data platform construction and configuration debugging, fault diagnosis, and performance tuning, with emphasis on cultivating students' ability to flexibly apply big data key technologies and AIGC tools to analyze and solve practical engineering problems in real-world contexts; the competence dimension highlights higher-order thinking, systems thinking, and innovative practical ability, guiding students to take real-world projects as carriers to complete the full pathway of problem identification, solution design, and iterative optimization, cultivating a rigorous professional attitude, effective communication and collaboration skills, and a continuous sense of innovation.

3.2 Construction of the AIGC-Enabled Teaching Model Framework

To systematically present the teaching logic and dynamic operation mechanism across the three dimensions of this model, this study has designed a four-layer architecture diagram of the AIGC-enabled teaching model framework, as shown in Figure 1. This framework presents a progressive structure of objective-guiding, four-dimensional empowerment, three-stage implementation, and data-driven closed-loop assessment.

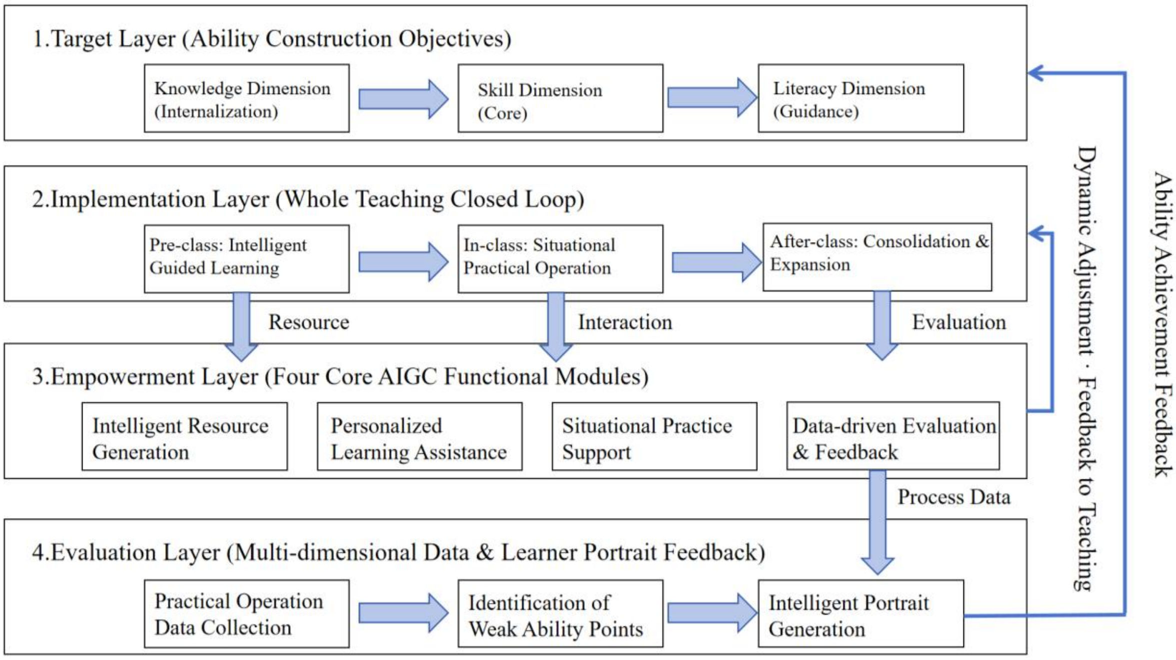

Figure 1: Four-Layer Architecture and Human-Machine Relationship Diagram

This overall framework presents a progressive human-machine relationship of objective-guiding, knowledge internalization, skill core competency, and integrated "knowledge-skill-competence" development. The objective layer serves as the top-level guide, decomposing the four-dimensional competency indicators of the course into specific teaching driving forces. The implementation layer runs through the entire teaching process of "pre-class guided learning + diagnostic assessment → in-class situated practice → post-class consolidation and expansion." Pre-class activities leverage AIGC cognitive scaffolding, using AIGC to support exploratory inquiry; in-class activities use AIGC to support full-path debugging and capability transfer. The empowerment layer consists of four major modules — resource generation, personalized learning diagnosis, situated practice support, and iterative professional capability development—as the core enabling technologies, deeply integrated throughout the entire process and dynamically supporting each stage of the implementation layer. The assessment layer collects in real time students' multi-dimensional behavioral data across cluster construction logs, configuration modification trajectories, and fault diagnosis processes, transforming them through AIGC into precise "professional competency profiles."

The innovative feature of this architecture lies in the establishment of a dual-path feedback and iterative loop. On one hand, the dynamic practical problems and cognitive obstacles generated by students in the "implementation layer" are uploaded and profiled in real time through the "assessment layer"; on the other hand, after the assessment layer identifies difficulties, it bifurcates feedback via two paths—one path provides real-time AIGC differentiated learning resources and teaching strategy adjustment suggestions to the "implementation layer" to assist teachers' decision-making, while the other path feeds back to the "objective layer" for mining precise pain points and calibrating the effectiveness of comprehensive student competency development goals, thereby forming a multi-dimensional, dynamically iterative digital teaching closed loop of education.

4. TEACHING PRACTICE AND IMPLEMENTATION PLAN

Taking the modularization of course professional competence as the framework, AIGC is deeply integrated into the entire teaching process of "pre-class → in-class → post-class," focusing on the cultivation of practical professional competence across three dimensions [6].

4.1 Pre-Class: Professional Resource Generation and Personalized Preview

Teachers, based on the teaching objectives of the module, use AIGC to generate teaching scripts closely aligned with enterprise scenarios [7], using the quasi-production-standard "Ship Big Data Analysis System"—which involves screening Weibo sentiment analysis and the distributed columnar database HBase module—as a case study. Teachers also use AIGC to generate preview resources such as HBase cluster architecture diagrams and core Linux command manuals. Simultaneously, an AIGC specialized knowledge base is connected to the intelligent teaching platform to aggregate student preview learning data, executing personalized diagnosis: for students with weaker foundations, it precisely supplements core concepts of non-relational databases and remedial instruction; for students with better foundations, it provides preview tasks on challenging aspects such as the underlying read-write logic principles of "vessel trajectory middleware" in advance. Before class, AIGC automatically collects and aggregates all student preview diagnostic data, precisely identifying students' common cognitive blind spots on topics such as "differences between non-relational databases and traditional SQL storage," providing professional, data-driven evidence for teachers' dynamic adjustments to classroom teaching strategies.

4.2 In-Class: Professional Practice and Personalized Guidance

In the classroom teaching phase, the school's proprietary vessel big data sandbox platform is used to carry out big data operation and maintenance hands-on practice. Taking the practical training project scenario of "Multi-dimensional AIS Vessel Trajectory Data Storage and Query Based on HBase" from the textbook as an example, the teaching implementation process proceeds as follows: First, during the scenario introduction phase, the teacher simulates the high-concurrency surge of vessel-mounted communication terminal signals in the Yangtze River channel, guiding students to intuitively perceive the pain point of low query efficiency caused by massive multi-source heterogeneous data. When planning storage, students encounter the cognitive challenge of how to achieve efficient mapping of multiple business indicators (such as MMSI code and timestamp) to the underlying RowKey design sequence in HBase. Next, during the human-machine collaborative inquiry phase, addressing the core bottleneck of "how to avoid full-table scanning caused by range queries for initial query speed improvement," students conduct investigations through the AIGC-assisted console. The AIGC prompts do not directly provide complete code but use a "progressive questioning" approach to guide students in thinking about timestamp boundary conversion logic and code stitching and reuse. Finally, in the verification phase, students use AIGC to assist in tuning the optimization range, successfully invoking the system's electronic chart interface to achieve real-time visual rendering of vessel navigation trajectories.

4.3 Post-Class: Professional Knowledge Internalization and Iterative Capability Assessment

The post-class phase does not stop at knowledge transfer; rather, AIGC automatically generates customized modular learning summaries—including core HBase maintenance points—based on students' hands-on performance data. For remaining issues identified in class such as "RegionServer node load balancing strategy," AIGC dynamically generates supplementary cases and troubleshooting practical exercises to achieve gap-filling reinforcement. Students submit practical reports through the platform, and AIGC, following teacher-established rubrics, automatically reviews and provides model-based feedback, focusing on verifying the standardization of practical operations and the rationality of cluster configuration parameters, and generates personalized "professional competency profiles." Ultimately, AIGC aggregates and integrates the full-path dynamic data from pre-class previews, in-class practices, and post-class diagnostics to generate class-level and individual competency achievement reports, providing students with systematic review guidance and supporting teachers in precisely adjusting the teaching difficulty of subsequent modules (such as Kafka and Spark real-time trajectory computation), thereby forming a closed-loop, iterative teaching improvement mechanism.

5. IMPLEMENTATION EFFECTIVENESS OF THE AIGC-ENABLED TEACHING MODEL

To objectively validate the actual operational effectiveness of the AIGC-enabled teaching model, a quasi-experimental controlled teaching comparative study was conducted by the research team. Students from the big data technology major who were taught using this reformed teaching approach were designated as the reform observation group, while historical students from the same major in parallel classes who did not undergo the teaching reform and were taught using the traditional "theory lectures + mechanical imitation" model served as the control baseline.

5.1 Student Perspective: Significant Improvement in Professional Performance and Certification Pass Rates

Through multi-dimensional teaching platforms such as Xuexitong (Superstar Learning Platform), students' practical data across dimensions such as cluster construction, data collection, and automated deployment were systematically recorded, enabling comprehensive formative and summative evaluation. Supported by AI teaching assistants and intelligent teaching support, students were able to precisely identify learning gaps and reinforce practical weaknesses, rapidly developing standardized and efficient troubleshooting approaches. In the academic year's "1+X" vocational skill level certificate examinations, the pass rate reached 100%, and students' professional course performance showed trending improvement.

5.2 Student Feedback: Notable Enhancement in Inquiry Exploration and Industry Competency Recognition

Through the practical training of ship big data projects, students' ability to transform business logic into mathematical algorithm models was exercised. In the course's comprehensive practical training, students systematically mastered the ship AIS data collection specification, internalized the qualitative benchmarking criteria for vessel abnormal behavior, and developed core big data practical abilities such as "position tracking," anomaly early warning, and density analysis. To understand students' learning experiences and gains empowered by intelligent tools, a questionnaire survey was conducted among 60 reform-class students at the end of the semester, measuring key indicators such as "AIGC accuracy of assistance," "efficiency of troubleshooting," and "acceptance of tools," with statistical results shown in Figure 2.

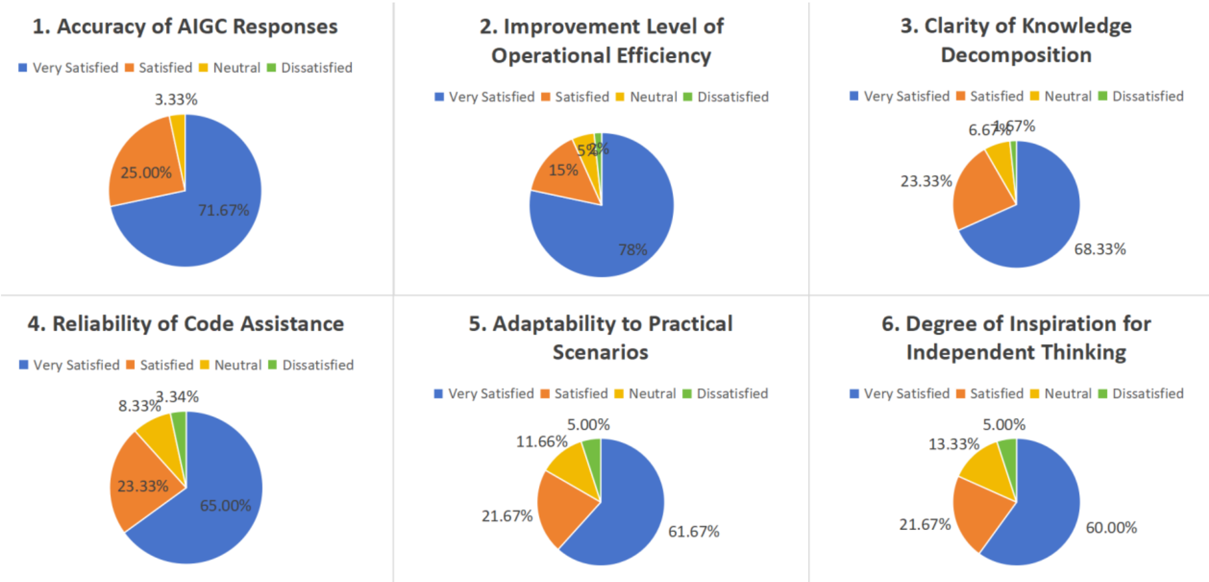

Figure 2: Questionnaire Statistical Results

Driven by the effective empowerment of intelligent tools, students are no longer solely bound by immediate guidance from a single teacher; a new model of self-directed learning supported by intelligent agents has preliminarily taken shape. Empowered by this model, students in this major have won multiple awards in national innovation and entrepreneurship research competitions for vocational college students and have been granted multiple invention patents and software copyrights.

6. CONCLUSION

This paper, grounded in a constructivist learning theory perspective, designed and implemented an AIGC-enabled teaching model and practical proposal for the Big Data Platform Construction and Maintenance course in higher vocational education. AIGC is woven throughout the entire process — from resource generation and personalized diagnosis to situated practice and iterative assessment — effectively resolving the bottleneck problems of traditional teaching such as the disconnection between theory and hands-on practice and the inadequacy of personalized guidance, and significantly enhancing students' big data cluster operation and maintenance capabilities as well as their practical competence development and engineering innovation literacy. Although this model has shown initial effectiveness, challenges have also been identified in practice, such as some students over-relying on AIGC tools for generating configuration commands, or occasional "hallucination" errors in AIGC outputs. Future research will further explore mechanisms such as the "AIGC capability boundary control" and "code originality verification," and will expand replication experiments across more specialized course clusters, aiming to provide more comprehensive empirical references for AI-empowered education reform in higher vocational education.

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REFERENCES

[1] Xiao Q, Li R, Wang X, et al. Research on Teaching Model of Generative Artificial Intelligence Empowering Design Thinking in Master of Landscape Architecture Program [J]. Journal of Intelligence and Knowledge Engineering, 2026, 4(2).
[2] Hu T, Wang Y, Wang J. Research on the Concrete Teaching of Abstract Theories in the "Fundamentals of Mechanical Engineering Control" Course Empowered by Generative Artificial Intelligence [J]. Computer Applications in Engineering Education, 2026, 34(3): e70184-e70184.
[3] Dehui Y. Design Research on Gamified Teaching of Junior High School Information Technology Empowered by Generative Artificial Intelligence [J]. Frontiers in Educational Research, 2026, 9(5).
[4] Fosnot T C. Constructivism: Theory, Perspectives, and Practice [M]. Teachers College Press.
[5] Glasersfeld V E. Cognition, Construction of Knowledge, and Teaching [J]. Synthese,1989,80(1):121-140.
[6] Wang B Y, Gao J F, Li H Z. Exploring the Teaching Path of the Systems Engineering Course Empowered by Generative Artificial Intelligence [J]. Education Reform and Development,2026,8(4):14-23.
[7] Zheng L, Liu Z, Huang Z. Using generative artificial intelligence to empower automatic assessment of lesson plans across different domains [J]. Education and Information Technologies, 2026, (prepublish): 1-47.