Construction and practice of teaching quality evaluation system for education management major based on education big data

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Abstract: Based on educational big data technology, this article builds a teaching quality evaluation system applicable to the education management profession, covering three dimensions: the teaching process, the teaching effect and the development of students. By integrating multi-source data such as academic systems and online learning platforms, a multi-level indicator system was constructed and analyzed using methods such as AHP and fuzzy synthesis. Practical applications show that the system has significant advantages in terms of accuracy, real-time and feedback value, which can help teaching improvement and scientific decision-making. In the future, we should further promote the integration of intelligent models and data platforms and expand the scope of applications.

Keywords: Education big data; Teaching quality evaluation; Education management; Data-driven; system construction

Introduction

As the reform of higher education is further advanced, the quality of teaching in the education management profession is directly related to the level of training of educational management talents. However, the current teaching quality evaluation method is still relatively single, relying mainly on student evaluation and classroom observation, and is highly subjective and insufficiently supported by data, making it difficult to fully reflect the actual teaching. At the same time, various types of teaching data are scattered across different platforms, lacking integration and in-depth analysis, and the feedback mechanism lags behind, affecting the timeliness and precision of teaching improvement. In this context, the development of big data in education provides a new opportunity to build a scientific and efficient teaching quality evaluation system. Through dynamic analysis of data from the entire process, such as teaching behavior and student performance, the scientific nature of evaluation and the pertinence of feedback can be improved, providing strong support for teachers to optimize teaching and managers to make scientific decisions.

1 Literature review and theoretical basis

1.1 Current status of research on teaching quality evaluation

As an important part of educational management, the evaluation of teaching quality

has long received widespread attention from the educational academic community at home and abroad. Foreign research has earlier focused on the multiple dimensions of teaching evaluation, emphasizing comprehensive analysis from multiple aspects such as teaching content, methods, organizational forms, teacher-student interaction, and learning results [1]. Developed countries such as the United States and the United Kingdom have established relatively complete higher education quality assurance systems in the mid-to-late 20th century, including mechanisms such as peer review, student evaluation, teaching observation, and evaluation of learning outcomes. In China, the development of the teaching quality evaluation system started relatively late, but with the large-scale development of higher education and the gradual deepening of relevant research, especially driven by policies such as “quality engineering ”“double first-class” construction, many universities have explored and formed distinctive teaching evaluation systems. Commonly used methods include questionnaires, teaching supervision, classroom observation, and graduate follow-up surveys, but most of these methods have problems such as strong subjectivity, long evaluation cycles, and low utilization of results. In addition, the current teaching quality evaluation in most colleges and universities focuses on result-oriented, ignores the closed loop of process evaluation and data feedback, and makes it difficult to accurately reflect the entire teaching picture. This is especially true in education management majors, which are both theoretical and practical. Not enough. Therefore, existing evaluation methods urgently need to integrate new technological means to achieve intelligent and digital transformation [2].

1.2 Research on the application of big data in education in teaching evaluation

With the rapid development of information technology, educational big data has gradually penetrated into all aspects of educational evaluation. Big data technology can realize real-time, comprehensive and multi-dimensional data collection in the teaching process, providing a solid data foundation for teaching quality analysis [3]. Foreign countries such as Knewton and EDX platforms in the United States have applied learning analysis technology to achieve learning behavior tracking and personalized feedback, effectively improving the accuracy of teaching decisions. Domestic systems such as “Smart Teaching Quality Monitoring Platform” are also being piloted in some universities, realizing process recording, abnormal early warning and accurate diagnosis of teaching activities, and promoting the transformation from experience-led to data-driven. Related research shows that teaching evaluation based on big data can not only improve evaluation efficiency, but also enhance the timeliness and pertinence of feedback. For example, there are scholars who mine data on students' online learning behavior and construct models of students' learning input for teaching improvement; there are also studies that use teaching data to analyze teachers' teaching rhythm, frequency of questions, and degree of interaction, thereby optimizing classroom management. Overall, research on educational big data in the field of teaching quality evaluation has shown a trend of shifting from theoretical exploration to practical

implementation, but it still faces challenges such as data fragmentation, high technical thresholds, and insufficient privacy protection, especially in the field of education management. Systematic and theoretical research is still weak and has a lot of room for expansion.

1.3 Theoretical support system

The scientific nature of the teaching quality evaluation system depends on solid theoretical support. First, the Learning Analytics theory provides a data-driven learning behavior insight framework that emphasizes predicting learning effectiveness and teaching risks through multi-source data analysis, providing a technical path for system design. Secondly, Bloom's taxonomy of educational goals, as a classic teaching evaluation theory, provides a cognitive, emotional and skill reference for constructing evaluation dimensions, and helps to evaluate the systematic and comprehensive content [4]. In addition, Kirkpatrick's four-level assessment model (response layer, learning layer, behavior layer, and outcome layer) is often used in the evaluation of the effects of educational interventions, providing a theoretical basis for results-oriented feedback on teaching quality. At the level of system design, the CIPP evaluation model (Context-Input-Process-Output) also provides structured support for the evaluation of the various stages of teaching and learning activities. Integrating these theories with educational big data technology can provide a solid theoretical foundation and methodological guarantee for the setting of teaching quality evaluation indicators, data collection and analysis, and interpretation of evaluation results. In summary, building a teaching quality evaluation system for the education management profession not only requires technical support, but also deeply integrates multiple education theories to achieve the scientific, systematic and sustainable development of the evaluation system [5].

2 Construction of a teaching quality evaluation system

2.1 Construction principles and basic ideas

In order to build an evaluation system for the quality of teaching in the education management profession, it is necessary to take scientific, systematic and operational principles as the basic principles to ensure that evaluation results are objective, impartial and enforceable. Scientificity requires the system to have a strict logical structure and theoretical support, which can accurately reflect the entire process of teaching activities; operability emphasizes the implementation ability of the system in a real teaching environment, covering the accessibility of data sources and the applicability of technical tools. and the convenience of the evaluation process; development reflects the system's ability to dynamically adjust and update, and can accompany teaching content Changes in technical tools, student characteristics, etc. are continuously optimized. In terms of "construction ideas", the evaluation system should adopt a top-level design framework that is “goal-oriented— data-driven —dynamic feedback”. First, start from the goal of cultivating professional talents and clarify the core connotation of teaching quality evaluation; secondly, build a full-process and full-dimensional data collection mechanism based on educational big data; finally, achieve accurate evaluation and result feedback through algorithm models to promote teaching quality

Continuous improvement.

2.2 Design of evaluation indicator system

The connotation of teaching quality is multi-dimensional, and an indicator system needs to be constructed from three perspectives: process, results and student development. The first-level indicators include the quality of the teaching process, the quality of teaching effects, and the quality of student development. Each first-level indicator has multiple second-level and third-level indicators, covering teachers' teaching preparation, classroom interaction, curriculum content updates, student learning participation, and knowledge mastery, thinking ability cultivation and many other aspects.

Table 1 System structure table for evaluation indicators of teaching quality in education management

First-level indicators	Secondary indicators	Example of a tertiary indicator
Quality of teaching and learning process	Teaching organization and design	Clarity of course structure and cutting-edge teaching content
Teaching implementation and interaction	Frequency of teacher-student interaction, and participation of students in questions	
Quality of teaching effect	Learningoutcomes performance	Distribution of test scores, completion rate of assignments
Teaching goal achievement	Teaching evaluation matching, self-evaluation and other evaluation consistency	
Quality of student development	Competence-building	Problem-solving skills, critical thinking performance
Learning satisfaction and perception of growth	Subjective satisfaction of students, perception of learning gains	

This indicator system achieves a hierarchical refinement from shallow to deep, which not only ensures the comprehensiveness of the content, but also provides a clear path for subsequent data collection and analysis.

2.3 Education big data collection and processing mechanism

In the evaluation system, data collection and processing is the core link. Teaching evaluation based on big data needs to open up a variety of information sources, including online learning platforms (such as MOOCs, LMS), academic systems (course scores, course selection data), classroom interaction platforms (teacher-student interaction records), and teaching evaluation systems (Student evaluation, peer evaluation), learning behavior monitoring tools (such as eye tracking, click behavior logs), etc. Multi-source data tends to have redundancy, missing or structural differences in its original state, so its quality needs to be improved through pre-processing processes such as data cleaning, standardized conversion, and feature extraction. Subsequently, the integration and visual management of the data is realized by combining the database and the analysis platform.

Table 2 Sources and collection content of educational big data related to teaching quality evaluation

Data sources	Acquisitable data content	Example of use of data
Online learning platform	Study duration, click records, quiz results	Analysis of student participation and knowledge acquisition
Academic Affairs System	Transcripts, attendance records, course schedules	Assist in assessing learning effects and quality of teaching organisation
Teaching evaluation system	Student satisfaction ratings, text feedback	Get teaching satisfaction with teaching advice
Interactive systems (such as Rain Classroom)	Number of questions, number of answers, frequency of likes	Reflecting the degree of classroom interaction and active thinking
Cyberbehavioral analysis systems	Login frequency, web browsing path, file download	Analysis of learning paths and utilization of learning resources

Through the deep integration of these data, it is possible to provide quantitative support for each indicator and enhance the computability and traceability of the evaluation system.

2.4 Evaluation models and analytical methods

After data collection, it is necessary to use scientific analysis methods to transform complex data into meaningful teaching evaluation results. In the selection of models, the allocation of weights to indicators, the accuracy of interpretation of evaluation results and the efficiency of system operation should be considered in a comprehensive manner. The analytic hierarchy process (AHP) can be used to empower multi-level indicators and ensure the scientific nature of system weight setting; the fuzzy comprehensive evaluation method is suitable for processing the evaluation of teaching behaviors containing fuzzy attributes and is suitable for use in combination with qualitative and quantitative data; cluster analysis can identify different teaching models or student group characteristics; the decision tree algorithm is suitable for constructing student performance prediction models Assisted early warning teaching problems.

Table 3 Comparison of commonly used data analysis methods in teaching quality evaluation

Analytical methods	Applicable scenarios	Advantage	Limitations
AHP analytic hierarchy process	Weight allocation of indicators	Rigorous theory and clear hierarchy	Strong subjectivity, relying on expert judgment
Fuzzy comprehensive evaluation	Evaluation of indicators with strong ambiguity	Adaptability, integration qualitative and quantitative	Complicated calculations, not very explanatory
Decision-tree algorithm	Behavior prediction, classification of outcomes	The results are clearly visualized, dealing with non-linear relationships	It is easy to "overfit" and the model complexity needs to be controlled
Cluster analysis	Teaching patterns and group identification	Identifiable potential structures, auxiliary strategy optimization	No causal explanation is provided, subject to other analyses

In summary, building a teaching quality evaluation system based on educational big data requires complete indicator design logic, multi-dimensional data collection and accurate analysis methods. Through reasonable design and systematic implementation, it can effectively solve the one-sidedness and lag of the traditional evaluation system. and inefficiency issues, providing data support and decision-making basis for improving the teaching quality of education management majors.

3 Practical application and effect analysis

3.1 Practical background and implementation process

In order to verify the feasibility and effectiveness of the teaching quality evaluation system based on educational big data, this study selected the core course "Education Management" of the education management major of a certain “double first-class” university education college as an application scenario to carry out a one-semester period of practice. explore. The course is offered to third-year undergraduate students, and its teaching content is highly theoretical, closely related to practice, and is typical and representative. In the "practical session", the research team relied on the school's existing smart teaching platform and data governance system to integrate academic system data (scores, course selection, attendance), online teaching platform data

(assignment completion, test scores, interactive records) and student evaluation Teaching and classroom observation data to build a teaching quality data warehouse. At the same time, intelligent classroom tools such as RainClassroom and Superstar Learning Pass are used to assist in the collection of classroom interaction data and learning behavior trajectories. The teacher team participates in the indicator design and data interpretation throughout the process, and conducts joint teaching reflection and improvement discussions at the end of the semester, effectively ensuring the integrity and controllability of system implementation.

3.2 Presentation of results of evaluation of teaching quality

In the teaching process, the system automatically collects and analyzes all types of data in real time based on the set indicator system, and generates a charted and structured teaching quality analysis report. Through data fusion analysis of multiple dimensions such as the frequency of classroom interaction, students' online activity, timeliness of assignment submission, distribution of test scores, and students' subjective evaluation, an overall evaluation portrait of course quality can be formed.

Table 4 Table of results of the analysis of the teaching quality of the course "Education Management"

Evaluation dimension	Specific indicators	Average score (out of 5)	Data sources
Quality of teaching and learning process	Teacher classroom organization, frequency of interaction	4.63	Interactive Platform for Classrooms
Quality of teaching effect	Distribution of unit test scores and total course scores	4.21	Academic Affairs System, Quiz Module
Quality of student development	Learning satisfaction, learning gain self-assessment	4.55	Final questionnaire, interview data
Teaching content appropriateness	Knowledge difficulty matching, case practicality	4.37	Teaching observation and feedback system
Teaching resource support	Courseware richness, data availability	4.48	Log of teaching platform usage

As can be seen from Table 4, the course performed well in all the core teaching quality dimensions, with the highest scores for “quality of teaching process” and “quality of student development”, reflecting the teachers' adequate investment in teaching interaction and curriculum design, and the students' overall satisfaction with the content and gains of the course. At the level of teaching effect, the distribution of test scores is relatively balanced, but there is still room for further improvement in the mastery of some knowledge points, reminding teachers that they can strengthen targeted explanations of difficult content in future teaching.

3.3 Feedback mechanism and suggestions for improvement

The results generated by the evaluation system are not only fed back to the teaching teachers and the teaching management department in the form of reports, but also show students the comparison between individual learning performance and the group through a visual platform to achieve a closed loop of the entire chain of teaching quality evaluation. Teachers can accurately identify weak points in students' grasp, adjust teaching progress, and optimize teaching design based on the results of systematic analysis. For example, for students with low interactive participation, the platform can push targeted learning suggestions and task

reminders; for content modules with poor mastery, teachers can arrange after-school Q&A or strengthen case teaching. At the teaching and research level, this evaluation system also provides data support for teaching dialogue between teachers and helps carry out evidence-based teaching improvements. In addition, the results of the course evaluation also serve as an important reference for the selection of funding projects for teaching training, merit evaluation and teaching reform organized by the Teaching Development Center, truly realizing data-driven precise management and continuous improvement, and promoting the overall improvement of the teaching quality of the education management major.

4 System advantages and existing problems

4.1 System advantage analysis

The teaching quality evaluation system built based on educational big data has shown more significant advantages than traditional evaluation methods in the actual application process. First, in terms of accuracy, the system relies on the fusion analysis of multi-source heterogeneous data to make comprehensive judgments from multiple dimensions such as students' learning behavior, recording of teaching processes, and evaluation of teaching outcomes, effectively reducing the bias caused by a single subjective evaluation and improving the objectivity and credibility of the evaluation results. Secondly, in terms of timeliness, the system, through real-time data collection and automated analysis mechanisms, can dynamically monitor the teaching situation during the teaching process, achieve rapid positioning and early warning of teaching problems, and provide immediate support for teaching adjustment and curriculum optimization. Again, the system breaks through the limitations of previous evaluation objects and evaluation content in terms of coverage, and achieves comprehensive coverage from teacher teaching to student learning, from in-class activities to extracurricular expansion. Teachers' lesson preparation quality, teaching interaction and use of course resources were all included in the scope of monitoring, and students' learning engagement, quality of homework completion and knowledge mastery trajectories were also systematically and exhaustively recorded, effectively depicting the entire teaching process. In addition, the systematization and personalization of feedback mechanisms is a highlight of the system. The system can generate customized feedback reports for different users, teachers can adjust teaching strategies accordingly, students can identify their own learning shortcomings, and managers can carry out macro-control accordingly, realizing the transformation of teaching quality evaluation from “final evaluation” to “formative diagnosis”. Overall, the system achieves full-process management of teaching quality “visible, evaluable, controllable and modifiable” based on data support, fully reflecting the core value of data-driven education reform.

4.2 Challenges in implementation

Although the teaching quality evaluation system based on educational big data has many advantages, it still faces a series of practical challenges in the actual advancement process, which urgently need to be solved through multi-party coordination and continuous optimization. First, there is the issue of the

complexity of building a technology platform. To achieve effective docking and cross-platform integration of multi-source data, we need to rely on a stable, open, and highly compatible technical architecture. At present, the information systems of most universities still have problems such as data fragmentation, inconsistent standards, and incompatible interfaces, which limits data circulation. and breadth and depth of sharing. Secondly, the issue of data privacy protection must not be ignored. In the context of big data, teaching evaluation involves a large amount of teachers and students' personal information, behavioral records and performance. If a complete privacy protection mechanism is not established, it is easy to cause ethical risks and legal disputes. It is necessary to "clarify data usage boundaries and authorization mechanisms at the institutional level, and introduce data desensitization, encrypted storage, access control and other means at the technical level to ensure data security and compliance". In addition, differences in data literacy between teachers and students have become a major obstacle in the operation of the evaluation system. Some teachers are not familiar with data analysis tools and find it difficult to effectively use feedback results to guide teaching improvement; some students lack data awareness and do not respond adequately to the learning portraits and suggestions provided by the system, which affects the autonomous adjustment of their learning behavior. Therefore, it is necessary to improve teachers' data application capabilities through continuous training mechanisms, and strengthen learning guidance and platform usage habits for students, so as to create a good data culture atmosphere. In order to address the above challenges, it is recommended that colleges and universities gradually promote the standardization of technology platforms, formulate systematic data governance and ethical norms, and at the same time build a three-in-one promotion mechanism of “technical support— institutional guarantee —ability training” to ensure the stable implementation of the teaching quality evaluation system and continuous operation to truly realize the scientific supervision and healthy development of teaching quality in education management majors.

5 Conclusion

Focusing on the real needs of improving the teaching quality of education management majors, this study constructed a teaching quality evaluation system based on educational big data, and conducted systematic demonstration and empirical analysis from evaluation index design, data collection and processing, model construction to practical application. The results of the study show that the system is significantly better than traditional evaluation methods in terms of accuracy, coverage, feedback efficiency, etc. It can provide scientific basis for teachers' teaching improvement, student learning support, and teaching management decisions, and has strong practical guidance value and potential for promotion and application. Through its practical application in educational management courses in colleges and universities, the effectiveness of this system in multi-dimensional dynamic monitoring and precise diagnosis was verified, and the goal of continuous improvement of data-driven teaching quality was initially achieved. Looking to the future, the teaching evaluation model based on educational big data

is not only applicable to educational management disciplines, but also has the feasibility and adaptability to promote it to other disciplines. In order to further enhance the intelligence and versatility of the system, follow-up research should focus on the embedded application of intelligent algorithms in the evaluation process, promote the evolution of teaching quality evaluation from quantitative analysis to deep learning, and at the same time strengthen cross-platform data integration and governance Mechanism construction to build a more open, interconnected and sustainable education quality assessment ecosystem.

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