Research Article

Classroom Teaching Performance Evaluation Model Guided by Big Data and Mobile Computing

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Performance management has evolved rapidly in recent years and has become increasingly dominant in enterprise applications, whereas its application in the field of education has progressed slowly. Because performance management focuses on improving business performance and empowering employees, implementing it in schools helps students develop practical skills. This research focuses on evaluating classroom teaching performance using a big data and mobile computing-driven model. In addition, in the era of educational big data, this paper investigates the general process by which teachers acquire, analyze, and use educational data to improve teaching performance. The data mining method and mobile data capture are organically integrated into the benchmarking analysis to evaluate the classroom teaching performance of local universities, enriching the teaching management theories and methods of local universities. The findings show that benchmarking analysis can produce more meaningful results and provide new data for improving teaching management quality.

1. Introduction

With the help of next-generation information technology, scholars have introduced traditional modern information technologies such as artificial intelligence and big data into the classroom, and based on this, they have built an intelligent educational environment, which enables teachers to realize intelligent, personalized and efficient educational activities [1]. Educational skills are the research and moral practice of promoting learning and improving results by creating, using, and managing appropriate technical processes and resources. The definition includes the word “performance,” and the teaching performance has also attracted much attention [2, 3]. In the face of various educational media with different functions and increasing use in education, many problems have arisen. Teaching is the central task of the university, and classroom performance evaluation is an important part of the university education quality management system, an important means to judge the school teaching quality and the cornerstone to promote the improvement of the university teaching quality management level [4].

From the perspective of the information technology era and the rapid development of information technology in universities, efforts must be made to find suitable methods and approaches to solve the problems of information technology [5]. The rapid development of data mining technology, big data, data visualization, and other technologies provides technical support for teachers to use educational data more conveniently, which not only ensures the quantification of educational data but also enriches the diversity [6, 7]. In fact, the performance evaluation of college classroom teaching is a complex systematic project, and the evaluator has to evaluate several performance objectives, but these performance objectives are often limited and conflict with each other. Appraisers can easily rank DMUs (decision unit sets), but doing so may cause them to ignore the real performance goals of the organization [8]. Your own key performance indicators to establish key performance standards and optimization and improvement strategies for sustainable development are analyzed, compared, and judged. Comprehensive evaluation of teachers’ teaching performance, research performance, community service
performance, and teachers’ professional development can effectively guide and motivate teachers’ effectiveness, promote the improvement of teachers’ comprehensive quality and professional skills, and develop the skills of schools and teachers [9].

Classroom performance evaluation is one of the most important components of a comprehensive assessment of university education quality, and it has piqued the interest of universities and teachers alike. With the deepening of China’s university education reform, improving education and education quality, as well as cultivating outstanding talents, has become a common concern among educational circles. Establishing a scientific, reasonable, and practicable classroom performance evaluation system is critical for increasing students’ interest in learning, improving teachers’ teaching abilities and allowing schools to efficiently carry out teaching tasks [10, 11]. This paper examines how teachers use data to improve their teaching skills, and it examines the data sources, analysis techniques, and how teachers use them in a systematic manner. We build a big data-based teaching performance model, organically integrate data mining methods into benchmarking analysis, and enrich local university teaching management theories and methods.

2. Related Work

The definition of performance is constantly changing with the development of society. Reference [12] points out that job performance refers to the performance specified in the job description. Literature [13] suggests that management performance can be divided into three dimensions: job performance, personal trait performance, and interpersonal performance. Literature [14, 15] hold that good relationship performance does not necessarily improve the job performance of employees, but it is believed that it will definitely contribute to other people’s organizational activities and organizational effectiveness, so be careful in management. Reference [16] points out that it is an urgent task to scientifically measure and evaluate learners and reveal which learning behaviors contribute to learning achievement and development based on data of various learning activities. Literature [17] analyzes the components of learning behavior evaluation and learning induction and uses this analysis to create a better online platform and teaching environment, so that more learners can have a better and more efficient learning experience. Reference [18] uses multidimensional data outlier mining method to analyze students’ disciplines, classroom, and extracurricular activities, then analyzes abnormal factors by attribute reduction method, and finally predicts students’ academic performance. Literature [19] holds that the advantages of educational media are of great help to our education. The rise of media and its application in education have not only contributed to the emergence of education but also exerted various influences on all educational reforms.

Foreign scholars have been deeply studying big data learning and analysis technology for a long time and have obtained rich research results through a number of empirical studies. Reference [20] puts forward an application model of learning analysis, which includes four steps: data collection, data analysis, data prediction, and personalized adjustment. Using complete online biological process tracking data, Reference [21] conducts an empirical study on learning analysis. To predict students’ learning state and determine the important factors that affect students’ success, Reference [22] employs semantic decomposition, global prediction modeling, learning analysis technology, and data visualization technology. Teachers can assess academic risks based on the output. Result visualization provides appropriate intervention services to reduce student dropout rates and improve course learning success rates. Literature [23] uses empirical research to present behavioral characteristics of teachers who have a positive teaching effect and uses them as indicators for teachers to evaluate teachers. According to literature [24], students’ evaluation results for different teachers are identical. Reference [25] introduces the external benchmarking analysis method into the field of university education, making university benchmarking analysis more scientific and systematic, changing the situation where previous university benchmarking analysis research lags behind enterprises, and promoting the continued development of American university education. Literature encourages exchanges and learning among universities and organizes discussions among major universities by circularly setting themes. This government-led method is called recessive benchmarking analysis.

3. Research Method

3.1. Information Classroom Teaching Performance Evaluation System. Teachers’ achievements in the entire educational process should be evaluated as part of a comprehensive evaluation of their educational performance. The use of performance evaluation in the information age can begin with classroom instruction. This is because, in the entire educational process, classroom teaching is the most basic implementation of teachers’ achievements. Classroom education is a time-limited, systematic, and institutionalized education. This is not only a teaching activity between teachers and students involving modern educational media but also a teaching activity involving information technology.

Everything is for teaching well, teacher-centered, students primarily learn to accept and imitate, and there is a lack of autonomy in the traditional teacher-centered education system, which is not conducive to cultivating students’ innovative ability. Students are encouraged to study independently, and students are taught to learn through cooperation and practical application, allowing them to truly "learn to learn, survive, cooperate, and develop." It not only fully encapsulates the concept of modern education, but it also better meets the needs of modern education’s development. The use of media is more important than the choice of media when it comes to achieving a teaching effect. There are numerous issues with understanding and implementing classroom teaching media, and the results are not satisfactory. Educational media serves as both a carrier of educational content and a tool for transmitting educational information in classroom teaching activities. It effectively
communicates the two aspects of teaching and learning and has a significant impact on classroom teaching effectiveness. As a result, the goal of optimizing training is to achieve high media performance.

Currently, the majority of our classroom teaching performance evaluation data comes from students, experts, consultants, and listening colleagues filling out classroom situation questionnaires, as well as the evaluation of students and teachers by the educational administration system and the educational administration system. Data from teachers’ self-evaluation, except for students’ self-study data before class, whole class data in class, and students’ academic achievement after class, the above data are primarily related to classroom progress and a portion of classroom achievement data. Most classroom performance evaluations are based on students’ evaluations of classroom teaching, and students’ evaluations of classroom teaching quality are arbitrary because most courses have never been heard by experts, consultants, or colleagues. The results are unlikely to accurately reflect the situation in the classroom [7].

Figures 1 and 2 show the index system of the “Information Teaching Performance Evaluation Scale” in the form of qualitative explanation. There are four first-level indicators in the evaluation gauge, among which economic benefits and social benefits belong to the evaluation indicators of educational benefits. There are several second-level indicators under each first-level indicator, and each indicator item is divided into four stages. Finally, all the scores are added to get the total score.

The pursuit of information-based classroom is expected to effectively improve the existing teaching methods and maximize the educational achievements through the intervention of information technology. The evaluation system should comprehensively evaluate the application of information technology in the classroom, from economic benefit analysis to the application of information technology equipment in the classroom, and then to the evaluation of whether the use of information technology means is effective or not. Traditional evaluations focus solely on students’ test scores, and teachers’ performance is frequently overquantified. To effectively evaluate teachers’ behavior in the teaching process, this performance evaluation uses the process evaluation method. Educational effect, educational efficiency, educational benefit, and relational performance are the four components of information-based classroom teaching performance evaluation. Information-based classroom teaching can be constantly improved and perfected, and the goal of classroom teaching can be better achieved, thanks to this systematic evaluation.

3.2. Construction of Classroom Teaching Performance Model Driven by Big Data. Using learning analysis technology to discover early warning factors that affect students’ learning outcomes and provide timely intervention support is an effective way to understand and optimize the teaching effect and realize personalized learning. The collection and tracking of online learning process data provides a solid foundation for learning analysis technology implementation. It is a critical smart campus application for achieving quantitative, evaluation, and analysis of teachers’ performance as well as establishing a platform for quantitative performance evaluation. Relevant information can be added to the quantitative model database and the teacher’s personal performance database. The functions of data collection, auditing, centralized reporting, comprehensive display and analysis, precise management, and intelligent decision-making are improved, and a standardized data collection and quantitative performance evaluation early warning system was established.

Analyzing teachers’ teaching performance from a qualitative perspective is also considered personal performance, and the factors that influence it are divided into two categories: context factors and teachers’ own quality. The composition of key achievements is largely determined by three factors: personal knowledge and skills, motivation and skills, and organizational knowledge and skills. The two factors of learners’ innate characteristics and class size have vanished, either because the relationship between learners’ innate characteristics, class size, and teachers’ teaching performance is weak and far lower than other factors, or because the relationship between learners’ innate characteristics and class effect is weak and far lower than other factors. Below a certain threshold, the measurement standard of the perceived teacher’s teaching performance can be ignored.

The standard commonly used in hard clustering methods is to minimize the sum of squares of errors. Then, the objective function of hard $c$ clustering can be defined as

$$J_1(U, P) = \sum_{i=1}^{c} \sum_{k \in U_i} d_{ik}^2.$$  \hspace{1cm} (1)

In this chapter, we intend to build a new benchmark model on the basis of existing benchmark methods and related models, combined with data mining-related technologies, so as to adapt to the application of management analysis and production practice in complex situations. Suppose in a certain production practice, given the production unit $DMU_0$ to be analyzed, the attribute $b_*$ and the alternative benchmark set

$$pB = \{pB_1, pB_2, \cdots, pB_n\},$$  \hspace{1cm} (2)

where $pB_i = \{pB_{i1}, pB_{i2}, \cdots, pB_{in}\}$ is the $i$th alternative benchmark and its attributes.
A reasonable set of benchmarks must be obtained in order to achieve a specific benchmark purpose. The “reasonable” here means that the obtained set of benchmarks should be able to provide strong support for the effective completion of the subsequent benchmark analysis. Therefore, it may be considered necessary to solve the following optimization problems:

$$
\min_{\mathcal{B} \in \mathcal{P}, |\mathcal{B}| \geq r} H(B, b_*) = \left( \frac{\sum_{r \in \mathcal{S}} (b_r - b_*)^+}{\sum_{r \in \mathcal{S}} (b_r - b_*)^-} - \alpha \right)^2,
$$

where $(b_r - b_*)^+ = \max \{b_r - b_*, 0\}$, $(b_r - b_*)^- = \min \{b_r - b_*, 0\}$; $\alpha$ is a positive real number, which is used to control the state of the ideal benchmark set; and $s$ represents the minimum scale of benchmark set. The indicator set represents the benchmark in $\mathcal{B}$ benchmark set $\mathcal{B}$. The definition of $H(B, b_*)$ can be adjusted according to actual needs.

After determining a reasonable benchmark set $\mathcal{B}^*$, we evaluate the performance of each DMU in this benchmark set and the evaluated DMU, so as to accurately understand the advantages and disadvantages and provide basic support for the subsequent improvement of production efficiency. Model with average preference based on reference set $\mathcal{B}^*$:

$$
\sum_{i=1}^{k} \left( \sum_{j=1}^{r} w_{ij}b_{ij} \right) \lambda_i = \sum_{j=1}^{r} w_{ij}b_{ij},
$$

$$
\sum_{i=1}^{k} \lambda_i = 1, \lambda_i \geq 0, i = 1, \cdots, k.
$$

After the experts scored the qualitative indicators of teacher $d$, the arithmetic average method was used to collect the expert opinions of each indicator. Namely, where $q_r$ is the expert scoring value of the $r$th index of the $d$th teacher, $r$ is the evaluation index serial number, $V_{rs}$ is the $s$th expert’s scoring value of the $d$th teacher’s $r$th index, $s$ is the expert serial number, $r$ is a certain item index number, and $T$ is the effective number of expert questionnaires.

There are many methods for dimensionless evaluation of index attribute values, and the most commonly used method is membership function method. The attribute membership degree of a qualitative indicator in teacher performance is as follows:

$$
a_r = \frac{q_r}{l_{\max}},
$$

where $a_r$ is the attribute membership degree of the $r$ indicator, $q_r$ is the score value of an indicator of a teacher, and $l_{\max}$ is the maximum value of the indicator attribute (usually 100).

Data analysis technology unlocks the hidden information behind the data and feeds back the evaluation and teaching links to achieve the goal of optimizing teachers’ teaching performance. The framework is shown in Figure 3. As can be seen from the Figure 3, the data source of the model includes all links in the whole process. Learning analysis collects data related to individual learners, while learning environment analysis and the rest of the whole process collect learning environment data. Among them, the teaching analysis of the teaching design part can use data analysis learning to analyze learners’ innate characteristics, development characteristics and acquisition characteristics.
4. Results Analysis and Discussion

Through on-the-spot education experiments, it can improve the deficiencies of existing university information technology courses and implement the performance management system in university information technology classes to verify the effectiveness, rationality, and effectiveness of the performance management system. As a result of the teaching experiment, the posttest result of the experimental class is obviously better than that of the pretest, and it is also found that it has obvious advantages over the control class. The application of performance management system in university information technology classroom teaching shows that students’ achievement, classroom management, and teaching effect have improved significantly.

The questions on the scale were repeatedly investigated and carefully selected, fully reflecting the students’ learning achievements, according to the purpose of this teaching experiment and the actual situation of examination subjects. Task performance measurement, for example, examines students’ academic performance, classroom performance, homework completion, and evaluation methods and chooses subjects that can reflect these aspects as evaluation scale subjects. Students’ learning interest, learning attitude, learning ability, interpersonal communication, extracurricular knowledge supplement, teachers’ teaching ability, and teaching environment are used to assess relationships. Students’ information literacy and practical application ability are used to measure delayed achievement, and the scale’s items are collected.

Before the start of the experiment, the pretest scores of the experimental class and the control class were compared according to the final scores of the last semester, and two relatively close classes were selected for student information investigation. Paired sample T-test is performed on each modal score and total score, and the results are analyzed (Figure 4).

It can be seen that before and after the teaching experiment in the experimental class, the total score of information technology classroom teaching performance rose from 41.60 to 72.40, which shows that there is a significant difference in the field of information technology. After the teaching experiment, the paired sample T-test was conducted on all aspects and total scores of the control class, and the results are shown in Figure 5.

According to the analysis, the average comprehensive scores of information technology classroom teaching performance of the control class before and after the teaching experiment were 42.66 and 55.87, respectively, indicating that there was no significant difference between the control class and the control class.

Performance management is a complex system, which needs to study the internal characteristics, operating mechanism, and external environment of the system. The change of external environment directly affects the operation of performance management system, and the self-development and smooth operation of performance management need the good support of system and external environment. Campus culture is one of the most important environmental factors in the performance management system. Other characteristics of campus management culture directly affect the effectiveness of the performance system of university information technology classroom teaching.

We establish a scientific and reasonable performance management system of university information technology classroom, institutionalize the teaching objectives and contents, clarify the learning objectives of college students, and strengthen the overall characteristics of university information technology classroom performance management. University information technology ensures the smooth progress of university information technology classroom teaching activities. The author checks the reliability of raters by checking the consistency of the results obtained by different raters, which is based on the fact that different raters use the same educational evaluation indicators to score the same subjects in a short time. The total score is shown in Figure 6.

When comparing the total scores of authors and participants for each topic, participants’ scores are generally
higher than authors’, but the difference is usually not significant. Students give the evaluation gauge a high score because they believe the author’s course choice accurately reflects the new curriculum’s concept and informatization intent. Overall, participants’ scores are higher than the authors’, but the majority of them do not differ significantly, indicating that the evaluation gauge is valid and reliable. The validity of the teaching effect and teaching efficiency is low, while the validity of the teaching effect and related performance is high, according to the verification of the main indicators of the evaluation system. The differences of the total scores of each first-level indicator in all class examples of the author and the participant are compared according to four first-level indicators after analyzing the comparison of the total scores of each class. Each measurement item’s reliability is compared and analyzed in greater detail. For a comparison of primary indicator statistics, see Figure 7.

In contrast, participants questioned the evaluation of teaching effect. Secondary indicators of teaching effect are quantitative, high efficiency can be considered several times or even more, long-term high feedback rate can be considered, how much participation can be considered and other clear indicators. Participants questioned the reliability of these quantitative indicators. The standard of these requirements varies from person to person, depending on their frequency and age.

An apriori modeling method is used to analyze the relationship between relational performance in university information education, which mainly includes the way that teachers attract students’ attention in information education, the way that teachers give feedback to students, and the attitude that teachers pay attention to students. Positive relationship with development, students’ classroom participation, and classroom participation are found. The minimum conditional support is set to 10%, and the minimum rule confidence is set to 60%. The analysis results are shown in Figure 8.
The meaning of Zhongguancun performance association rules is shown in Table 1.

<table>
<thead>
<tr>
<th>Association rule</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>(s_{23} = b \text{ and } s_{26} = a)</td>
<td>Teachers give oral feedback and pay attention to the development of most students.</td>
</tr>
<tr>
<td>(s_{20} = a \text{ and } s_{26} = a)</td>
<td>Multimedia attracts attention and pays attention to the development of most students.</td>
</tr>
<tr>
<td>(s_{23} = a \text{ and } s_{20} = a \text{ and } s_{26} = a)</td>
<td>Multimedia attracts attention, multimedia feedback and pays attention to the development of most students.</td>
</tr>
<tr>
<td>(s_{23} = a \text{ and } s_{20} = a)</td>
<td>Multimedia attention, multimedia feedback</td>
</tr>
<tr>
<td>(s_{23} = b \text{ and } s_{20} = a)</td>
<td>Multimedia attention, verbal feedback</td>
</tr>
<tr>
<td>(s_{23} = a \text{ and } s_{20} = a \text{ and } s_{26} = a)</td>
<td>Multimedia attracts attention, multimedia feedback and pays attention to the development of most students.</td>
</tr>
<tr>
<td>(s_{26} = b \text{ and } s_{20} = a)</td>
<td>Multimedia attention, hierarchical teaching</td>
</tr>
<tr>
<td>(s_{23} = a \text{ and } s_{26} = a)</td>
<td>Multimedia feedback, paying attention to the development of most students.</td>
</tr>
<tr>
<td>(s_{23} = a \text{ and } s_{20} = a)</td>
<td>Multimedia attention, multimedia feedback</td>
</tr>
</tbody>
</table>

The introduction of multimedia teaching methods, feedback, and attention in association rules has a significant impact on improving students’ enthusiasm and can motivate students to actively follow their teaching arrangements. In information-based education, teachers can choose the appropriate multimedia format and introduce it into the classroom, increase the feedback of multimedia format in students’ interaction, and attract students’ attention with multimedia format, which can greatly improve students’ academic performance and affect class relations and overall educational performance.

The selection of benchmark set is mainly based on subjective experience of existing research, while a few studies are based on simple data processing combined with subjective experience. There is little research on the best choice of a set of benchmarks and data mining-related technologies. The cost of FCM (fuzzy C-means clustering) is \(\sigma\). When \(\sigma < n\), \(\eta \leq n(1 + n)^2/2\), that is, the computational complexity of the model solving algorithm, does not exceed \(O(n^3)\). The complexity curve is shown in Figure 9.

In order to evaluate the development status of related universities more scientifically and help to improve the future development of universities and teachers’ management level, benchmarking analysis will be conducted based on representative ranking data and questionnaire survey data. The calculation results based on conservative benchmark set are shown in Figure 10.

The thread and center line of the teacher’s classroom is the teaching idea. Teaching activities and classroom structure should be designed and organized in accordance with the content of the lesson and the level of the students. The level and connections of education are reflected in the
classroom structure. Teachers should pay attention to the establishment of various parts of the curriculum and their relationships when setting up the classroom. The classroom structure should be strict and interlocking, the content should be naturally changed, and the time allocation should be reasonable. More time should be spent explaining the course’s core content to avoid putting the cart before the horse. Teachers’ and students’ activity time should be appropriately allocated, teachers’ time should be well managed, and students should be given more activity time.

Teaching methods should be adjusted and used in the best way. Education is a complicated and changeable systematic project, and there is no one-size-fits-all method. Teaching methods always change according to the nature of the course, students, and teachers themselves. Teachers need to be able to properly choose their teaching methods, so that classroom teaching is always new and full of art. Classroom thinking training should focus on cultivating innovative ability, and main activities should be able to make the classroom more artistic. Comprehensive education cannot adapt to the development of modern society, and it needs to give students more space for independent thinking and innovative learning.

Because each discipline has different characteristics and different ways of knowledge transmission, curriculum knowledge should be viewed objectively. You need to study the subjects you are interested in, put more energy into the subjects you are not interested in or hard to understand, and study harder. When encountering problems that are difficult to understand or cannot be solved, you should actively consult materials and seek help from classmates and teachers. When evaluating the teaching achievement, the research mainly used a single comprehensive evaluation, and the subject achievement evaluation only evaluates the students’ test scores in the final exam. This method is obviously out of date, and many evaluation methods are needed to evaluate teaching performance, with special attention to process evaluation.

To sum up, the analysis process shows the effectiveness and application value of the optimal selection model based on a set of benchmarks. In addition, more complicated situations need to further verify the effectiveness and application value of the model.

5. Conclusion

In human resource management and the overall development of businesses, performance management plays a crucial role. Its goal is to help employees develop their own abilities while also helping the company achieve its objectives. This topic will examine and comprehend the performance management system in depth, combine university information technology teaching practices, identify the fusion point between the two, and apply and construct the concept of efficient and quick performance management into university information technology classroom teaching. The performance management-based university classroom teaching system examines and resolves issues in university information technology classroom lectures. Big data analysis can help students improve their learning styles and abilities. It can assist teachers in quickly identifying and correcting flaws in their teaching methods, as well as improving their overall education level. Simultaneously, it has the potential to disrupt traditional teaching performance evaluation methods in universities and to invent new teaching performance evaluation methods, which is critical for improving school management and teaching performance evaluation.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References


