Research on the Construction of Teaching Mode Based on Big Data

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Abstract: With the rapid development of big data technology, data resources in the field of education are constantly enriched, which provides a new opportunity for the improvement and optimization of teaching mode. Based on big data technology, this paper constructs a data-driven refined teaching mode by analyzing the laws of teaching activities and learners' cognitive behavior. Firstly, the framework of introducing big data into the teaching mode is analyzed. The four key steps of big data application in education are elaborated: data collection, data cleaning and preprocessing, feature extraction and data analysis, and model construction and optimization. Then how to use big data for teaching activities is analyzed. Finally, from three aspects: the construction of adaptive learning system, personalized feedback and support, and dynamic classroom activity design, how to build an innovative teaching model through big data is discussed in detail. The model aims to improve the quality of teaching, provide personalized services for learners, and help them get targeted support, so as to maximize the learning effect.

Keywords: Big Data; Teaching Mode; Personalized Service; Classroom Activities

1. Introduction

The traditional teaching mode usually follows a unified teaching process and progress, and teachers impart knowledge to students according to the established curriculum arrangement. However, due to the differences of students in learning foundation, cognitive level, hobbies and learning methods, this single model is difficult to meet the needs of all students, resulting in uneven learning results. For example, some students may find it difficult to understand more complex knowledge points in class, while others may think that the progress is slow and lack of challenge, resulting in reduced interest in learning. The limitations of this teaching mode are particularly prominent in large-scale classes, especially the difficulty for teachers to pay attention to and understand each student's learning status and feedback in real time in the classroom [1].

With the rapid development of information technology, the field of education has gradually entered the era of digitalization and informatization. Data such as students' learning behavior and learning trajectory can be recorded and collected through learning management systems, online classrooms, smart classrooms and other ways. The application of big data technology in education enables these data to be analyzed in depth, providing educators with a clearer portrait of learners. Teachers can use big data to analyze learners' learning behavior, such as learning progress, knowledge mastery, classroom participation, etc., so as to better understand students' needs and confusion, and find out the common knowledge blind areas and learning preferences in the learning process [2]. This not only helps teachers to dynamically adjust the teaching content and teaching methods, but also lays the foundation for the construction of student-centered personalized teaching mode.

Analysis tools based on big data can help teachers accurately grasp the cognitive behavior patterns of learners. For example, by analyzing the frequency of homework submission, the distribution of wrong questions, the number of classroom speeches and the length of watching teaching videos, teachers can fully grasp the performance of each student in the learning process and predict their potential problems in future learning. At the same time, big data analysis can help schools identify common problems in teaching activities from a higher dimension, and optimize the overall teaching strategy through these regular data trends. In this way, educational institutions can gradually shift from "experiential" education to "data-driven"

education based on data support, and use data insight to guide teaching decisions [3].

Today, with the development of education informationization and big data technology, teachers can use big data to analyze learners' behavior data, dynamically optimize teaching activities, and build a teaching mode that meets the needs of individualization. By means of big data analysis, this paper explores the relationship between teaching activities and cognitive behavior, and provides a theoretical basis for the realization of refined and personalized education services.

2. Big Data Analysis Framework in Teaching Mode

The introduction of big data analysis framework in education can collect and utilize multi-dimensional data of students in the learning process more systematically, optimize teaching methods through data analysis, and meet personalized learning needs. The following will elaborate on the four key steps of the application of big data in education: data collection, data cleaning and preprocessing, feature extraction and data analysis, and model construction and optimization [4].

2.1 Data Collection

Data collection is the first step of big data analysis, especially in the field of education. Data sources mainly include learning management system (LMS), online classroom, interactive platform, examination system, virtual laboratory, intelligent classroom and so on. The types of data collected are very rich, covering the details of learners' operation records, homework submission, test results, classroom attendance, interaction times and so on. For example, in the LMS system, students' course access frequency, video viewing time and homework submission can be obtained; while in the interactive platform, students' speech records, discussion and interaction can be collected. Through comprehensive data collection, students' learning path, knowledge mastery, learning input and other multi-dimensional information can be obtained, which provides a basis for subsequent analysis.

2.2 Data Cleaning and Preprocessing

The large amount of data collected is not always valuable, and some of the data may be noisy due to misoperation, network delays, or equipment failures. Therefore, before data analysis, data cleaning and preprocessing are the key steps to ensure the accuracy and validity of data. Data cleaning mainly includes removing missing values and abnormal values, identifying invalid or duplicate records, and unifying data formats. Data preprocessing then normalizes or normalizes the data to ensure comparability. After cleaning and preprocessing, the data can not only eliminate redundancy, but also improve the accuracy and efficiency of analysis, laying a good foundation for subsequent feature extraction and analysis.

2.3 Feature Extraction and Data Analysis

In big data analysis, feature extraction is the process of transforming raw data into information with analytical value. In educational scenarios, feature extraction can help to reveal learners' learning behavior characteristics and cognitive patterns. For example, through the analysis of homework and examination results, students' knowledge can be extracted. By analyzing data such as video viewing time, pause times, fast forward or playback operations, we can gain insight into students' learning habits and preferences. In addition, the use of data mining technology can further identify the potential problems and weaknesses of learners in the learning process, such as inadequate mastery of knowledge points, slow pace of learning and so on. Data analysis methods usually include cluster analysis, association analysis, classification and regression, which can effectively capture the patterns of learners' behavior and help teachers adjust their teaching strategies.

2.4 Model Construction and Optimization

Through machine learning algorithms, personalized teaching models can be constructed based on the extracted features. Model construction mainly includes the selection of appropriate algorithms, such as decision trees, support vector machines, neural networks, and so on, and training the data to form a personalized learning model. This model can predict students' performance on specific learning content, identify possible learning disabilities, provide teachers with data-supported suggestions, and assist them in optimizing teaching content and methods. At the same time, model optimization is an iterative process, which continuously improves the prediction accuracy

and adaptability of the model by adjusting parameters and training data. Teachers and system developers can optimize the model based on actual teaching feedback to ensure that it can better meet the needs of different learners, thus effectively supporting personalized teaching services.

The key of this big data analysis framework is to transform students' learning behavior data into a strong support for educational decision-making through systematic collection, cleaning, analysis and modeling process. This can not only help educators understand students' learning characteristics and needs more clearly, but also enhance students' learning experience through personalized recommendation and teaching intervention. The application of big data analysis in education makes the adjustment of teaching mode more scientific and efficient, and promotes the transformation from "experiential" education to "data-driven" education.

Teaching activity analysis based on big data, through data mining and analysis methods, discovers rules from the teaching process, reveals students' learning behavior patterns and cognitive characteristics, so as to provide data support for personalized teaching. The following will discuss in detail the specific application of big data in the analysis of teaching activities from the aspects of law discovery of teaching activities, modeling of learners' cognitive behavior, personalized teaching design and optimization of teaching feedback [5].

3. Analysis of Teaching Activities Based on Big Data

3.1 The Discovery of the Law of Teaching Activities

The law discovery of teaching activities is an important part of big data teaching analysis. Through the statistics and analysis of a large number of teaching data, we can find out the key factors affecting the learning effect. For example, data dimensions such as video learning time, interactive Q & a times and homework completion rate can reveal the specific impact of teaching content, teaching time and interactive mode on learning effect. The study found that students were more likely to maintain their attention during shorter video learning, and that long video could lead to distraction. Therefore, by analyzing the relationship between different video duration and learning effect, teachers can optimize the length of video resources to improve teaching efficiency. At the same time, the number of interactive Q & a can also reflect the learning needs of students. By analyzing the relationship between the frequency of Q & a and students' knowledge mastery, we can find out which knowledge points are more difficult to understand, so as to focus on explaining them in teaching. In addition, the completion rate of homework after class is the embodiment of students' learning enthusiasm and initiative. By analyzing the relationship between completion rate and learning effect, teachers can improve the design of homework to make it more targeted, so as to improve students' learning effect.

3.2 Modeling of Learner's Cognitive Behavior

Learner's cognitive behavior modeling is a very important part of the teaching analysis method based on big data. In the process of learning, students will show their own unique behavioral characteristics, such as the frequency of watching videos, the speed of completing exercises, the activity of interactive discussion, etc. These behavioral data can reflect students' cognitive state and interest tendency. Through data clustering analysis, the learning behavior of students can be divided into different types, and the cognitive behavior model of learners can be constructed based on these types. For example, some students prefer "video-based" learning and tend to understand knowledge by watching teaching videos, while others prefer "practice-based" learning and consolidate knowledge through a lot of practice. Cognitive behavioral modeling can not only help teachers understand students' learning styles and cognitive characteristics, but also meet the learning needs of different types of students in the course design, so as to improve the teaching effect [6].

3.3 Individualized Teaching Design

On the basis of teaching activity analysis and cognitive behavior modeling, personalized teaching design is the core goal of big data teaching activity analysis. Different students have different learning needs and levels, and traditional teaching is often difficult to take into account the individual differences of each student. Based on big data analysis, teachers can customize teaching content and learning paths for students with different cognitive characteristics. For example, for students who

make faster progress in learning, they can provide more difficult exercises and expand knowledge points. For students with learning difficulties, more basic knowledge explanations and auxiliary resources can be provided. Personalized instructional design can also push appropriate learning resources for students through intelligent recommendation system, and formulate reasonable learning tasks to improve learning efficiency.

4. Construction of Teaching Mode Based on Big Data

With the continuous progress of big data technology, the field of education has gradually ushered in a digital and intelligent teaching revolution. The construction of teaching mode based on big data can achieve more accurate and efficient teaching methods through data collection, analysis and application. The following will discuss in detail how to build an innovative teaching mode through big data from three aspects: the construction of adaptive learning system, personalized feedback and support, and the design of dynamic classroom activities [7].

4.1 Construction of Adaptive Learning System

Adaptive learning system is an intelligent teaching mode based on big data analysis. By collecting real-time data of students in the learning process (such as homework submission, correct answer rate, learning time, etc.), the adaptive learning system can automatically adjust the teaching content, difficulty and mode according to students' learning performance, so as to better meet students' learning needs.

For example, the system can push learning resources in real time according to students' mastery. If a student scores low in the test of a certain knowledge point, the system will automatically push the corresponding supplementary materials and exercises to help students deepen their understanding and consolidate their foundation. For students with faster learning progress and better mastery, the system will provide more challenging tasks or advanced learning resources to promote students to further expand the depth and breadth of knowledge. This adaptive learning style breaks the traditional "one-size-fits-all" model of teaching, so that each student can learn according to his own rhythm and ability.

In addition, the adaptive learning system can also predict the trend of students' learning data and find out the potential learning difficulties or advantages of students. For example, if a student repeatedly gets a low score in a specific subject, the system can warn in advance and provide timely help through the intelligent tutoring tools in the system to prevent students from lagging behind in some knowledge points for a long time, so as to ensure that students can make up for the weak links in time and maintain a good learning progress.

4.2 Personalized Feedback and Support

Based on the analysis results of big data, personalized feedback and support are the core components of big data teaching mode. Through the comprehensive analysis of students' learning behavior data (such as learning time, homework completion, interaction frequency, etc.), the system can generate personalized learning feedback for each student, help students identify their strengths and weaknesses, and provide corresponding learning suggestions.

For example, the system can automatically generate detailed learning reports according to students' learning situation, including the analysis of students' weak knowledge points, the change trend of learning time, and the comparative analysis with other students. These data can help students more clearly understand their weaknesses and room for improvement in the learning process. In addition, the system will provide personalized learning suggestions based on students' feedback and behavior patterns. For example, if a student has repeatedly failed in a module, the student can be advised to review the module and provide additional practice questions, or help students make up for learning loopholes by recommending relevant videos and resources.

At the same time, personalized feedback should not only be limited to academic performance and progress, but also pay attention to students' emotional and psychological state. Big data can analyze students' emotional changes in the learning process, such as emotional fluctuations, changes in participation, and so on, and then provide teachers with relevant data about students' psychological state, so as to give timely support or adjust teaching strategies. Through this personalized feedback mechanism, students can get more teaching support that meets their needs, and enhance their learning motivation and

effectiveness. In addition, personalized feedback can help students better understand their own learning situation, so as to adjust their learning methods and strategies. For example, through data analysis, the system can discover students' learning habits, such as being more active in the evening, or completing a large number of tasks in a short time. Based on these feedbacks, students can optimize their time arrangement and choose suitable learning methods in their future studies. In addition, the system can also generate comprehensive periodic learning reports, which provide teachers with detailed learning information about students, and help teachers understand students more comprehensively, so as to formulate more targeted teaching strategies [8].

4.3 Design of Dynamic Classroom Activities

The traditional classroom is usually a fixed teaching mode, in which students receive the knowledge imparted by teachers, and teachers explain and interact according to the preset teaching plan. However, the teaching mode based on big data can achieve more flexible and dynamic classroom design. Through real-time analysis of classroom data, teachers can flexibly adjust the arrangement of classroom activities according to students' feedback, participation, emotional state and other information, so as to improve classroom interaction and learning effect.

For example, teachers can adjust the pace of teaching based on student participation data collected in real time in the classroom. If it is found that students' participation in a certain link is declining or the error rate of answering questions is high, teachers can slow down the progress, re-explain the key content, or enhance students' sense of participation through group discussion and interactive questioning. On the contrary, if students master a certain knowledge point quickly, teachers can adjust the progress in time, explain more difficult content in advance, or design more challenging tasks to maintain classroom activity and students' interest.

The design of dynamic classroom activities can also be adjusted according to the real-time feedback of students. For example, teachers can know students' interest and understanding of a topic in real time according to the frequency and type of questions they ask on the interactive platform in class. Based on these data, teachers can adjust their teaching methods and adopt more suitable ways for students to explain, such as video broadcasting, case analysis, role playing and so on. This dynamic adjustment of teaching strategies can not only stimulate students' interest in learning, but also effectively improve teaching efficiency, and ensure that every student can fully participate in the classroom and gain something.

4.4 Continuous Improvement of Teaching Strategies

The construction of teaching mode based on big data also supports the continuous improvement of teaching strategies. By analyzing the teaching data accumulated over a long period of time, teachers can identify the common problems in teaching and the direction of improvement. For example, if students in multiple classes are found to have difficulty in understanding certain knowledge points, teachers can increase the explanation time of these contents or design more exercises in the teaching design. In addition, the system can also identify the effect of different teaching methods, for example, when it is found that the learning effect is significantly improved through group discussion, teachers can add discussion links in the future classroom and constantly optimize teaching methods.

4.5 Data-driven Teaching Decision-making

The decision-making under the big data teaching mode is more scientific and data-based. Educational institutions can optimize the allocation of teaching resources according to the accumulated data analysis. For example, according to the frequency of students watching the course video, we can judge which knowledge points need to be further supplemented. According to the analysis of homework data, we can optimize the difficulty and form of topic setting. In addition, big data also provides more basis for students' evaluation and assessment, not only limited to examination results, but also based on multi-dimensional data to examine students' learning process and progress trajectory, to help education managers make more comprehensive and objective decisions.

4.6 Continuous Learning Support

The construction of teaching mode based on big data can also support students' continuous learning, not only in classroom learning

activities. For example, the data of self-study tasks, exercises and preview content completed by students after class can be incorporated into the system, through which teachers can understand the situation of students' extracurricular learning and provide timely feedback and guidance. The system can also recommend after-school learning resources, such as reference materials, extended reading, online learning courses, etc., to provide students with support on the learning path, so as to help them learn and improve independently outside formal teaching.

To sum up, the construction of teaching mode based on big data greatly improves the scientificity and flexibility of teaching through adaptive learning system, personalized feedback, dynamic classroom design and data-driven decision-making. Big data technology not only realizes the fine analysis of learning process, but also provides strong decision support and improvement basis for educators, thus effectively promoting the innovation and reform of teaching mode. In the future, with the continuous maturity of big data technology, this data-driven teaching mode will become more and more popular, providing a solid foundation for personalized learning and the improvement of education quality.

5. Conclusion

Big data has brought new opportunities for the reform in the field of education, and the teaching mode based on big data helps to understand the needs of learners in a refined way, provide targeted help and optimize the teaching process. Future research can further explore the diversified application of big data in teaching mode, such as combining artificial intelligence algorithm to further improve the accuracy of personalized recommendation. At the same time, the protection of data privacy and the solution of ethical problems are also the key to the promotion of big data teaching mode.

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