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Selection and Construction of Evaluation Indicators and System for Geography Graduate Courses Based on Teaching Big Data

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Abstract: Educational big data analysis is one of the current focal points in academia. The involvement of big data has enriched the functions of educational evaluation, expanding and deepening the connotations and functionalities of education and teaching itself. This development directly supports scientific decision-making in education, gradually becoming an important technological force driving the advancement of higher education. As a crucial component of higher education, the quality of course instruction at the graduate level directly affects the overall quality and standards of graduate education. This study focuses on the evaluation of graduate classroom teaching based on educational big data, examining the current issues in graduate course evaluation systems. By concentrating on geography graduate courses, it builds a comprehensive framework for data collection, quantification, and analysis, addressing specific teaching challenges. The research explores the selection of evaluation indicators and the establishment of a systematic framework, developing a big data-mining model based on various statistical methods. Using "Frontiers in Geographic Information Systems" as a case study, the research demonstrates favorable outcomes.

Keywords: Big Data for Teaching and Learning, Geography, Postgraduate Student, Evaluation Indicators, Rating System

1. Introduction

Educational big data analysis is currently a hot topic in academia, with more educators focusing on its application value in educational reform and development[1-2]. The involvement of big data enriches the functions of educational evaluation, expanding and deepening the connotations and functionalities of teaching, while directly serving scientific decision-making in education. This gradual integration has become a crucial technological force driving the advancement of higher education. Educational big data refers to the various structured and unstructured data collected through diverse channels in the education sector, such as student and teacher information management systems[3], online learning platforms[4], and course management systems[5]. This data encompasses students' learning conditions, teachers' instructional information, and online behavior records, containing rich information and value that serve as important bases for more scientific and accurate educational decisions and reforms[6].

The era of big data presents new challenges for universities regarding the reform and development of graduate courses. Firstly, for students, the quantifiable dimensions of learning have reached unprecedented levels, making a student-centered teaching system essential. Students are no longer passive recipients; they must become well-rounded talents skilled in data analysis. They are gradually establishing personalized adaptive learning systems based on big data, primarily through educational environments such as cloud education platforms, smart education platforms, and social media[7-8]. These systems facilitate direct and indirect interactions among learners, teachers, and educational resources, generating various data. Moreover, techniques like data statistics and learning analytics push information about similar interests to learners, enabling them to control and self-regulate their learning while receiving targeted, personalized guidance from teachers. This allows for a more

individualized learning path tailored to each student's characteristics and needs. Secondly, for educators, the drive of educational big data requires them to adopt a data-centric mindset, consciously applying data literacy to their teaching practices and student development. Teachers must effectively utilize the rich educational data and resources available to them. In this big data era, it's crucial for educators to comprehensively and rationally understand the role of big data in transforming teaching and learning, thereby enhancing their data literacy[9-10]. Additionally, educational big data facilitates refined educational management. It enables continuous innovation in management and service models, improving the level and quality of university administration. Traditional management methods tend to rely on conventional experiences and are often imprecise. With the widespread use of the internet, university administrators can scientifically collect, integrate, and analyze various data related to teacher and student information and resource utilization, establishing a more scientific and comprehensive management system[11-12]. Big data platforms, leveraging advanced data collection and text analysis capabilities, can help institutions acquire diverse educational data, monitor public sentiment in real-time, and integrate analytical results into daily management and services, thereby becoming vital tools for information management and offering unprecedented opportunities for innovation in educational evaluation.

2. Problems of the Index System for Evaluating the Teaching Quality of Graduate Courses

2.1 Problems of Big Data Application in Teaching Evaluation in Colleges and Universities

(1) The research is poorly targeted, not very practical, and rarely applied to graduate program evaluation.

Research generally remains at the conceptual and ideological level of educational big data, lacking sufficient focus on its practical applications and solutions for teaching evaluation issues. Moreover, big data-based teaching evaluations often concentrate on undergraduate education, with minimal application in graduate courses.

(2) Inadequate Educational Data Collection and Low Levels of Datafication.

Currently, most researchers rely on commonly used smart learning platforms from the software market (such as "LanmoYun-class," "Chaoxing-Learning," and "WeizhuJiao" etc.) for collecting and processing educational data. However, these platforms generally emphasize the development and application of teaching modules (such as online learning and course live streaming) while neglecting the data collection and processing functions. The main reasons for this are:

① Novel functional modules can more effectively attract users, especially students, thereby increasing the market share of the software;

② Different disciplines have significantly varied data requirements, making it difficult for smart learning platforms to accommodate all, which greatly increases the cost and time required for software development;

③ Many teaching processes are difficult to quantify, resulting in limited quantities and types of data that can be effectively collected;

④ During major public health emergencies from 2020 to 2023, companies generally focused on supplementing and upgrading online teaching-related modules, paying insufficient attention to big data functions for teaching evaluation.

As a result, the complexity and diversity of educational data structures, the differing data requirements across disciplines, the considerations of commercial software, and the demands of special periods have all posed significant challenges for big data collection and analysis in education.

(3) Lack of Educational Data Modeling and Analysis, Low Big Data Utilization Efficiency

Currently, the smart learning platforms used by researchers generally lack sufficient data and analytical models. The variety and quantity of samples are often inadequate to ensure the reliability of the results, and research involving the construction of mathematical models and data mining based on real-world data is relatively rare. Furthermore, due to the independence and confidentiality of commercial software databases, users can only access data generated from their usage, while a program leader cannot view detailed information for every course within their

domain. As a result, although a certain amount of data is collected, the data available for users to analyze is highly limited, leading to very low efficiency in the utilization of big data.

2.2 Problems in the Evaluation System of Teaching Quality for Geography Graduate Students

Through an investigation into the teaching quality evaluation of geography graduate students at our university, the following issues in the evaluation system were identified:

(1) Low Differentiation in Student Scores, Affecting Evaluation Effectiveness

The overall student ratings are generally high, and the evaluations across different courses are highly homogeneous. This type of evaluation standard cannot effectively distinguish between different levels of teaching performance and is insufficient as a reference for school performance reviews or end-of-year evaluations. Furthermore, because most scores are uniformly high, the evaluation results fail to effectively differentiate between students' learning conditions and teachers' teaching quality.

(2) Incomplete Quantitative Standards, Difficult to Assess Geography Teaching Quality

The quantitative indicators for geography courses are very simplistic, typically only measuring student performance based on attendance and final assessments. In the context of modern educational big data, fixed standards should be used to evaluate teaching quality. However, teachers are not utilizing digital tools to collect and analyze data throughout the teaching process. This lack of a comprehensive system also makes it difficult for teachers to use fixed standards to quantify teaching quality.

(3) Non-Transparent Evaluation Methods, Students Lack Full Understanding

Regarding the use of teaching evaluations, many students are not fully aware of the methods used by teachers and the university to assess educational effectiveness. Students merely participate in the process but are often unaware of the purpose or outcomes of these evaluations. Additionally, this lack of transparency may result in a lack of motivation for teachers to evaluate their peers.

(4) Teachers Do Not Take Evaluations Seriously, Leading to Inaccurate Results

For graduate courses, some teachers only complete the evaluations to meet requirements without paying attention to their significance. A deeper analysis reveals that many teachers fail to recognize the importance of evaluations, resulting in missed opportunities to harness their positive impact, which in turn causes evaluation results to be skewed or inaccurate.

3. Construction of a Graduate Course Evaluation System Based on Teaching Big Data

3.1 Research Objectives

This study focuses on the evaluation of classroom teaching for geography graduate students, addressing specific issues related to course instruction. The goal is to develop a systematic framework for big data collection, quantification, and analysis, and to establish an evaluation index system for graduate courses. By constructing a big data mining model based on various statistical methods, the study aims to deeply integrate information technology with graduate course teaching. Through the application of new technological forms, data structures, organizational methods, and relational models, the framework will effectively analyze graduate students' research capabilities, ultimately reshaping the traditional classroom teaching model for geography graduate courses.

3.2 Overall Framework and Content

(1) Construction of a Mobile Teaching Big Data Index System

Based on the training objectives for geography graduate students, this study explores the selection of teaching evaluation indicators and quantification standards. A systematic set of functions is established to collect and quantify data on teaching and student learning from three dimensions: knowledge, behavior, and experience. This system enhances big data management functionalities. Knowledge Data: Reflects students' mastery of knowledge. By combining information such as response time and accuracy, it provides a comprehensive analysis of the learning level, question quality, and instructional effectiveness. Behavior Data: Indicates students' engagement in learning activities. It primarily records behavior such as using mobile phones in class when not allowed, response time when required, and other

engagement metrics. Experience Data: Represents the level of student participation during teacher-student interactions.

(2) Establishing Data Analysis and Visualization Capabilities; Building a Classroom Data Analysis System for Teachers

For each course, the system processes data by performing data cleaning, which includes steps such as removing irrelevant data, correcting errors, filtering, integrating, and transforming data to generate valid results. Statistical methods like correlation analysis, factor analysis, and regression analysis are used to create a multi-dimensional data analysis mechanism. Combined with basic course information, such as teaching objectives and grade weights, the system establishes evaluation index weights. The results of the data analysis are displayed through charts and color-coded visualizations, enabling teachers to analyze course data from both teaching and learning perspectives.

In Teaching: Teachers can analyze error rates for each problem to improve question quality. They can assess daily performance using detailed learning process data and identify weak points in instruction. Additionally, by reviewing individual students' learning data, teachers can offer targeted guidance on research practices and study planning. In Learning: The learning data obtained for graduate students is notably different from that of undergraduates. At the undergraduate level, the focus is primarily on knowledge mastery and learning trajectories. For graduate students, however, teachers are more concerned with their research and knowledge application capabilities. Thus, the system prioritizes research ability, learning efficiency, and knowledge composition in its data analysis.

(3) Graduate Course Education Evaluation Based on Big Data

This system is applied to all graduate courses in geography, assisting teachers in classroom instruction and evaluating teaching quality. Using the results from big data mining, it supports decision-making in graduate education across related disciplines. Furthermore, based on feedback and the specific characteristics of different disciplines, algorithms are refined, and the data mining model library is expanded to continually improve the quality of system services.

4. Application Research of the Graduate Course Evaluation System Based on Teaching Big Data

This study applies the constructed evaluation system to the "Frontiers of Geographic Information Systems" course for geography graduate students.

Before Class: Before the class, the teacher gathers data, including prerequisite course grades (such as Cartography and Physical Geography), student learning data (e.g., average GPA, historical attendance records), and course-related data (such as difficulties identified from previous cohorts and current students' preparation levels). By analyzing this data, a learning profile is created, helping the teacher determine specific teaching methods and content for the lesson.

During Class: Throughout the lesson, the teacher collects real-time classroom data for timely evaluations and process data collection. The data is then analyzed, and the results are shared with students for discussion. This dynamic approach allows for adjustments in teaching pace and methods, making the instruction more responsive to students' needs.

Post-Class: After the lesson, exercises are assigned, knowledge points are reinforced, and grades are assessed. The data from the class is analyzed both at the class level and for individual students. This analysis is then carried over to inform the preparation and student analysis for the next lesson (Figure 1).

Outside of Class: Teachers can use statistical methods to analyze the collected data, evaluate the learning processes of individual students, and implement classroom teaching reforms. This continuous feedback loop, based on subsequent data collection and evaluation, ensures that educational big data is effectively utilized, moving from theory to practice. Ultimately, this process drives the datafication and proceduralization of the evaluation for geography graduate course teaching.

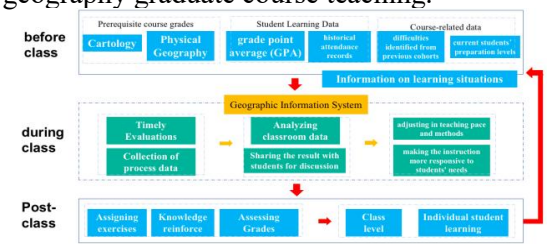

Figure 1. Teaching Evaluation Process Diagram for the Course "Frontiers of Geographic Information Systems"

5. Conclusion

This paper explores the current issues in the evaluation system for graduate course teaching and constructs a more comprehensive big data collection and analysis system for graduate courses. Focusing on geography graduate courses, it deeply integrates information technology with course instruction, establishing a systematic framework for data collection, quantification, and analysis. The study discusses the selection of evaluation indicators and the establishment of the system, constructing a big data mining model based on various statistical methods. By leveraging new forms of technology, data, organization, and relationships, it aims to reshape traditional graduate classroom teaching. This approach facilitates a more process-oriented assessment of courses, increases the volume of process data, refines teaching evaluations, and supports data-driven decision-making in education. Ultimately, it aids various disciplines in implementing teaching evaluation models and reforming teaching methods, continuously promoting the application of educational big data analysis from theory to practice, and gradually realizing the informatization of higher education in China.

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References

[1] Zhao X, Lao L. Research on the construction of personalized learning system supported by big data in education. Applied Mathematics and Nonlinear Sciences, 2024, 9 (1):

[2] Arissa S S, Noraffandy Y, Hassan A. Education big data and learning analytics: a bibliometric analysis. Humanities and Social Sciences Communications, 2023, 10 (1):

[3] Rao W. Design and implementation of college students' physical education teaching information management system by data mining technology. Heliyon, 2024, 10 (16): e36393-e36393.

[4] Libo X, Wenbo Y. Design and Implementation of Artificial Intelligence Online Learning Platform Based on Resource Scheduling Technology. Journal of Cases on Information Technology (JCIT), 2024, 26 (1): 1-22.

[5] Zibo Z. Design and Research of Virtual Reality Course Management System Based on Artificial Intelligence. Journal of Physics: Conference Series, 2021, 2066 (1).

[6] Gupta A, Saxena A, Kishore B. College English Teaching Reform Program under the Multimodal Environment in the Era of Big Data Education. Indian Journal of Public Health Research & Development, 2017, 3 (8):

[7] Hu W. Evaluation of Course Teaching Reform Effects Based on Smart Education Cloud Platform: Take Marketing as an Example. Journal of Higher Education Teaching, 2024, 1 (2):

[8] Luo S, Alia B N. Research on the innovation of ideological and political education for college students based on the Civic and Political Science Cloud Education Platform. Applied Mathematics and Nonlinear Sciences, 2024, 9 (1):

[9] Xiaoying L. Teacher Education and Management: Innovative Application of Ecological Management System of Big Data Management System. Journal of Sensors, 2022, 2022

[10] Xiaochuan J. Prospective Study on Professional Competence Development Planning of Higher Education Teachers in the Context of Big Data. Mobile Information Systems, 2022, 2022

[11] Yanli J. The Dilemmas and Practical Exploration of Undergraduate Education Management in Universities in the Era of

Big Data. Education Reform and Development, 2024, 6 (8): 253-259.
[12]Lu M. Research on the application of university education management driven by big data. Region - Educational Research and Reviews, 2023, 5 (4):