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Problems and Countermeasures in the Quality Monitoring of Online Teaching in Colleges and Universities

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Abstract: The rapid development of online education has posed brand-new challenges to the teaching quality monitoring system in colleges and universities. This paper systematically explores the three major characteristics of online teaching quality monitoring in colleges and universities: the complexity of monitoring brought by the separation of time and space, the enhanced accuracy based on technology dependence, and the monitoring dimensions expanded by the diversification of interaction. The research reveals the key existing problems at present, including the analytical predicament caused by data fragmentation, the stability crisis triggered by technical failures, and the validity limitations due to the insufficient adaptability of teachers and students. In response to these challenges, this paper proposes systematic solutions such as building a unified data platform, strengthening the technical support system, and conducting targeted training. Through multi-dimensional analysis, this study provides a theoretical framework and practical path for constructing a quality monitoring system that ADAPTS to the characteristics of online education, and has important reference value for improving the quality of online teaching in colleges and universities.

Keywords: Online education; Quality monitoring; Data integration; Technical support; Teacher training

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1. Introduction

Under the wave of digital transformation, online teaching in colleges and universities has evolved from an emergency measure to a regular mode. This transformation has posed unprecedented challenges to the traditional quality monitoring system. The unique spatio-temporal separation characteristics of online teaching have broken the physical boundaries of traditional classrooms. The intervention of technological media has restructured the interaction mode between teachers and students. The diversified teaching forms have put forward new requirements for monitoring indicators. Current research mostly focuses on the technical implementation or instructional design of online teaching, while systematic discussions on the key link of quality monitoring are relatively insufficient. Based on educational ecology and the technology acceptance model, this paper adopts the method combining literature analysis and case study to deeply analyze the internal mechanism and practical

predicaments of online teaching quality monitoring in colleges and universities. The research aims to answer three core questions: What are the typical characteristics of online teaching quality monitoring that distinguish it from traditional classrooms? What structural challenges does the current monitoring system face? How to build a quality assurance mechanism that suits the characteristics of online education? Through the discussion of these issues, theoretical support in terms of quality assurance is provided for the sustainable development of online education in colleges and universities.

2. The characteristics of online teaching quality monitoring in colleges and universities

2.1. The complexity of monitoring brought about by spatio-temporal separation

One of the most notable features of online teaching lies in its breaking through the temporal and spatial limitations of traditional classrooms. Teachers and students no longer coexist in the same physical space, and teaching activities are instead carried out asynchronously, relying on digital platforms. This characteristic of spatio-temporal separation, on the one hand, endows teaching with great flexibility, enabling learners to arrange the learning process according to their rhythms. On the other hand, it has made quality monitoring face unprecedentedly complex challenges [1]. In traditional classrooms, teachers can adjust teaching strategies by directly observing students' immediate feedback, such as classroom reactions, interaction frequency and concentration. However, in the online environment, the intuitiveness of such real-time monitoring is greatly weakened, and instead, there is a reliance on digital traces - such as indirect indicators like login duration, video viewing progress, and the number of forum posts. However, these data often only reflect the superficial behaviors of students and are difficult to deeply capture their true learning states and cognitive inputs, thus leading to the questioning of the accuracy of monitoring. Asynchronous teaching may also lead to delays in the interaction between teachers and students, prolonging the feedback and resolution cycle of problems and further exacerbating the lag in quality monitoring. Therefore, to construct a dynamic monitoring mechanism that ADAPTS to the characteristics of spatio-temporal separation, it is necessary to take into account both the comprehensiveness of data and the depth of analysis. It should not only cover multi-dimensional learning behaviors but also dig out potential teaching problems through data representations, so as to reconstruct a quality assurance system similar to that of offline classrooms in the virtual environment.

2.2. Technological dependence enhances the accuracy of monitoring

The construction and operation of the online teaching quality monitoring system are highly dependent on the support of digital technology. This technological dependence shows a dual effect in improving the accuracy of monitoring: it not only optimizes the objectivity of assessment through automated data collection and analysis, but also may cause new monitoring blind spots due to the limitations of technical tools. Modern learning management systems (LMS) can capture and quantify multi-dimensional teaching data in real time, including but not limited to students' login frequency, video viewing duration, test completion degree, and depth of participation in discussion forums. These refined behavioral trajectories provide a detailed basis for teaching quality analysis that is difficult to reach in traditional classrooms [2]. The intervention of artificial intelligence technology has further enhanced the intelligence level of monitoring. For instance, it can identify students' classroom concentration through sentiment computing or analyze the academic value of forum discussions by using natural language processing technology, thus going beyond the surface quantitative indicators and reaching a deeper level of learning effectiveness assessment. However, while technological tools enhance

accuracy, they are also limited by the explanatory power of the algorithms themselves - excessive reliance on data may lead to the systematic neglect of those key elements that are difficult to quantify in the teaching process, such as the cultivation of innovative thinking and the shaping of values. In addition, the differences in data standards among different technical platforms, interface compatibility issues, and the potential bias risks of algorithms may all undermine the reliability and fairness of the monitoring results.

2.3. The diversification of interaction methods affects the monitoring dimensions

The interaction mode of the online teaching environment has broken through the single question-and-answer mode between teachers and students in the traditional classroom, presenting complex characteristics of multiple levels and channels. This fundamental transformation of the interaction paradigm has put forward brand-new dimensional requirements for the quality monitoring system. From synchronous interactive live-streaming classes and real-time bullet comments, to asynchronous communication discussion forums and homework feedback, and then to human-computer interaction intelligent Q&A and virtual experiments, the diversified interaction channels, while expanding the possibilities of teaching, also require the corresponding expansion of the evaluation standards for teaching quality [3]. Specifically, the monitoring system not only needs to focus on the traditional content delivery efficiency indicators, but also needs to establish a specific evaluation framework for different interaction scenarios: For real-time video interaction, it is necessary to examine the multimedia presentation ability and immediate feedback quality of teachers; For asynchronous text discussions, emphasis should be placed on analyzing the cognitive depth and academic value of the teacher-student dialogue. In the context of human-computer interaction, it is necessary to evaluate the adaptability of intelligent systems and the effectiveness of learning support. This multi-dimensional monitoring requirement has led to severe challenges for traditional linear evaluation models, and there is an urgent need to construct a composite analysis system that can integrate structured data (such as interaction frequency, response duration) and unstructured data (such as language quality, sentiment tendency). It is worth noting that the diversification of interaction methods has also led to a shift in the focus of monitoring - from merely paying attention to the quality of teachers' "teaching" to simultaneously emphasizing the participation and constructiveness of students' "learning." The complexity of this two-way monitoring requires evaluators to possess both professional expertise in educational measurement and the operational skills of educational technology tools.

3. Problems existing in the online teaching quality monitoring of colleges and universities

3.1. Monitoring data is fragmented, making it difficult to form a systematic analysis

The core predicament currently faced by online teaching quality monitoring in colleges and universities lies in that massive teaching data are discretized and distributed, and there is a lack of an effective integration mechanism among various information islands, making it difficult to grasp the overall picture of teaching quality at the macro level. The specific manifestations are as follows: On the one hand, different teaching platforms (such as MOOCs systems, live streaming software, course management systems, etc.) adopt heterogeneous data standards and storage formats, resulting in learning behavior data, interactive communication data, and assessment and evaluation data being fragmented in mutually independent systems; On the other hand, even within the same platform, there is a lack of effective correlation analysis paths between structured data (such as attendance records, test scores) and unstructured data (such as video emojis, text discussions) [4,5]. The direct consequence of this phenomenon of data fragmentation is that quality control often falls into the predicament

of "seeing the trees but not the forest" although managers can obtain partial data from various dimensions, it is difficult for them to restore the true picture of teaching through this fragmented information. What is even more worthy of vigilance is that the data barriers between different platforms can also lead to the double calculation or omission of key teaching indicators. For instance, students' online participation may be separately tallied by multiple systems without the possibility of deduplication and integration, and cross-platform learning path analysis is even more difficult to achieve. The lack of this systematic analytical ability not only casts doubt on the objectivity of teaching quality evaluation but also seriously restricts the scientific nature of data-based teaching improvement decisions. To break through this predicament, it is not only necessary to have a data governance plan at the technical level, but also to establish a unified data standard and cross-departmental collaboration mechanism at the institutional level. Only by unblocking the key nodes of data circulation can the potential value of educational big data be truly released, providing strong support for the improvement of teaching quality.

3.2. Frequent technical malfunctions interfere with the stability of monitoring

The stable operation of the online teaching quality monitoring system is increasingly threatened by continuous technical failures. This technical vulnerability not only directly interrupts the teaching process, but also shakes the data foundation of quality monitoring at a deeper level. From the perspective of infrastructure, hardware issues such as server downtime and insufficient network bandwidth have led to approximately 12.7% of online courses being unable to implement complete monitoring as planned. In the software dimension, technical flaws such as platform compatibility conflicts, functional anomalies caused by system version iterations, and the failure of third-party plugins have led to more covert but far-reaching monitoring data distortion phenomena [6,7]. It is particularly worth noting that the interference of technical failures on the stability of monitoring shows a significant asymmetric feature: On the one hand, real-time monitoring indicators (such as classroom attendance rate, frequency of interaction between teachers and students) are particularly sensitive to technical interruptions, and a brief platform lag can cause the loss of key data; On the other hand, anomalies in process evaluation data (such as learning behavior trajectories and assignment submission timestamps) are often latent, and by the time problems are discovered, the best remedial opportunity has already been missed. What is more complicated is that there is a cascading effect of monitoring failures caused by different technical faults in the infrastructure layer may cause a chain crash of multiple monitoring modules in the application layer, and an anomaly of a single function may distort the overall teaching quality evaluation results. The domino effect of this technological risk has forced universities to invest a large amount of resources in system maintenance and troubleshooting, instead of squeezing out the valuable resources that should have been used for improving teaching quality. Facing this predicament, the linear thinking of simply increasing technological investment is insufficient. It is necessary to reconstruct the monitoring system from the perspective of system resilience and establish a full-chain guarantee mechanism, including fault early warning, rapid response, and data compensation, to maintain the reliable operation of the monitoring system in an environment of technological uncertainty.

3.3. Insufficient adaptability between teachers and students restricts the effectiveness of monitoring

The actual effectiveness of the online teaching quality monitoring system is fundamentally constrained by the insufficient adaptability of the subjects. This adaptation gap is not only reflected in the unfamiliarity at the

technical operation level, but more profoundly reflects the lag in the cognitive transformation of the digital teaching paradigm between the teaching and learning sides [8,9]. Specifically, the widespread "technological anxiety" among teachers often leads them to simply transplant online teaching into a digital copy of traditional classrooms, failing to fully explore the teaching value of innovative functions such as interactive tools and learning analysis systems, resulting in monitoring data only being able to capture surface teaching activities. The student side, on the other hand, shows a significant "digital native paradox" although the younger generation is proficient in daily digital technologies, they exhibit unexpected adaptive obstacles in academic online learning environments, including but not limited to: Insufficient utilization of the functions of the Complex Learning Management System (LMS), decreased attention duration in multitasking situations, and reduced willingness to cooperate with non-contact learning evaluations, etc. This dual adaptability dilemma leads to a systematic deviation between the behavioral data collected by the monitoring system and the real teaching quality: Teachers avoid innovative teaching practices due to technological fear, resulting in the monitoring data presenting a false "low activity level". Students adopt superficial learning strategies due to cognitive overload, resulting in the distortion of learning effectiveness indicators. What is more alarming is that this lack of adaptability often forms a complex interaction effect with individual characteristics; older teachers may affect teaching innovation due to their low acceptance of technology, while lower-grade students may have poor online learning effects due to their weak self-regulation ability. If these differences are not effectively identified and corrected by the monitoring system, it will lead to structural biases in the quality evaluation results. To break through this predicament, it is not only necessary to enhance the superficial efforts of technical training, but also to reconstruct the cognitive framework of online education among teachers and students through innovative teaching design, so that quality monitoring can truly become an effective tool for promoting mutual growth in teaching and learning rather than a formal burden.

4. Countermeasures for online teaching quality monitoring in colleges and universities

4.1. Build a unified data integration platform to enhance monitoring efficiency

The fundamental solution to the current predicament of fragmented data in online teaching quality monitoring lies in building a cross-platform data integration system with intelligent analysis capabilities. The innovation of this technical architecture not only requires solving the technical problems of data intercommunication but also reconstructing the underlying logic of data governance in higher education [10]. From the perspective of technical implementation, a microservice architecture should be adopted to design and develop the school-level teaching data middle platform. Through standardized API interfaces, the data barriers among heterogeneous systems such as the MOOCs platform, live teaching system, and course management software should be broken down. The ETL (Extract-Transform-Load) technology is applied to clean, transform and standardize multi-source heterogeneous data, and finally, a full-dimensional data warehouse including student behavior data, teaching interaction data, and academic evaluation data is formed. At the data analysis level, it is necessary to introduce educational data Mining (EDM) and Learning Analytics (LA) technologies to develop an intelligent analysis module with multimodal data fusion capabilities. This module can not only conduct statistical analysis on structured data (such as attendance records and test scores), but also use natural language processing technologies to parse unstructured data (such as discussion forum texts and video emojis). Establish the correlation model among different data dimensions through machine learning algorithms. More crucially, the construction of this platform must follow the design philosophy of "teaching-oriented" and avoid falling into

the trap of technology-centrism - the visual presentation of the data cockpit should focus on the key indicators of teaching improvement, and the intelligent early warning system needs to set reasonable threshold parameters based on educational theories. The data analysis report should be transformed into teaching improvement suggestions that teachers can understand and implement. Only by organically integrating advanced data technology with profound educational insights can a qualitative change from data accumulation to intelligent decision-making be truly achieved, providing solid data support and decision-making basis for improving the quality of online teaching. The successful implementation of this systematic project not only requires the participation of educational technology experts but also demands that teaching administrators, front-line teachers, and data analysts form an interdisciplinary collaborative team to jointly promote the paradigm transformation of educational data from fragmentation to integration, from description to prediction, and from monitoring to improvement.

4.2. Strengthen technical support to ensure the stability of monitoring

The stability construction of the online teaching quality monitoring system requires the establishment of a multi-level and three-dimensional technical guarantee system. This system should not only focus on the emergency handling of immediate faults, but also establish a long-term mechanism for preventive maintenance. At the infrastructure level, colleges and universities should adopt the cloud computing architecture to achieve the elastic expansion of the monitoring system, and dynamically allocate computing resources through load balancing technology to ensure the system's stability in the context of high concurrent access. Deploy the distributed storage solution simultaneously and adopt the multi-node redundant backup strategy to fundamentally eliminate the risk of data loss. In the software system dimension, it is necessary to establish a full life cycle quality management process, including code review, stress testing, and gray-scale release. Special attention should be paid to the robust design of API interfaces and exception handling mechanisms to avoid chain reactions caused by the interruption of third-party services. What is more crucial is to build an intelligent operation and maintenance monitoring center. By deploying a comprehensive APM (Application Performance Management) system, real-time monitoring of key indicators such as server status, network quality, and database performance can be achieved.

Moreover, machine learning algorithms are used to establish a prediction model for system health, transforming passive repair into proactive prevention. For inevitable technical failures, a hierarchical response plan should be designed: for general failures, second-level recovery should be achieved through automated scripts; For severe system disruptions, the disaster recovery system is activated to ensure the continuity of the monitoring service. It is worth noting that the construction of the technical support system must be dynamically adapted to the teaching cycle at the beginning of the semester, the stability of the user authentication system should be emphasized; during the mid-term examination period, the reliability of the data collection module should be strengthened; and at the end of the term, the accuracy of the evaluation and analysis function should be ensured. This "teaching-oriented" technical support strategy, combined with regular stress tests and emergency drills, can build a monitoring system that is both resilient and flexible, providing a solid technical foundation for the evaluation of online teaching quality. Ultimately, achieve a qualitative leap from "fault response" to "risk prevention," and from "system availability" to "reliable service," making technical support truly become an enabler rather than a constraint for improving the quality of online teaching.

4.3. Conduct targeted training to enhance the quality of participation from both teachers and students

The special training program for enhancing the digital literacy of teachers and students must break through the superficial guidance of traditional technical operations and instead build a multi-dimensional development system integrating cognitive reshaping, skill cultivation and cultural immersion. This training framework should be differentiated based on precise demand analysis: For the group of teachers, the focus should be on cultivating their "data literacy" and "online teaching design ability," so that they can not only operate various teaching platforms proficiently, but also understand the educational implications of monitoring indicators, thereby actively adjusting teaching strategies. For the student group, it is necessary to strengthen the "digital citizen awareness" and "metacognitive ability of online learning," and help them establish a self-regulation mechanism that ADAPTS to the virtual learning environment. In terms of the implementation path, a blended training model of "workshop + practice community + personalized tutoring" should be adopted. Through case teaching, the characteristics of monitoring data in excellent online teaching practices should be demonstrated. With the help of situational simulation, the ability of teachers and students to deal with typical technical problems should be trained. Learning analysis reports should be utilized to help individuals identify their behavioral patterns. It is particularly necessary to emphasize that the training content must be dynamically connected with the specific monitoring system of the institution when new quality indicators are introduced; their educational value needs to be explained simultaneously. When the platform functions are updated, the key points of operation should be demonstrated in a timely manner. This "monitor-oriented" training strategy can effectively alleviate the technical anxiety of teachers and students and prompt them to shift from passive adaptation to active participation. A deeper transformation lies in fostering a "data-inspired teaching culture," enabling both teachers and students to gradually understand that quality monitoring is not an external supervision mechanism but a professional tool that promotes mutual growth in teaching and learning. By establishing a training effect tracking mechanism, indicators such as the proficiency of teachers and students in using the platform and the adoption rate of teaching innovation are incorporated into the monitoring system itself, forming a virtuous cycle of "training - practice - monitoring – improvement," and ultimately achieving an all-round improvement from technical ability to participation quality, providing the most fundamental subject guarantee for the monitoring of online teaching quality.

5. Conclusion

This study reveals the complexity and particularity of the online teaching quality monitoring system and points out its essential differences from traditional classroom monitoring. The separation of time and space, technological dependence, and diverse interactions have not only changed the technical path of monitoring, but also profoundly influenced the value orientation of monitoring. In the face of practical challenges such as data fragmentation, technical risks, and adaptation obstacles, systematic response strategies need to be adopted: achieving scientific monitoring through data governance, ensuring the stability of monitoring with the aid of technological reinforcement, and enhancing the participation in monitoring by relying on the improvement of literacy. The development of online teaching quality monitoring in the future should go beyond simple technical optimization and shift to an ecological monitoring model centered on learners. While ensuring the standardization of teaching, it is even more necessary to promote teaching innovation and personalized development. The framework proposed in this study provides a new idea for the quality guarantee of online education in colleges and universities. However, how to balance the relationship between monitoring efficiency

and teaching freedom, as well as quantitative indicators and qualitative evaluation, still needs to be further explored and improved in practice.

Disclosure statement

The authors declare no conflict of interest.

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