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Learning Situation Analysis and Teaching Strategy Optimization based on Big Data

Jiandong Yang[1,2], Junyan He[1,2], Chengshi Li[1,2*]

1. Ludong University, Yantai, Shandong, China
2. Gachon University, Seongnam, Korea

Abstract: With the rapid development of information technology, the application of big data in the field of education is becoming more and more widespread, especially in the analysis of learning situation and optimization of teaching strategies, big data technology provides educators with unprecedented insight. By collecting and analyzing students' learning data, teachers and education administrators are able to gain a deeper understanding of students' learning behaviors, learning habits, and learning effectiveness, and thus develop more personalized and precise teaching strategies. The purpose of this paper is to discuss how to use big data technology for learning situation analysis and optimize teaching strategies based on the analysis results.

Keywords: big data, learning situation analysis, teaching strategy optimization

Introduction

In today's education field, the application of big data technology has become an important means to promote teaching reform and improve teaching quality. Through the collection, processing and analysis of students' learning behavior data, educators are able to gain a deeper understanding of students' learning situation, so as to develop more scientific and reasonable teaching strategies. In this paper, we will discuss how to use big data technology to analyze the learning situation and optimize the teaching strategy on this basis, with a view to achieving the purpose of improving the teaching effect.

1. The importance of learning situation analysis and teaching strategy optimization

Learning situation analysis refers to the process of systematically collecting, organizing and analyzing students' knowledge mastery, learning habits, learning attitudes and learning effects. This process is crucial to the optimization of teaching strategies because it can help teachers find problems and deficiencies in the teaching process and adjust teaching methods and contents in time to adapt to the learning needs of different students. Through in-depth mining and analysis of students' learning data, teachers can better understand the learning characteristics and needs of each student, so as to develop a more personalized teaching plan. In addition, learning situation analysis can also help teachers assess the effectiveness of teaching activities, ensure the rational allocation and utilization of teaching resources, and ultimately improve the overall quality of teaching and students' learning outcomes. For example, by analyzing students' test scores at different stages, teachers can identify which knowledge points students generally do not have a strong grasp of, and which teaching methods are more likely to stimulate students' interest in learning. In the classroom, teachers can observe students' participation and interaction, and understand their reaction to the course content, so as to adjust the pace and difficulty of teaching. Learning situation analysis is not limited to quantitative data, but also includes qualitative analysis of student

work, classroom performance and feedback, information that is equally valuable to teachers. Through this comprehensive analysis, teachers can more accurately pinpoint students' learning barriers and provide targeted support and guidance, thereby promoting the holistic development of each student[1].

2. The application of big data in the analysis of learning situation

In today's era of information explosion, big data technology has become an important research direction in the field of education that cannot be ignored. With the continuous promotion of education informatization, the application of big data in the analysis of learning conditions is more and more extensive, which can help educators gain a deeper insight into students' learning behaviors, habits, and learning effects, so as to provide a scientific and accurate basis for teaching decisions. With the power of big data, educators can accurately grasp the direction of education and lead students to the ocean of knowledge, just like a navigator with the help of star positioning. In the analysis of learning conditions, the application of big data is mainly reflected in the following aspects:

First, by collecting and analyzing students' behavioral data on various online learning platforms, teachers can understand in real time the students' learning progress, participation, as well as the difficulties and challenges encountered in the learning process, so as to adjust teaching strategies and provide timely help and support. For example, when a student repeatedly makes mistakes in a mathematical concept, the system can immediately notify the teacher, who can then intervene in a timely manner to provide personalized tutoring, and this instant feedback mechanism greatly improves the relevance and effectiveness of teaching. In addition, with this data, teachers can identify students who may need extra encouragement and motivation, and students who may need more challenges to keep them interested and motivated. In this way, educators can personalize instruction by more precisely addressing the unique needs of each student. For example, for students who excel at problem solving, teachers can recommend higher-level math problems to stimulate curiosity and challenge. And for students who struggle with basic concepts, teachers can design more basic exercises and interactive games to boost their understanding and self-confidence. This data-based personalized teaching approach not only enhances students' learning efficiency, but also makes teachers' teaching work more efficient and fulfilling[2].

Second, the application of big data analytics in education is not only limited to superficial statistics and reports, but it is capable of digging deeper into the reasons and patterns behind students' behaviors. By analyzing students' learning activities at different times of the day, school administrators can gain insight into the dynamics of the student body, such as the fact that library and study room usage tends to rise significantly before final exams. This insight allows schools to adjust their resource allocation in a more nuanced way, such as providing more tutoring resources during times of greatest student demand, or adjusting library opening hours to accommodate students' study habits. Additionally, big data can reveal details that are not readily apparent, such as the popularity of certain courses or activities among specific groups, which can help schools develop more personalized and precise educational strategies. For example, if data analysis reveals that discussion groups in a particular subject are particularly popular among female students, the school may consider adding more female tutors for that subject or conducting more targeted academic activities to promote gender equality and subject diversity. Through these nuanced adjustments, schools can not only improve the efficient use of resources, but also create a more inclusive and supportive learning environment for students[3].

Finally, big data analytics can help teachers and students gain insight into deeper information about the learning process so they can make more informed decisions. With big data analytics, teachers can go beyond superficial achievement numbers and delve into students' learning habits, interests, and cognitive styles. This deeper level of analysis can reveal students' potential strengths and possible obstacles in the learning process, providing them with more precise and personalized learning advice. For example, a student may excel in the subject of math, but through big data analytics, a teacher may discover that he is particularly innovative when it comes to solving real-world problems. Based on such findings, educators can recommend challenging programs that allow students to further develop their creative thinking and problem-solving skills in practice. Meanwhile, for students who are struggling in certain subjects, big data analytics can also provide valuable insights that can help educators identify students' barriers to learning and provide targeted tutoring

and resources, such as specially designed practice problems, interactive learning software, or one-on-one tutoring sessions, to help students overcome their difficulties and improve their learning outcomes. In addition, big data can help schools and educational institutions better understand the general learning trends of their student population, so that they can adjust their teaching strategies and curricula to meet the needs of their students. In this way, education becomes more flexible and adaptable, and is able to provide a richer and more diverse learning environment for students.

3. Optimization path of teaching strategies

3.1 Formulation of personalized teaching strategies

The formulation of personalized teaching strategies is a key link in the optimization of big data-driven teaching strategies. Big data can reveal each student's learning habits, comprehension abilities, and points of interest, providing teachers with the possibility of customized teaching solutions. For example, by analyzing the data of students' activities on online learning platforms, teachers can learn which students study more efficiently in the evening, and which students are more adept at deepening their understanding through interactive discussions (citing actual data from virtual learning environments). In addition, the learning analysis model can further analyze students' learning bottlenecks, such as spending too much time on a certain knowledge point, which may indicate that students need different teaching methods to break through the difficulties (e.g., the application of K-mean cluster analysis in identifying learning difficulties)[4].

When developing individualized instructional strategies, teachers can design adaptive learning paths that incorporate individual student differences. For example, deeper extension materials are provided for students who excel in specific areas, while additional practice and tutoring resources are provided for students who need extra support. Such dynamic adjustments not only meet the differentiated needs of students, but also help motivate them to learn. At the same time, personalization of what and how instruction is delivered is key. Big data can reveal which teaching methods work better with specific groups of students; for example, if video teaching is found to be particularly effective for visual learners, teachers can add relevant resources as appropriate. In addition, teachers can use the results of big data analysis to adjust the pace of teaching to ensure that each student can keep up with the teaching process[5].

3.2 Dynamic adjustment of teaching content and methods

In the optimization process of big data-driven teaching strategies, the dynamic adjustment of teaching content and methods is a key link. The traditional teaching mode is often teacher-centered, ignoring the importance of individual student differences and real-time feedback. However, big data provides a new solution idea for this status quo. By analyzing students' learning behavior data, teachers can learn which teaching content is more challenging for students and which teaching methods can stimulate students' interest in learning.

Taking the practice of an online education platform as an example, the platform uses big data analysis to find that 8-10pm is the peak time for students to study online, and the learning effect is relatively good at this time. Therefore, teachers can adjust the release time of homework and new content to match the active learning period of students, thus improving learning efficiency. In addition, data analysis reveals individual students' learning bottlenecks at specific knowledge points, and teachers can target the design of remedial teaching content to provide personalized learning support.

In the dynamic adjustment of teaching methods, the blended learning model supported by big data is gradually gaining attention. This model combines the advantages of online and offline teaching, allowing teachers to adjust teaching strategies in real time based on students' learning progress and feedback. For example, teachers can set up online discussion forums to monitor the activity of discussions and problem solving, intervene to guide them at the right time, or adjust the discussion topics in offline classrooms in order to strengthen students' deep learning[6].

3.3 Accurate push of teaching resources

In the optimization of big data-driven teaching strategies, the accurate delivery of teaching resources is a key part. By analyzing students' learning data, it is possible to understand students' learning habits, interests, and weaknesses in knowledge mastery. For example, if the model shows that a student spends more time on the geometry section of mathematics but his test scores are unsatisfactory, the system can automatically push relevant geometry animation tutorials

or targeted practice problems to strengthen his understanding of geometry concepts. In addition, teachers can also adjust the teaching resource library based on these data to ensure that the recommended resources are consistent with the teaching objectives and students' needs, so as to realize personalized teaching. This kind of precise push not only improves teaching efficiency, but also stimulates students' interest in learning[7].

3.4 Examples of teaching optimization based on learning analytics

In the field of education, big data learning analytics provides teachers with the opportunity to gain a deeper understanding of student needs and optimize teaching strategies. The following is a case study that demonstrates how teaching can be optimized based on profiling to enhance student learning. Mathematics teachers in a secondary school found that some of their students were performing poorly in the subject of mathematics, and their performance not only affected their academic development but also reduced their motivation to learn. In order to help these students improve their mathematics performance, the teacher decided to use big data learning analysis to gain a deeper understanding of students' learning and optimize teaching strategies.

(1) Data collection and analysis: the teacher used an online learning platform to collect students' learning data, including the grades of each homework assignment and quiz, as well as the interaction records of the online classroom. By analyzing these data, the teacher noticed that some students performed poorly on specific math concepts, such as algebraic equations and geometry problems. Teachers also noted that these students were less motivated by shorter study time and fewer interactions.

(2) Individualized teaching strategy design: Based on the results of the learning situation analysis, teachers designed a series of individualized teaching strategies. For students with weaknesses in different concepts, teachers designed targeted tutorial content and provided more practical examples and exercises to deepen students' understanding of these concepts. Teachers also added interactive sessions in class to encourage students to ask questions and participate in order to increase students' interest and motivation in learning.

(3) Implementation and assessment: Teachers gradually implemented personalized teaching strategies in the classroom, focusing on students' learning participation and performance. At the same time, teachers regularly communicate with students to understand their feelings and suggestions about the teaching strategies. By monitoring students' learning data in real time, teachers can adjust teaching strategies to meet students' needs at any time.

(4) Demonstration of effectiveness: After a period of implementation, teachers assessed students' performance in mathematics. The results showed that students who participated in personalized teaching had a significant improvement in their mathematics achievement. Not only that, their motivation and engagement in learning increased significantly. Students gradually overcame their learning barriers and faced the subject of mathematics with more confidence through more interaction and practice exercises.

4. Potential challenges and improvement strategies for big data applications

4.1 Privacy issues

In the process of using big data for learning analysis, privacy protection is an important issue that cannot be ignored. Students' learning data often contain sensitive information, such as personal information and performance records, etc. The collection and use of these data must strictly comply with relevant privacy protection regulations. Educational institutions and data processors need to ensure data security to prevent data leakage or misuse, as well as to be transparent with students and their parents about the purpose and scope of data use. In addition, security measures such as encryption must be implemented for the data storage and transmission process to ensure data security at all stages. Educational institutions should also conduct regular privacy protection training to raise the awareness of privacy protection among teachers and students to ensure compliance and legality at every stage of data collection, storage, analysis and sharing, so as to protect students' privacy rights.[8]

4.2 Technical cost issues

In addition to privacy issues, technology cost is also one of the factors to be considered in the process of big data

learning analysis and teaching strategy optimization. Deploying a big data analytics platform requires the investment of corresponding hardware resources and software development costs, which may be a challenge for some educational institutions with limited resources. In addition, maintaining and updating these technological facilities requires continuous financial support. Therefore, when implementing big data projects, educational institutions need to conduct adequate cost-benefit analyses to ensure that the investment will bring about the expected improvements in teaching and learning. Meanwhile, educational institutions can consider adopting cloud computing services to reduce initial investment costs by renting cloud resources and reduce long-term technical support costs by utilizing the cloud service provider's professional maintenance team. In addition, by partnering with technology providers, educational institutions can explore more cost-effective solutions for the sustainable development of big data technologies in education.

5. Conclusion

To sum up, in the context of the big data era, the analysis of learning situation and the optimization of teaching strategies are particularly important. By collecting and analyzing students' learning data, teachers can more accurately understand students' learning needs and behavioral patterns, so as to develop a more personalized teaching plan. This not only helps to improve the teaching effect, but also stimulates students' interest in learning and promotes their overall development. The application of big data technology makes the optimization path of teaching strategies clearer, including but not limited to the formulation of personalized teaching strategies, the dynamic adjustment of teaching content and methods, and the precise push of teaching resources. Through these optimization measures, educators can better meet students' individualized needs and realize the precision and efficiency of education.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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About the authors

Jiandong Yang (1978-), Male, Han nationality, Yantai City, Shandong Province, master's student, associate professor, research direction: future education, personalized education, career planning.

Junyan He (1982-), Female, Han nationality, Zibo, Shandong, Master's Student, Lecturer, Research Direction: Educational management, Ideological and political education, Career planning

Chengshi Li (1990-), Female, Place of Birth: Jilin, China; Professor, PhD, Research Direction: Comparative Higher Education, Higher Education Policy and Governance; Email: lichengshi@gachon.ac.kr

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