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The Construction of University Teaching Evaluation System Based on Big Data under the Concept of Blockchain

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Abstract: Enhancing classroom teaching models and evaluation methods, strengthening data mining and analysis, and deepening the integration of information technology and educational innovation have become important goals of China's recent implementation of digital education strategies. This paper proposes the use of blockchain concepts to create a more comprehensive system for data collection, sharing, and analysis, facilitating efficient coordination of data between disciplines, teachers, and courses. By deeply integrating big data technology with university teaching evaluation systems, it assists in reforming teaching evaluation modes and methods in different disciplines, addressing the practical issues of "limited practicability, limited data availability, and system development challenges" in current practices. Furthermore, it aims to promote the practical implementation of educational big data and gradually achieve the goals of building a university teaching evaluation system based on big data.

1. Introduction

1.1. Background

A crucial undertaking for the tremendous revitalization of the Chinese people is the development of a robust education system. In January 2022, the State Council issued the 14th Five-Year Plan for Digital Economic Development, which proposed to promote smart education, build a high-quality education support system, and facilitate the continuous and healthy development of "Internet + education". Furthermore, in February 2022, the Ministry of Education released the 2022 Work Priorities of the Ministry of Education. One of the key focuses for this year is implementing the strategic action of education digitalization, enhancing classroom teaching methods and evaluation approaches, strengthening data mining and analysis, and deepening the integration and innovation of information technology and education.

Hence, the strategic action of education digitalization entails more than simply converting instructional information into online data. It seeks to enhance the collection of teaching process data in a more efficient and secure manner, utilizing blockchain technology. Moreover, it aims to

process instructional information more effectively and with higher quality through data mining techniques. Simultaneously, it strives to improve classroom teaching models while establishing an instructional evaluation system based on big data.

1.2. The Influence of Blockchain Technology on Teaching Big Data

Blockchain is a distributed shared ledger and database, characterized by decentralization, immutability, and collective maintenance. At its core, it represents an idea embodied in technological form[1,2].

Currently, the collection of big data in China remains predominantly centralized, with data primarily obtained by industry giants. Small and medium-sized enterprises, as well as individuals, tend to serve as contributors rather than beneficiaries of big data[3,4]. This is evident even in the realm of intelligent learning platforms. While companies gather teaching data from every educator, the respective disciplines of teachers do not have access to relevant datasets, and educational institutions are unable to access comprehensive teaching big data generated within their fields[5,6]. Although this serves to maintain corporate ownership of big data, it creates a disconnect between the true producers of data (teachers and students) and those who have a demand for it (disciplines and universities). As a result, on one hand, intelligent learning platforms predominantly focus on developing teaching assistance functionalities, overlooking the analysis and utilization of teaching big data. On the other hand, universities have an increasing demand for teaching big data but are often limited to theoretical research and small-scale data experiments, lacking the ability to truly conduct comprehensive big data-based evaluations of teaching quality within their respective disciplines.

The decentralized and collectively maintained nature of blockchain effectively addresses the challenge of acquiring big data[7,8]. Its distributed storage model, combined with targeted sharing of teaching data, enables efficient connections among disciplines, teachers, and courses. This pioneering technological foundation and practical model provide a novel approach for universities to improve their teaching evaluation systems based on big data.

2. Research Progress and Dilemma of Big Data in Education

2.1. Research Progress of Big Data in Education

Educational big data analysis is currently one of the focal points in academia, attracting increasing attention from education practitioners who recognize its value in driving reforms and advancements in higher education[9,10]. The integration of big data enhances the functionality of educational evaluation, expanding and deepening the essence of teaching and learning. Consequently, it gradually emerges as a crucial technological force that propels the development of higher education.

First and foremost, big data entails comprehensive collection of educational data, providing an authentic reflection of students' states and issues during the learning process, which in turn supports more precise and viable teaching methods[11]. Secondly, the use of big data in educational evaluation breaks away from the traditional reliance on students' exam scores, integrating fragmented assessments into a systematic framework that supports diverse evaluation approaches involving multiple stakeholders. This ensures the comprehensiveness and sustainability of evaluations while enriching the functionality of educational assessments[12]. Lastly, educational big data furnishes schools, disciplines, and teachers with reliable information and empirical evidence for accurate teaching evaluations, thereby enhancing the scientific nature of evaluations[13].

2.2. The Dilemma of Big Data in University Teaching Evaluation

The focus on collecting diverse educational data and the emphasis on in-depth data analysis in educational big data has significant implications for improving teaching quality and promoting comprehensive development in professional education. However, to date, the integration of big data into higher education teaching evaluations remains an underexplored topic, largely due to the challenges faced by big data technologies in this context. Based on recent literature, these challenges mainly include:

(1) Limited practicality of research: Failing to effectively harness the value of educational big data

Research in this field often remains at the conceptual and ideological level, lacking sufficient focus on the application of educational big data and addressing practical issues in teaching evaluations. Due to limited research time, most findings are not based on extensive knowledge or data accumulation. Many papers tend to prioritize "theoretical speculations" rather than "practical implementations". Furthermore, studies that are based on real-world data primarily analyze individual courses, lacking a comprehensive evaluation of teaching from a disciplinary perspective.

(2) Limited data availability: Data producers cannot access a sufficient amount of data.

In terms of data volume, the data generated by each teacher during the teaching process may not meet the threshold for "big data". Only when data is aggregated at the level of courses or disciplines can true big data analysis be conducted. Currently, most researchers mainly rely on widely-used intelligent learning platforms in the software market to collect educational data. However, due to the independence and confidentiality of commercial software databases, as well as considerations related to data commercialization, teachers can only access the data they generate themselves, and a single discipline cannot retrieve specific information about each course it oversees. This runs counter to the "decentralized nature" of blockchain thinking, resulting in software collecting a considerable volume of data while users have access to only a limited amount.

(3) Difficulty in system development: Insufficient exploration of the value hidden within educational data.

The analysis of educational big data often involves multiple disciplines, including educational sciences, which focus on educational theories and subject-specific knowledge, as well as computer sciences, which primarily deal with big data and system development technologies. Currently, there is a significant shortage of talent in higher education institutions who possess the capabilities in big data analysis and system development. Most teachers find it challenging to "decode" and "effectively utilize" the collected data, hindering the realization of innovative teaching concepts due to their lack of development skills. Consequently, the application of big data technologies in higher education teaching is greatly limited, resulting in an inadequate exploration of the value embedded within educational data.

3. Framework and Content of University Teaching Evaluation System Based on Big Data

(1) Establishing a university teaching evaluation system based on big data.

Taking into account the variances among disciplines and course types, emphasizing the assessment of classroom teaching processes, and incorporating the theories of big data analysis, a hierarchical framework for evaluating teaching effectiveness in universities can be established. This framework, known as the three-tiered structure for teaching evaluation indicators at the discipline-teacher-course levels, aims to define indicators for the teaching process, quantify teaching process data, standardize data collection procedures, and institutionalize data management models. By implementing such a system, it becomes possible to achieve a multi-tier evaluation of teaching effectiveness within the academic setting, leveraging the power of big data analysis.

(2) Establishing a teaching big data system based on blockchain concept.

Aligned with the principles of blockchain technology, a data collection and sharing system for educational purposes can be developed. This system aims to address the specific goals of different disciplines, discuss the selection of evaluation indicators, and establish quantifiable standards. Additionally, it incorporates robust data management capabilities, leveraging the potential of big data analysis. By integrating various statistical methods, a hierarchical big data analysis system can be constructed, enabling in-depth analysis of educational data at the discipline, teacher, and course levels.

(3) Research on university teaching evaluation based on big data in education.

The system can be applied to courses across multiple disciplines, providing assistance to teachers in conducting classroom instruction and evaluating the quality of their teaching. Moreover, it can aid disciplines in making informed teaching evaluations and decisions by incorporating insights from data mining results. By utilizing feedback information and accounting for the unique characteristics of different disciplines, continuous improvements can be made to algorithms and the expansion of the data mining model library, ultimately enhancing the quality of service provided by the system.

4. The Construction of University Teaching Evaluation System Based on Big Data

4.1. The Design of Teaching Evaluation Indicator System

(1) Determining evaluation content and constructing a three-tiered structure for teaching evaluation indicators at the discipline-teacher-course levels.

In the three-tiered structure of teaching evaluation indicators at the discipline-teacher-course levels (Figure 1), the course-level indicators focus on evaluating the teaching of individual courses and provide teachers with evaluation content in terms of teaching effectiveness and student learning. The discipline-level indicators evaluate all courses within the discipline, providing the program director with evaluation content in four areas: teacher performance, student outcomes, course quality, and annual evaluation indices.

(2) Determining and quantifying the teaching process data to achieve multi-channel teaching evaluation.

Based on the evaluation content and indicators at different levels, specific quantitative process data can be determined. The teaching process of teachers is quantified by collecting data from three aspects: knowledge, behavior, and experiences. “Knowledge data” represents the level of students’ mastery of knowledge, “behavior data” reflects the extent of students’ engagement in learning behaviors, and “experience data” captures students’ participation in the teacher-student interaction process. At the discipline level, data on teaching processes for all courses within the discipline can be obtained, including the collection and quantification of “student evaluations” and “peer evaluations”.

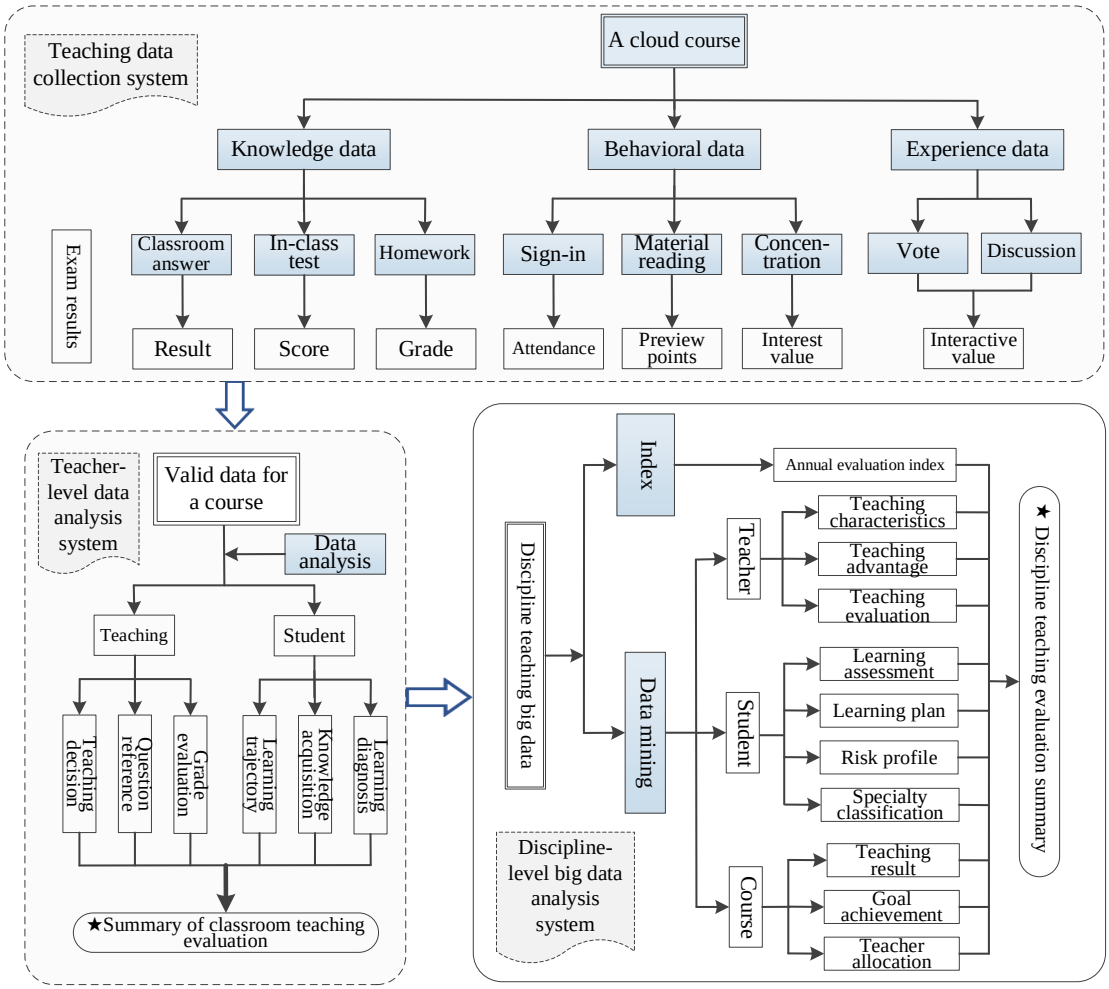

Figure 1: Design ideas and technical routes

4.2. System Design

The big data teaching evaluation system is developed on the WeChat platform, collecting data on a course-by-course basis and combining and analyzing data at different levels such as course, teacher, and discipline. It serves as a supporting system for higher education teaching evaluation. It consists of three main parts (Figure 1):

(1) Teaching data collection system: This system allows teachers to easily manage the cloud course and silently collects process data in a passive manner while assisting users in their daily teaching activities.

(2) Teacher-level data analysis system: Each teacher has a unique account that includes all the data from the cloud courses they teach and provides various analysis tools for teaching evaluation.

(3) Discipline-level big data analysis system: Program directors can access all the classroom data within their discipline and perform analysis on the big data collected.

4.3. Research on Teaching Evaluation Based on Big Data Analysis System

(1) Based on the natural science disciplines of the university, an evaluation system for teaching in these disciplines is established, and the system is applied to relevant courses. The system aims to improve the usage level of teachers and students through data supervision, communication after class, and meeting summaries. It evaluates the course teaching based on the system and supports the

evaluation and annual work summary of the relevant disciplines by utilizing the teaching summary, big data mining results, and annual evaluation indexes derived from the courses.

(2) In accordance with the characteristics of engineering and liberal arts disciplines, the university further enhances its big data-based teaching evaluation system. The system expands the library of big data mining models, improves the system, and applies it to related disciplines. The applicability of the big data teaching evaluation system and the system's suitability for different disciplines are explored. Comparative analysis is conducted to examine the differences and connections between big data-based teaching evaluation in higher education and traditional teaching evaluation.

5. Conclusions

This paper is founded upon the principles of blockchain technology. By examining the advancements and challenges in the field of educational big data research, it seeks to seamlessly integrate big data technology with university teaching evaluation systems. Through this integration, a university teaching evaluation system based on big data was constructed, aiming to facilitate the reform of teaching evaluation models and methods across various disciplines. The innovative modes primarily encompass the following:

(1) Innovation in the university teaching evaluation system based on big data: With a solid foundation in big data, this system standardizes the evaluation content while giving significant importance to the classroom teaching process. It establishes a three-tier teaching evaluation system that encompasses disciplines, teachers, and courses. Leveraging the advantages of big data analysis in teaching evaluation, it provides a systematic guarantee for a comprehensive, scientific, and systematic assessment of university teaching quality.

(2) Innovative practice in the collection and sharing of educational big data based on the blockchain concept: Recognizing blockchain technology as a "crucial breakthrough in national core technological innovation", this approach breaks free from the long-standing monopolization of data by traditional commercial institutions. It facilitates the sharing and efficient connection of information among disciplines, teachers, and courses, holding substantial value for the healthy development of educational big data.

(3) Innovative practices in constructing a big data teaching evaluation system: "Theoretical innovation stems from practical innovation". The innovative achievements attained through this research system and mode necessitate a complete application system for practical implementation and verification. By constructing a teaching evaluation system, it enables the comprehensive and full-process collection of educational data, and establishes a repository of big data mining models and analysis functions. Its profound application in teaching evaluation across different disciplines promotes continuous improvement in the "practical contributions of applied research and technological innovation in addressing key technical challenges in practical production".

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