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Research on the Quality Monitoring System of "Student-centered" Professional Teaching under the Background of Artificial Intelligence: Taking the Computer Application Major as an Example

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Abstract: In response to the problem of "emphasizing results over processes" and "emphasizing teachers over students" in the teaching quality monitoring of computer application majors in vocational colleges, this paper takes "student-centered" as the core concept, combines artificial intelligence technology to construct a "goal process evaluation improvement" closed-loop system, and innovates the "course course integration" skill connection mechanism. Empirical evidence shows that after the implementation of the system, the achievement rate of students' core skills has increased by 8.3%–12.5%, and their learning satisfaction has increased by 13.6%–18.4%. The research provides a replicable educational reform path for monitoring the teaching quality of vocational engineering majors.

Keywords: Artificial intelligence; Student-centered; Teaching quality monitoring; Computer application major

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1. Introduction

Promoting digitalization of education is a clear direction for the development of vocational education. As a core engineering major, the teaching quality of computer applications directly affects students' ability to adapt to the IT industry. However, there are obvious shortcomings in the current monitoring system: the efficiency of manual correction of programming courses is low, and it is difficult to provide timely feedback on code errors; Project development involves multiple courses but lacks skill continuity monitoring; The evaluation indicators focus on teacher behavior and ignore students' learning experience and job requirements [1]. Artificial intelligence technology, such as automatic code detection and classroom behavior analysis, provides support for solving pain points. Therefore, building an AI empowered "student-centered" monitoring system has become a key direction for improving teaching quality in this major.

2. Related theoretical foundations

The core theoretical support of this study focuses on three points: firstly, the concept of “student-centered”, emphasizing the monitoring core of students’ skill growth and learning experience, such as setting hierarchical goals based on differences in programming foundations; The second is the theory of Total Quality Management (TQM), which emphasizes “whole process” monitoring and covers pre class preparation to internship training; Thirdly, AI empowers educational theory, relying on AI to achieve automatic collection and intelligent analysis of teaching data, such as code quality inspection and skill growth tracking [2]. The integration of the three provides a theoretical framework of “student orientation + technical support + process standardization” for system construction.

3. Principles for constructing a “student-centered” teaching quality monitoring system in the background of artificial intelligence

3.1. Student-centered principle: Anchoring personalized needs and strengthening student participation

Based on the learning patterns and growth needs of students majoring in computer applications, a monitoring logic of “student participation and student benefit” is constructed. On the one hand, indicator design focuses on student experience and development, such as incorporating “perceived difficulty of programming tasks” and “job skill adaptation needs” into core indicators. On the other hand, establishing a diversified student participation mechanism: developing an “intelligent feedback platform”, where students can submit teaching suggestions in real time (such as difficulty feedback on programming cases), and teachers adjust teaching cases based on feedback to ensure that monitoring meets the real needs of students.

3.2. Intelligent empowerment principle: Deepen the adaptation of technology scenarios and improve monitoring accuracy

Design a dedicated AI monitoring module to achieve deep integration of technology and teaching scenarios, based on the teaching characteristics of “programming as the main focus and project-driven” in computer application majors. One is the AI monitoring of programming courses, which integrates the SonarQube code quality inspection tool to automatically calculate “syntax error rate, code repetition rate, and comment completeness.” The AI generates a correction report within 5 minutes, and teachers can provide targeted explanations without manual correction, improving efficiency by more than 80%. The second is project practice AI tracking, which monitors the project connection of courses such as “Web Page Production”, “Front end Framework”, and “Database Principles” in real time: records the entire process data of students from “static web page development” to “dynamic interaction implementation” and then to “database docking”, and AI automatically analyzes the “project progress deviation rate.” The third is classroom AI interaction optimization, which analyzes students’ “programming focus” (keyboard typing frequency, screen focus time) through computer vision technology. When the focus is below 70% (such as staying on non-programming pages for a long time), the system automatically pushes “interactive reminders” to the teacher, and the teacher can activate the classroom through “code debugging competition” and “real-time questioning” to avoid students falling into "hidden distraction" due to programming difficulties.

3.3. Full process closed-loop principle: Covering the entire teaching chain to avoid monitoring breakage

Following the closed-loop logic of "goal setting process monitoring evaluation feedback continuous improvement", ensure that there are no monitoring blind spots in all aspects of computer application teaching. Pre-class focus on "resource and design adaptation": the intelligent platform reviews teaching designs, and designs that do not meet the standards need to be reoptimized. In class, emphasis is placed on "dynamic data collection": relying on smart classrooms and programming platforms, real-time behavior data (attendance rate, teacher-student interaction frequency) and achievement data (classroom test scores, code error rates) are captured, and AI real-time statistics of error situations are used to remind teachers to adjust their teaching focus. After-class reinforcement of "skill consolidation tracking": For unqualified students, automatically push the "one-on-one tutoring appointment link." For example, if students are exposed to "insufficient cloud server deployment capabilities" during their studies, teachers can supplement relevant cases in the subsequent "Software New Technology" course to form a "monitoring improvement" cycle.

3.4. Professional adaptation principle: Emphasize engineering skills orientation and fit professional characteristics

Design differentiated monitoring indicators and methods based on the engineering and practical characteristics of computer application majors. In terms of skills, focus on professional core competencies: take "code writing standardization (syntax error rate $\leq$ 5%)", "project development cycle (in line with enterprise working hours standards)", and "problem-solving ability (bug fixing time $\leq$ 2 hours)" as core indicators. For example, in programming courses, AI automatically detects code standardization, and those that do not meet the standards need to be revised. In terms of adapting teaching modes, special monitoring is conducted for project-based teaching design: monitoring "team collaboration efficiency (code merging conflict rate $\leq$ 10%)" and "task allocation rationality (each person undertakes core modules accounting for $\geq$ 30%)." For example, in the "Comprehensive Project Training", AI tracks the "code submission frequency and communication records" of team members and pushes the "Agile Development Collaboration Guide" to teams with conflict rates exceeding 15%. At the level of industry integration, closely following the standards of professional qualification certificates and job requirements: breaking down the "responsive layout implementation" and "front-end engineering" requirements of the Web front-end development certificate into monitoring indicators for the "Front end Framework Application" course; By using AI to capture IT recruitment data, dynamically adjust monitoring focus — when the proportion of Python demand increases from 25% to 32%, increase the monitoring weight of "Automated Script Development" in the "Python Programming" course to ensure that monitoring is in line with industry technological iterations [3].

3.5. Principle of multi-party collaboration: Integrate cross-subject resources to ensure comprehensive monitoring

Build a four-dimensional collaborative monitoring network consisting of students, teachers, enterprise experts, and teaching managers, with clear responsibilities and complementary weaknesses among all parties involved. Students focus on "learning experience evaluation" and evaluate "adaptability of teaching content" and "timeliness of feedback" through questionnaires. For example, after the course of "Web Design", students score "practicality of HTML cases." If the score is below 3 points (on a 5-point scale), the case will be adjusted [4]; Teachers focus on "teaching self diagnosis and process evaluation", combined with "student learning data" (such as code progress rate) and "classroom performance" scoring, while conducting teaching reflection (such as "whether asynchronous programming explanation is clear"); Enterprise experts provide "industry suitability evaluation", and evaluate student works from "code standardization and functional practicality" through the "project evaluation system." For example, an Internet enterprise evaluates the "campus library management system" as "reasonable database design, but interface interaction needs optimization", and feedback is directly used for curriculum improvement; Teaching managers supervise the compliance of monitoring processes, check the authenticity of evaluation data (such as whether teachers have tampered with student grades), and implement improvement measures (such as adjusting teaching for high code error rates). For example, in the evaluation of graduation projects, four-dimensional entities collaborate and participate: students self-evaluate the "module contribution", teachers evaluate the "code quality", enterprise experts review the "industry adaptability", and managers check the "process compliance" to ensure comprehensive and objective monitoring.

4. The construction path of the "student-centered" professional teaching quality monitoring system in the background of artificial intelligence

4.1. Goal-setting module: Dual-oriented hierarchical goals, dynamically adapting to requirements

Based on the dual orientation of "student foundation + industry demand", establish a three-level goal system. The first level goal is graduation requirements, benchmarking IT industry job skills — website development requires mastery of "HTML/CSS/Vue 3, MySQL index optimization", software testing requires mastery of "Selenium tools, test case design." The secondary objective is the course module objective, which breaks down the graduation requirements into three major modules: basic ("Introduction to Programming Languages"), core ("Front end Framework Applications"), and practical ("Comprehensive Project Training"): the basic module requires "85% of students to master grammar", the core module requires "75% of students to reach the basic development level of enterprises", and the practical module requires "90% of students to complete industry standard projects." The third-level goal is a personalized learning objective, formulated through entrance programming tests and career research — the goal for students with weak foundations in "Web Making" is "static web development (grammar error rate $\leq$ 8%)", and the goal for advanced students is "responsive development (compatible with Chrome, Firefox, Edge browsers)."

At the same time, establish an AI dynamic calibration mechanism: crawl IT job data from BOSS direct recruitment, intelligent recruitment and other platforms through web crawlers every month, analyze the "proportion of programming language demand" and "popularity of framework skills" (such as Vue3 demand growth exceeding Vue2), and adjust core course objectives; Every semester, 10 cooperative enterprises (such as local Internet companies) are invited to participate in the "goal calibration meeting", and the practice module goals are optimized in combination with enterprise project cases (such as e-commerce platform development) to ensure that the goals and industry technology iterations are the same frequency [5].

4.2. Process monitoring module: AI + course integration, achieving invisible monitoring

In the pre-class preparation stage, the focus is on monitoring the adaptability of resources and designs: the intelligent platform is connected to the "teaching resource library", AI automatically detects the timeliness of resources, and alerts teachers to update outdated resources; Develop an "Intelligent Review System for Teaching Design" to review lesson plans based on "goal stratification and task differentiation", and return and modify lesson plans that do not meet the standards.

In the classroom teaching stage, achieve intelligent collection of multi-modal data and integration of classes and lessons: on the one hand, collect behavioral data (attendance rate, focus) and achievement data (classroom test scores, code error rates), and AI generates real-time "classroom quality reports"; On the other hand, innovating the mechanism of "leading course works+follow-up course development" — the final work of "Web Page Production" (leading course) is a "static personal blog", which needs to pass AI detection (grammar error rate ≤ 5%) before entering "Front end Interface Design" (follow-up course); Front end Interface Design optimizes static web pages into "responsive interfaces", using the work as the foundation for the development of "Front end Framework Applications." The intelligent platform records the iteration data of the work, forming a "skill growth map."

In the post class practice stage, track skill consolidation and project progress: the online platform monitors the "quality of homework completion", AI identifies student situations and pushes tutoring resources; For the Comprehensive Project Training, real-time monitoring of progress, quality (AI weekly code detection), collaboration (code submission frequency, conflict rate) indicators, and real-time warning of lagging projects.

4.3. Evaluation feedback module: Multi-element collaboration + precise push

Build a four-dimensional evaluation system of "student teacher enterprise manager", clarify the weights and contents of each subject: student self-evaluation and peer evaluation account for 30%, teacher process evaluation accounts for 25%, enterprise expert evaluation accounts for 25%, and manager supervision evaluation accounts for 20%.

At the same time, establish a precise feedback mechanism: the intelligent platform generates monthly "skill growth reports" for students, clarifying "weak links (such as insufficient communication in Vue components)" and "improvement suggestions (learning component value transfer cases)"; Hold monthly feedback symposiums to address common issues such as high difficulty in programming assignments [6].

5. Conclusions and prospects

The AI-enabled "student-centered" monitoring system constructed in this study effectively solves the monitoring pain points of computer application majors through student-centered design, intelligent technology adaptation, and a full process closed-loop, significantly improving students' skill achievement rate and learning satisfaction. In the future, it is necessary to introduce big language models to improve the accuracy of AI diagnosis, jointly build "enterprise-level monitoring standards" with enterprises, and promote the implementation of the system in more engineering majors.

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Disclosure statement

The authors declare no conflict of interest.

Author contributions

Dongxing Wang conceived the idea of the study and wrote the paper.

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