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Application and practice of personalized education based on big data analysis in Java object-oriented program design

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Abstract. This paper delves into the application and practice of personalized education based on big data analysis in the teaching of Java object-oriented programming. By constructing a big data analysis model, we have achieved precise collection and processing of student learning data, thereby tailoring personalized learning paths and resource recommendations for each student. The aim of this paper is to analyze the implementation effects of this innovative educational model in the teaching of Java object-oriented programming, with the hope of providing valuable insights for improving teaching quality and student learning outcomes. Furthermore, we also explore the advantages of applying Java object-oriented programming in personalized education. The object-oriented nature of Java makes program design more aligned with human thinking patterns, aiding in the development of students' logical thinking and innovative capabilities. Additionally, the widespread use of the Java language also offers expansive opportunities for students' future career development.

Keywords: Big data analysis, Personalized education, JAVA object-oriented programming.

1 Introduction

With the rise of technologies such as "Internet +", cloud computing, big data, and artificial intelligence, higher education teaching has been presented with new opportunities. Various universities have successively introduced new technology-related courses and have been actively exploring how to utilize new technologies to integrate and fuse existing course content, as well as how to transform teaching methods and teaching models[1,2].

In the context of big data, the course "Java Object-Oriented Program Design" needs to break through traditional teaching models, effectively utilize advanced information technology to explore diverse teaching methods, focus on students' learning needs, and emphasize the cultivation of students' autonomy and innovation capabilities. The course fully leverages the advantages of the Internet and big data technology, with application as the goal, practical teaching as the core, students as the main body, and projects as the

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carrier, to construct a curriculum system and introduce diversified teaching methods. The course reasonably adopts teaching methods such as scenario introduction, story inspiration, task-driven approach, teacher summarization, group exercises, and student discussions to integrate the content being taught. By fully understanding the students' learning situations, conducting rational teaching design, planning the teaching process, and visually displaying abstract concepts in data structures and algorithm implementation processes through information technology, students can easily comprehend and master the content, strengthen the application of knowledge points in specific tasks, and continuously enhance their programming skills through the process of "practice-learn-practice-improve," achieving the integration of theory and practice in teaching.

2 Issues in object-oriented programming education

2.1 The intricacy lies in the formidable task of data acquisition and integration.

Educational institutions generate copious amounts of data in their day-to-day teaching endeavors, encompassing students' exam scores, learning behavioral data, and the utilization of course resources. These data are scattered across diverse systems, rendering their integration a formidable challenge. Moreover, standardizing the data presents another hurdle. Variations in data recording methods and standards among different schools and educators necessitate data cleansing and standardization procedures prior to analysis.

2.2 There is a need for enhancement in data analytics proficiency.

Although big data analysis technologies have found widespread application in the realm of education, not all educators possess profound data analysis capabilities. This underscores the necessity to bolster teacher training programs to elevate their adeptness in utilizing data analysis for resolving pedagogical quandaries. Additionally, educational institutions should contemplate the recruitment of specialized data analysis professionals to furnish expert support for educational practices.

2.3 A vexing issue arises in the implementation of personalized education - finding equilibrium between personalized instruction and collective teaching.

Personalized education accentuates tailored instruction according to individual needs, yet an excessive emphasis on personalization risks undermining collective teaching, potentially stunting students' collaborative skills. Thus, meditating on how to uphold the significance of collective teaching while ensuring the advancement of personalization is imperative.

2.4 Safeguarding data privacy poses a substantial concern in the realm of personalized education.

With the advent of big data technologies, students' personal information and learning data are susceptible to breaches, underscoring the imperative of establishing robust data protection measures to shield students' privacy from encroachment.

3 The application of big data analysis in personalized education

3.1 Data collection and processing of student learning data

In the realm of personalized education, the pivotal role of big data analysis technology cannot be overlooked. Primarily, the collection and processing of various types of data generated during students' learning processes are imperative. These data encompass, but are not limited to: students' academic achievements, learning habits, study duration, learning styles, and course preferences. By accumulating these data points, we can gain a comprehensive understanding of individual students, laying the groundwork for subsequent analysis and exploration[3,4].

3.2 Analysis and exploration of student learning behavior

An inadequate understanding of child development can have significant negative impacts on children. When parents or caregivers lack knowledge about the stages of cognitive, emotional, and social development in children, they may struggle to provide appropriate support and guidance. This can result in missed opportunities to nurture key skills and abilities in children, hindering their overall growth and well-being.

Upon collecting student learning data, it is essential to analyze and explore these data to uncover the patterns and characteristics of students' learning behaviors. Throughout this process, data mining techniques such as association rule mining, clustering analysis, and classification algorithms can be employed. Taking association rule mining as an example, by delving into student learning data, we can unveil correlations between factors such as academic performance, study duration, and learning styles. Subsequently, personalized learning recommendations tailored to individual student characteristics can be proposed to enhance their learning effectiveness. In the context of Java object-oriented programming, existing data mining libraries like Weka and Apache Mahout can be utilized to implement algorithms such as association rule mining. Additionally, custom data mining algorithms can be created, and parallel computing using Java's multithreading capabilities can be leveraged to improve the efficiency of data analysis and exploration.

3.3 Prediction and recommendation of student learning needs

Based on the analysis and exploration of student learning behaviors, we can predict students' learning needs and recommend corresponding learning resources. Specifically, the following steps can be taken to achieve the prediction and recommendation of student learning needs: (1) Construct a model for predicting student learning needs: Utilize machine learning algorithms such as decision trees and support vector machines to build a model for predicting student learning needs based on historical learning data. (2) Real-time collection of student learning status: Continuously gather current learning data of students to update the prediction model in real-time. (3) Predict student learning needs: Utilize the prediction model to foresee students' future learning needs. (4) Recommend learning resources to students: Based on students' learning needs, offer personalized learning resources from a vast repository of educational materials.

3.4 Collection and analysis of student learning data

In the realm of personalized education, big data analytics technology plays a pivotal role. Initially, it is imperative to collect and analyze various types of data generated during students' learning processes. These data encompass, but are not limited to students' academic performance, learning habits, study duration, learning methodologies, and preferences for courses. By gathering these data, a comprehensive understanding of individual students can be achieved, laying a solid foundation for subsequent analysis and exploration.

4 Establishment of personalized education platform

4.1 Platform architectural design

Technical Selection and Module Division: In constructing a personalized education platform, the initial step involves selecting the appropriate technologies. We have chosen Java as the primary programming language, leveraging its high performance, cross-platform compatibility, and robust security features to meet the demands of a personalized education platform. Moreover, with the integration of big data technology, we are able to effectively gather, analyze, and store student learning data. According to the platform's functional requirements, we have divided the platform into several modules: Student Information Management Module, Learning Data Collection Module, Learning Behavior Analysis Module, Learning Needs Prediction Module, and Recommendation System Module.

System Layered Design and Interface Definition: To ensure scalability and maintainability of the platform, we have adopted a layered design approach. The platform is divided into presentation layer, business logic layer, and data access layer. The presentation layer is responsible for user interface display, showcasing student learning data, analysis results, and recommendations. The business logic layer focuses on core functionalities of the platform, such as student data collection, learning behavior analysis, prediction of learning needs, and recommendations. The data access layer facilitates interaction with the database for storing and querying student learning data. To enable seamless integration with other systems, we have defined a series of interfaces, including student information query interface, learning data interface, learning behavior analysis interface, and recommendation interface.

4.2 Core function implementation

Student Learning Data Collection and Storage: To enable real-time data collection of student learning data, we have implemented a client/server communication framework using Java socket programming technology. Students send their learning data to the server using a Java client, which then receives and stores the data.
Learning Behavior Analysis and Visualization: Learning behavior analysis is a pivotal feature of the personalized education platform. Leveraging big data technology, we conduct real-time analysis of student learning data and present the results in a visual format to students and teachers. Visualization can include bar charts, pie charts, line graphs, etc., facilitating quick understanding of learning patterns.
Learning Needs Prediction and Personalized Recommendations: To forecast learning needs and provide personalized recommendations, we employ machine learning algorithms (such as decision trees, support vector machines) to analyze student learning behavior and uncover their latent learning needs.Coupled with the recommendation system module,personalized learning resource recommendations are offered to students.

4.3 Platform testing and optimization

Functional Testing: Throughout the platform development phase, we conduct detailed testing of each functional module to ensure smooth operation. Functional testing includes assessments of student information management, learning data collection, learning behavior analysis, learning needs prediction, and recommendation functionalities[5]. Performance Testing: To ensure stability under high-concurrency scenarios, we conduct performance testing on the platform. This includes stress testing, concurrency testing, and other evaluations to guarantee optimal performance even under high user traffic. User Experience Optimization: A paramount focus during platform development is optimizing user experience. By enhancing interface layout, operational processes, response speed, and other aspects, we strive to elevate user satisfaction while utilizing the personalized education platform.

5 Conclusions

This article delves into the application and practice of personalized education based on big data analysis in Java object-oriented programming teaching. By constructing a big data analysis model, we have achieved precise collection and processing of student learning data, tailoring personalized learning paths and resource recommendations for students. The practical results demonstrate that personalized education has significant advantages in enhancing the quality of Java object-oriented programming teaching and student learning outcomes.

In the future, we will continue to deepen our research, further refine the big data analysis model and personalized education strategies. Additionally, we will explore more personalized education applications based on big data, making greater contributions to the improvement of education quality and student development.

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References

1. Belhachat F, Larbes C. 2018 A review of global maximum power point tracking techniques of photovoltaic system under partial shading (Renewable Sustain Energy Rev) p 92
2. Xing Dan 2018 Preliminary Exploration of Teaching Reform in Medical School Data Structure Course in the Era of Big Data(Computer Knowledge and Technology) p 5.

3. Huang Y-P, Huang M-Y, Ye C-E. 2020 A fusion firefly algorithm with simplified propagation for photovoltaic MPPT under partial shading p 10.
4. Jin Weijian 2019 Exploration of Building School-Enterprise Collaborative Education Platform under the Context of New Engineering(Science and Technology Information) p 17
5. Vito Rosemary;Schmidt Hanbidge Alice.2021 Teaching Social Work Leadership and Supervision: Lessons Learned From On-Campus and Online (Journal of Social Work Education) p 83