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Research and Design of Digitally Empowered Teaching Model Transformation

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Abstract: ***Traditional offline teaching models, particularly in courses like Data Structures and Algorithm Design, struggle to meet the demands of modern education due to limited classroom time, lack of personalized instruction, and insufficient real-time feedback. To address these issues, this paper proposes a digitally empowered teaching model that integrates big data, cloud computing, and artificial intelligence. By extending learning beyond the classroom with online platforms like MOOC, PTA, and Rain Classroom, and using a Student Concentration Analysis System, the deep learning model collects and analyzes data on students' learning behaviors. This enables personalized feedback and dynamic adjustments to teaching content, improving both engagement and learning outcomes. Additionally, a Blockchain-based Student Record System ensures secure data management, making the approach more adaptive, data-driven, and student-centered.***

Keywords: Digital teaching model, Online platform, Deep learning model, Student-centered.

1. Introduction

As information technology advances rapidly, the digital transformation of education and teaching has become a critical direction for the development of higher education. Digital empowerment not only signifies the application of technology but also emphasizes the deep transformation of teaching philosophies, models, and evaluation methods. This paper aims to explore the integration of big data, cloud computing, and artificial intelligence to study intelligent, efficient, and all-encompassing teaching application models, methods, and strategies throughout the entire teaching process (pre-class, in-class, and post-class). It seeks to investigate and establish digital transformation strategies for higher education teaching models, providing theoretical and practical foundations for improving teaching quality and student learning outcomes.

Taking the course *Data Structures and Algorithm Design* as an example, this paper analyzes the characteristics and requirements of the course and examines relevant digital resources and platforms, transforming the traditional teaching model through digital means. Based on the utilized digital platforms, big data and artificial intelligence technologies are applied to design a teaching model within a digital context, grounded in constructivist theory. By adhering to the core principle of "student-centered" learning, the approach is designed to gradually shift the focus from teaching to learning in order to better serve educational needs. The traditional classroom structure, which revolves around the teacher, students, textbooks, and media, is redesigned to focus on the teacher, students, teaching information, and the learning environment. This restructuring of the teaching process and feedback mechanisms is expected to improve teaching effectiveness.

2. Requirement of Digital Transform of Teaching Model

In recent years, the digital transformation of education has become a significant focus in higher education, particularly with the rapid advancement of information technology. The integration of big data, cloud computing, and artificial intelligence into teaching practices has been explored extensively, emphasizing a shift in educational paradigms from traditional instructor-centered approaches to more student-centered models. Research has shown that leveraging digital resources and intelligent platforms can enhance engagement, improve learning outcomes, and facilitate personalized education. For example, studies have demonstrated that implementing digital tools in the classroom leads to higher student motivation and better retention of knowledge [1-2] (García et al., 2022; Wang & Wang, 2021).

Specifically, in the context of courses like "Data Structures and Algorithm Design," the need for effective digital resources is paramount. Recent investigations have focused on creating robust digital environments that incorporate constructivist theories to foster deeper understanding among students. By utilizing intelligent data analysis and feedback mechanisms, educators can tailor learning experiences to meet the diverse needs of students, ultimately transitioning the focus from teaching to learning [3-4] (Huang et al., 2023; Li et al., 2021). This shift not only enhances the educational experience but also aligns with the contemporary demands for flexible and efficient learning solutions in higher education [5] (Yang & Li, 2022).

3. Design of Digital Teaching Model Transformation

This paper takes the course *Data Structures and Algorithm Design* as a case study, with undergraduate students as the target audience. The course content involves complex logical reasoning and extensive programming practice, requiring a high level of abstract thinking and hands-on skills from students. The limited classroom time is insufficient to meet the needs of improving students' programming skills. Therefore, it is necessary to reform the traditional teacher-centered, classroom-based teaching model. By leveraging digital teaching platforms, the classroom teaching content is extended to pre-class and post-class activities. Additionally, big data and artificial intelligence technologies are utilized to analyze students' learning progress in real-time. Through the collection and analysis of students' learning behavior data, teachers can continuously optimize the teaching model based on feedback, formulating more targeted and effective teaching strategies, thereby effectively motivating students and significantly improving both teaching effectiveness and students' learning experience.

In *Data Structures and Algorithm Design*, when organizing and implementing smart classroom teaching, digital classroom service platforms are used to integrate online and offline learning environments. In the teaching model design, teachers can use relevant platforms and tools to conduct pre-class learning assessments and push personalized learning resources. During class, based on the progress, discussion topics can be published to the platform's teacher space, and students can provide feedback on their learning questions in their space. Simultaneously, by utilizing program design experiment auxiliary teaching platforms, real-time class tests can be released, with results promptly fed back to students for discussions. The system also makes use of the Student Attention Analysis System to provide real-time dynamic data, which allows for personalized assistance to advance classroom teaching. After class, based on the analysis of teaching data, personalized assignments can be pushed to individual students. This approach collects data on the entire teaching process, including pre-class learning, in-class tests, and post-class assignments, which helps in evaluating the effectiveness of classroom teaching activities. The specific design process is illustrated in Figure 1.

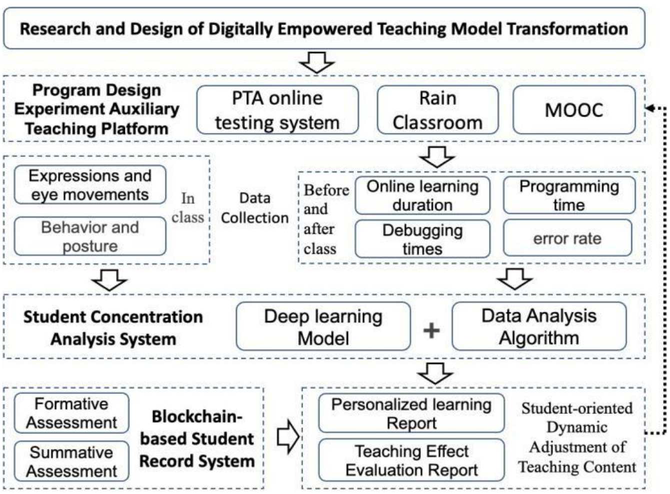

Figure 1: Design scheme of teaching model transformation

In Figure 1, we utilize platforms such as MOOC, PTA, and Rain Classroom as part of the online Program Design Experiment Auxiliary Teaching Platforms. By collecting data on students' performance in pre-class and post-class activities, including online learning duration, programming time, debugging times, and error rates, we can analyze their progress outside the classroom. Concurrently, data on students' in-class performance, such as expressions, eye movements, behavior, and posture, are gathered. All this data is fed into the Student Concentration Analysis System, which comprises two key components: a deep learning model and a data analysis algorithm. These systems process and analyze the collected data to generate personalized learning reports and teaching effect evaluation reports. These reports provide insights into the overall learning situation, such as students' completion of pre-class and post-class assignments, their level of concentration in class, and whether their learning outcomes meet course requirements. Additionally, by integrating the Blockchain-based Student Record System, regular performance, exam results, and learning reports are analyzed together. This allows for dynamic adjustments to the teaching content based on student needs, and for the update of assignments, tests, and their levels of difficulty on the learning platform, forming a closed-loop positive feedback system that enhances the overall teaching effectiveness.

Compared to traditional offline teaching models, this design introduces a hybrid online and offline approach, extending teaching activities beyond the classroom to pre-class and post-class sessions. By employing deep learning models and data analysis algorithms, student learning data is processed and analyzed scientifically, making it easier for teachers to understand learning outcomes and dynamically adjust teaching content. The blockchain-based grade recording system ensures data security.

4. Conclusion

This paper presents an innovative approach to transforming the traditional teaching model of the Data Structures and Algorithm Design course by integrating digital platforms, big data, and artificial intelligence technologies. The proposed teaching model extends the classroom environment to pre-class and post-class activities, thereby fostering continuous learning and engagement. Through real-time analysis of students' learning behaviors and feedback, the model enables teachers to dynamically adjust teaching content and strategies, improving both teaching efficiency and student outcomes. The integration of a student concentration analysis system and a blockchain-based student record system ensures data security and provides personalized learning insights, which enhance student participation and foster a more effective and adaptive learning environment.

By leveraging these advanced technologies, the model shifts from a teacher-centered approach to a more student-centered paradigm, ensuring that students' unique learning needs are addressed in a timely and efficient manner. This transformation offers significant potential for improving the quality of higher education, as it promotes a more interactive, data-driven, and feedback-oriented learning experience. Future work could focus on further refining the system and expanding its application to other courses and disciplines, contributing to the broader digitization of higher education.

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