

Research on Visualization System of Student Behavior Analysis Based on Campus Big Data

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Abstract: This study aims to design and implement a visualization system for student behavior analysis based on campus big data, in order to provide a deep understanding of student behavior patterns. The article designs a student behavior analysis visualization system, which collects relevant information such as student grades, attendance, and book borrowing, conducts data analysis and mining, presents it with visualization tools, and constructs a warning management platform. Practice has proven that this visualization system can accurately analyze the learning situation, intelligently analyze and warn students of violations and disciplinary violations, providing reliable reference for student behavior management, and has high feasibility and reliability. Teachers can dynamically reflect students' exam scores, attendance, and pass rates during their school years in the form of a curve chart. Teachers can intuitively grasp the learning situation of students. Through online behavior monitoring, teachers can understand the hot topics of student groups and their attention to politically sensitive issues. By analyzing security data through the system, students can visualize their emotions and attitudes, grasp their actions and behavioral trajectories, and develop intervention plans. When there are signs of exceeding the standard in the monitoring system, the system will issue a warning, closely monitor student behavior, and actively take measures to avoid the occurrence of bad behavior. In the future, the system can further expand its functionality by combining machine learning algorithms to improve its ability to predict student behavior and provide stronger support for school management and teaching decisions.

Keywords: campus big data; Analysis of students' behavior; Visualization system; early warning system

1 Introduction

With the vigorous development of education in China and the implementation of the enrollment expansion policy in colleges and universities, the number of students in colleges and universities in China has reached an unprecedented scale. According to the education data of the National Bureau of Statistics in 2016, the number of college students in China has reached 25.48 million ^[1]. The study and life problems of such a huge student group have gradually become a problem that can not be ignored by all walks of life. In recent years, all kinds of student problems occur frequently, and all kinds of student incidents are thought-provoking, which brings great challenges to campus management. In all kinds of student incidents, college students belong to the high incidence group of abnormal behavior. Because these students have problems in social interaction, personality, life, psychology, etc., they often lead to unconventional behaviors such as being isolated, withdrawn, irregular in

work and rest, truancy, failing classes, online lending, disappearance and even suicide, which are collectively called abnormal behaviors of students. This kind of students' abnormal behavior is generally difficult to monitor, analyze and predict, which has brought great pressure to campus management [2]. The traditional "one-to-many" campus psychological counseling management mode has been unable to quickly and comprehensively identify the above-mentioned abnormal behaviors of students. How to detect students' abnormal behaviors from campus students with large base, wide activities and strong personality, and make group association analysis and visualization have become the key issues that campus managers pay attention to. Fortunately, in the information age with the rapid development of the Internet and the Internet of Things, the vigorous development of various emerging technologies such as artificial intelligence, machine learning and visual mining can provide new ideas for solving the current student management problems. All kinds of information hardware or software comprehensively record the study and life data of students in school, such as canteen credit card data, shower data, recharge data, library borrowing data, library access control data, network browsing data and so on. These campus behavior data can provide important data resources for students' abnormal behavior mining and correlation analysis [3]. Nevertheless, in the face of frequent student problems, the existing information construction projects still remain in the way of monitoring students' behavior by recording and data monitoring, and still lack the mode analysis of learning behavior for specific students and groups, and the visual display of the relationship between students and individuals, so it is difficult to carry out the investigation and analysis of abnormal individuals in campus life. As one of the hot technologies, big data has brought great convenience to people's life and study, and also revolutionized the management of colleges and universities. At present, the campus management of colleges and universities mainly adopts the methods of preaching and post-event analysis, which has a certain lag and lacks effective prediction and evaluation of the dynamic changes of students' thoughts and behaviors. The arrival of the era of big data has broken the drawbacks of traditional campus management in colleges and universities. It can mine valuable student information from massive data, provide objective, accurate and comprehensive basis for campus management, predict students' behavior, and improve the pertinence of campus management, which is of great significance to the improvement of students' education management level and the construction of digital campus [4].

2 Methods

2.1 Information technology

In the 1980s, information technology had been widely applied in various fields, but there was no specific theory to explain the adoption behavior of users towards information technology. In 1989, someone used the Theory of Reasoned Action (TRA) as a prototype, absorbed the relevant theoretical cores of expectancy theory and self-efficacy theory, and proposed the Technology Acceptance Model (TAM). TAM is a model specifically designed to study user adoption behavior towards information technology from the perspectives of psychology and behavior. The TRA rational behavior theory framework is shown in Figure 1:

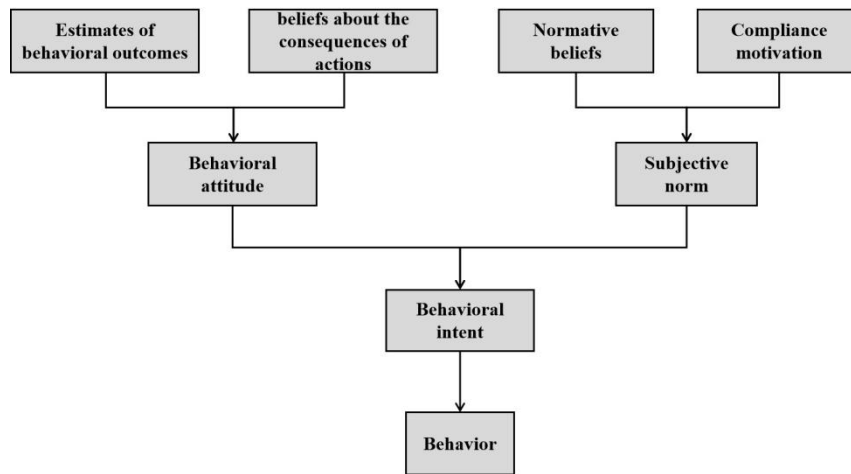


Figure 1 TRA theoretical framework of rational behavior

It has been identified as two unique design characteristics, user experience value and ease of use, as two important factors influencing user access to information technology. The TAM model is shown in Figure 2:

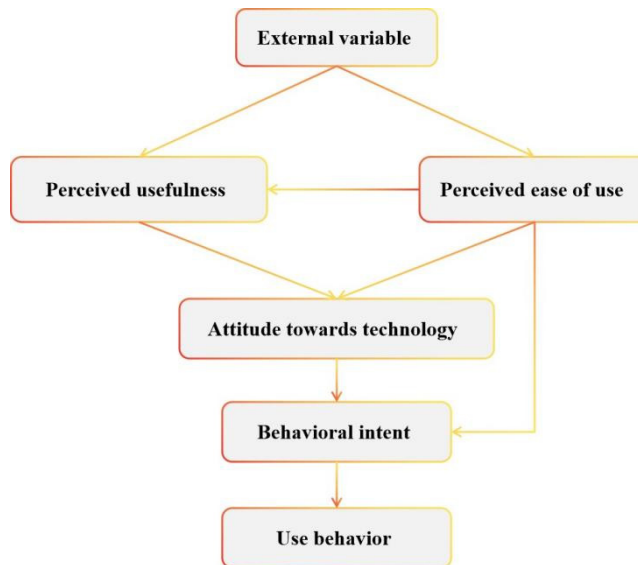


Figure 2 TAM model

2.2the overall framework of student behavior analysis visualization

Under the background of information age, the construction of digital campus has been highly valued by colleges and universities, and a large amount of data will be generated in daily teaching activities and education management, mainly from Weibo forums, book lending,

network behaviors, etc. The data types include structured and unstructured, which are closely related to the teaching activities and management of the school. With the continuous advancement of digital campus construction, the amount of data is increasing, forming a data collection port with potential value. The behavior data of college students are complex and diverse, and it is difficult to integrate them, and it is difficult to establish correlation between them. In addition, the staff lacks professional data processing experience, which makes it difficult to meet the needs of data mining. Under the background of Internet information age, colleges and universities establish campus networks, and students' behaviors can be analyzed through "all-in-one card", campus networks and basic education data. Based on the practice of student management, with the support of big data technology, this study uses the educational administration system to collect students' performance information, and uses the attendance system to collect students' class and attendance data, so as to explore students' participation in the second classroom in the comprehensive quality system. At the same time, the campus card covers students' book borrowing information. ETL tools are used to extract and convert the data from the above platforms, which are loaded in Oracle database to realize data storage and management. According to the campus management system, the corresponding rule base is designed, including award and evaluation, disciplinary action against rules and regulations, achievement warning, etc., and data mining is implemented to construct a visualization process based on three dimensions of college, class and individual, which mainly involves attendance, rewards and punishments, comprehensive quality and achievement management. The overall framework of the constructed visualization system is shown in Figure 3 [5].

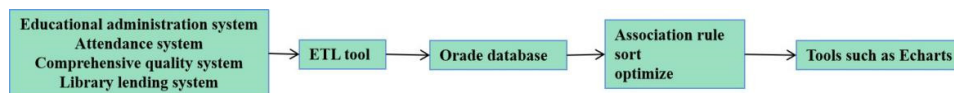


Figure. 3 Overall Framework of Visualization System for College Students' Behavior Analysis under Big Data

2.3 Design of Visual System for Student Behavior Analysis Based on Campus Big Data

(1) System development environment

Visualization system mainly includes hardware system and software system. The hardware system consists of a server and a processor, and is equipped with two 64-core 2.1G memories. The hard disk is 256G and the model is Barracuda 7200.7plus. The software system includes MySQL and Hadoop2.7.1.

(2) Introduction of system functions

At present, there are many ways to deal with massive data, among which Hadoop technology is the most mature one. It is developed by Apache software fund and forms a perfect ecosystem, which plays an important role in the field of big data analysis and processing. With the support of Hadoop technology, the system can realize data storage and analysis, and is convenient for data management and maintenance of data security, which has distinct advantages. In this study, a big data student management platform is developed under the integrated environment MyEclipse, which involves system management, personal information and class information analysis, regional relevance analysis, etc. The system functions are shown in Table 1 [6].

Table 1 Analysis of Platform Functional Architecture

University Students' Behavior Analysis and Visualization System Based on Big Data	Systems management	Login data management exit
	Student information analysis	Analysis of performance, attendance, comprehensive quality, early warning and evaluation
	Class information analysis	Summary of achievements, attendance, comprehensive quality, early warning and evaluation
	Regional correlation analysis	Overall ranking of achievement, comprehensive quality and early warning

(3) Module introduction

System management module: The campus-based big data student behavior analysis system mainly includes three levels: login, data management and exit. Login users include system administrators and ordinary users. Users can complete the login after selecting the corresponding identity and inputting the user name and password, and the data interfaces related to students' grades and attendance need data management. The system can help data cleaning and storage. The main responsibility of the system administrator is to maintain and manage data, such as data import, export, analysis, and regularly update data, and maintain and manage logs. The data mainly come from the basic information of admission, academic performance, attendance data, comprehensive quality score and so on. Freshmen can complete data collection within one month after entering school, which can be used as the original information data of students. In the subsequent learning activities, the scores of each exam and make-up exam will be entered into the student achievement system; The attendance system mainly records students' leave, absenteeism and lateness as attendance information. The comprehensive quality score is derived from the comprehensive evaluation system of students, and reliable data information is obtained through sorting and calculation. As managers of classes and students, counselors need to comprehensively manage students' grades, attendance and comprehensive quality scores. Counselors can recommend outstanding students to participate in awards and appraisals, and can warn students' behaviors according to their grades, attendance and violations of discipline, and track and give feedback. The head teacher bears the heavy responsibility of class management, and needs to check the students' basic grades, attendance and comprehensive quality evaluation, which plays an important role in the award and evaluation. Early warning should be given when students are found to be in violation of rules and regulations, abnormal attendance or other abnormal behaviors. Students use the big data visualization system to mainly check their own basic information, attendance, grades, etc., to understand their own shortcomings and the direction of efforts, which can play a warning role for violations^[7].

Analysis of student and class information: the analysis of student information mainly includes five aspects: after selecting the corresponding class, you can get the total score, average score and ranking of students by clicking on the name of the person. Attendance analysis, the operation method is the same as (after selecting the corresponding class, you can get the total score, average score and ranking of students by clicking on the name of the person.), after

clicking the corresponding students' names, it can automatically display the times of students' leave, absenteeism and lateness, etc. Not only that, it also corresponds to the courses that are absent from class, and the data is detailed and comprehensive. Comprehensive quality analysis, which mainly involves ideological and political education, innovation and entrepreneurship and labor practice, scores each item according to the corresponding scoring rules, calculates the total score, and ranks the comprehensive quality scores. Early warning analysis, when you need to view a student's behavior data, you can click on the name to view its absenteeism, lateness and grades and other related data. Award for Excellence, ranking students according to their grades and comprehensive quality scores, and recommending outstanding candidates. At the same time, students' truancy, lateness and make-up exams are also important basis for award for Excellence.

Analysis of regional information: In order to understand the differences of students' grades in different regions, teachers can screen the top 20% students in each semester, divide them according to different places of origin, calculate the proportion of different places of origin in the total students, and rank them to understand the quality of students in various regions of the country. The overall ranking method of comprehensive quality and early warning is the same as above [8].

3 Key technologies of student behavior big data analysis

3.1 Data acquisition method

With the support of Internet, cloud computing and Web technology, a large number of data related to students' campus behaviors are generated. When analyzing students' campus behaviors, university administrators often use correlation method, feature analysis method, anomaly analysis method, etc., which need a large amount of data as support. "All-in-one card", "library borrowing card" and "network monitoring" belong to structured data, and they can transform information while collecting information. Internet, community forums and post bars are the main sources of semi-structured data, which usually need to be processed by ETL tools, and data collection mostly uses web crawler tools. In the aspect of extracting students' behavior characteristics, including explicit characteristics and implicit characteristics, in the aspect of analyzing students' group life, we can input students' credit card times, consumption amount, average consumption amount, online time, etc. In order to extract implicit characteristics, we need to use social network platform to extract students' online types, card usage frequency, etc. In addition, the feature extraction of students also includes behavior law, social situation, consumption characteristics, the number of books borrowed and the types of books borrowed. As an important indicator of students' abnormal behavior, students' social network plays an early warning role. Through the extraction and classification of social network card swiping events, the following ranking can be made (see Table 2).

Table 2 Sorting of Student Events

All-in-one card number	Student number	scene	occurrence time	event type
218345	141811be	2	2020/3/23 18:32	004
210432	152343ah	2	2020/3/21 12:28	004

184726	142013ah	2	2020/4/15 11:36	004
218535	151 824ad	3	2020/5/12 13:23	004
274536	16041 2ch	4	2020/5/24 13:48	004
309373	140224aa	5	2020/5/29 7:28	010

3.2 Construction of Early Warning Model

Common mining methods of students' campus behaviors include prediction, clustering, relationship mining, etc. Based on the above information, university administrators need to construct an analysis of students' behaviors and emotions, and the data correlation analysis mainly includes family background, emotional attitudes and interpersonal relationships. In this study, the correlation analysis method is used to analyze the relevant data of students in a specific time range, such as time, space-time overlap and spatial similarity, by using the similarity of individuals in time, space and life characteristics, so as to obtain the similarity of movement patterns among students. In the analysis, it is necessary to design the grading indicators and weight ratios of different modules, deeply analyze students' personality characteristics and behavior rules, build a campus behavior safety early warning model integrating images, texts and graphics, predict students' behaviors, check erroneous ideas at the outset, and realize the construction of a harmonious campus. The "1+1+4+N" model is adopted to build the early warning model, with two "1" indicating the basic data source and big data operation platform respectively, and "4" indicating four management platforms, and N mainly indicating various analysis and mining technologies, such as intelligent early warning, multidimensional analysis and thematic analysis [9].

3.3 Construction of Big Data Visualization Model

The big data visualization mode mainly relies on SAS tools and SPSS to achieve intuitive and convenient visualization management of college student behavior data. This mode can form clusters of similar behavior feature values for students through outlier analysis, and construct data analysis modules for multiple topics. This enables teachers to track students' exam scores, attendance, pass rates, and other information in the form of graphs, providing dynamic and comprehensive feedback for educational management. Through online behavior monitoring, teachers can intuitively understand the hot topics that students are concerned about and their attention to politically sensitive issues. In addition, the system analyzes safety data to visualize students' emotions and attitudes, helping teachers gain a deeper understanding of students' actions and behavioral trajectories, and develop targeted intervention plans. In the entire monitoring system, once there are signs of exceeding the norm, the system will issue a warning, and teachers can closely track students' behavior and take proactive measures to prevent the occurrence of bad behavior. This comprehensive and detailed big data visualization model provides scientific and practical tools for education management, which helps to improve the efficiency and accuracy of student management [10].

4 Conclusion

In the era of big data, university student management has gained new technological support, and the construction of a visualization system for student behavior analysis has become an important measure. The establishment of this system makes it possible to accurately analyze

and diagnose students' academic situation, illegal and disciplinary behaviors, and provides schools with forward-looking warning capabilities. This not only promotes the improvement of student management level, but also effectively ensures the safety control of students in universities, promoting the implementation of smart digital campuses. The visualization system for student behavior analysis not only provides decision-making support for schools, but also provides more scientific and intelligent means for student management. Through in-depth analysis of student behavior, schools can more accurately identify and understand students' needs, problems, and potential risks, and then develop targeted management strategies. This is not only conducive to improving the overall management level of the school, but also provides students with a better learning and living environment. Overall, the visualization system for student behavior analysis has broad development prospects and will provide more intelligent and precise support for university student management. It is expected to inject new vitality into the construction of a safer, more efficient, and intelligent digital campus.

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