

Deep Mining of Factors Influencing Student Performance in Smart Campus and Its Application in Teaching

QIAO Jiaxin

School of Management Science and Engineering, Anhui University of Finance & Economics, Bengbu City, Anhui Province, China

Corresponding Author: QIAO Jiaxin

Abstract

Against the backdrop of high social attention to student performance, how to deeply mining the influencing factors of student performance has become a current research hotspot. In response to various factors that affect students' academic performance, such as individuals, families, universities, and society, literature review is first used to qualitatively analyze the main influencing factors of students through questionnaire surveys. Then, based on the massive data accumulated on smart campuses, the Apriori algorithm is used to deeply mining and quantitatively analyze the influencing factors of students' academic performance, identifying the main factors that affect students' academic performance. On the one hand, the research results indicate the direction for students to improve their academic performance, On the other hand, it also provides reference for university teachers in teaching.

Keywords: Smart Campus, Impact Factors, Data Mining.

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I. INTRODUCTION

Achievement is an important indicator for measuring students' learning effectiveness and the quality of teachers' teaching. It is a reflection of students' intellectual and ability achievements during their school years. Reasonably utilizing the feedback information brought by grades can not only improve teaching quality, but also provide important basis for teaching reform. How to efficiently and accurately analyze grades and implement personalized measures for students is a problem that universities have been striving to solve. The introduction of smart campuses in universities has brought many conveniences to teaching work. At the same time, it has also accumulated a large amount of underutilized massive data, and faces the challenge of discovering and utilizing valuable information from it, providing reasonable decisions for improving education quality and teaching reform.

Data mining and Big data processing technology provide strong support for people to explore deeper data information, and mine the undetected, potential and valuable information from the massive data. Data mining technology was applied to campus activity analysis earlier in foreign countries, and a relatively complete smart campus management plan has been developed. By drawing on the experience of foreign smart campus management, data mining and processing of students' campus data are carried out to identify the main factors that affect students' grades, providing decision-making support for optimizing teaching plans and improving teaching quality.

II. CURRENT RESEARCH STATUS

In foreign countries, researchers in the field of education identify students who need after-school tutoring by dividing them into high and low groups; Analyze factors such as grades and student origins, divide students into different groups[1,2], understand their competitive advantages, and improve their grades; Analyzing and monitoring academic performance can effectively monitor the progress of academic performance in a short period of time, helping teachers and classmates adjust teaching and learning methods at any time.

In China, relevant researchers have also conducted similar research. Based on data from the academic administration system, analyze students' final grades, complete student classification, and propose personalized teaching strategies based on the characteristics of each type of student, which helps to achieve precise teaching; According to the student file management system, analyze the factors such as students' Learning styles and complete the design of student grouping system, which will help improve the teaching quality; According to the school's student information management system, the impact of student campus behavior on academic performance was analyzed. The results showed that lifestyle habits such as library visits, borrowing professional books, and schedule were closely related to academic performance; Based on the school student competition

system, analyze the academic performance, scholarships, competition situation, and other behavioral characteristics of students on campus, and identify the common characteristics of each type of student. This helps teachers teach students according to their aptitude and efficiently manage students.

Under the condition of massive data in the smart campus integrated system, a fine-grained analysis is conducted on factors affecting students' personal, family, school, and society. Data mining technology is used to analyze the impact of each factor on students' grades. Through the mechanism of influencing factors on students' grades, the main factors affecting grades are identified, and research strategies for improving grades are formulated to optimize course teaching plans for teachers in the teaching process Provide decision support to improve teaching quality.

III. QUALITATIVE ANALYSIS

3.1 SELECTION OF FACTORS INFLUENCING STUDENT PERFORMANCE

The selection of influencing factors for student performance is the foundation of deep data mining, and the selection process is shown in Figure 1. Firstly, based on project requirements, literature review and interview consultation were conducted to summarize the impact of factors on academic performance[1,3]. A student performance impact factor questionnaire was designed and distributed to students for filling out. The survey questionnaire can be conducted in two ways: online questionnaire and paper questionnaire. By conducting data statistics and analysis on effective questionnaires, the influencing factors of students' academic performance and the degree of influence of different factors can be obtained.

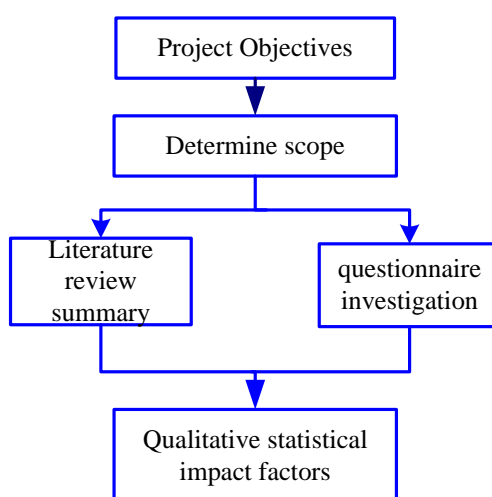


Figure 1:Process for selecting influencing factors.

3.2 OVERALL STRUCTURE OF THE IMPACT FACTOR SYSTEM

Research on the influencing factors of student performance, combined with literature review analysis, summarizes the influencing factors of academic performance into four categories: personal factors, family factors, school factors, and social factors[2,3,4]. The classification of impact factors is shown in Figure 2.

From the perspective of students' personal factors, college students' academic performance will be affected by factors such as learning motivation, learning initiative, learning self-discipline, network obsession, and mental health; From a family perspective, a good family environment helps students develop a cheerful and optimistic personality, making them willing to express themselves; From the perspective of the school, the influence of factors such as teachers, curriculum, teaching environment, and teaching resources on students' academic performance cannot be ignored. The learning initiative of college students is easily influenced by good friends, and their learning initiative and interaction with teachers are influenced by the teacher's teaching attitude and student-centered teaching methods. At the same time, from a societal perspective, the impact of factors such as a good employment environment and higher salaries on students' academic performance cannot be ignored. The four major factors of student personal factors, family factors, school factors, and social factors interact with each other and jointly affect students' academic performance.

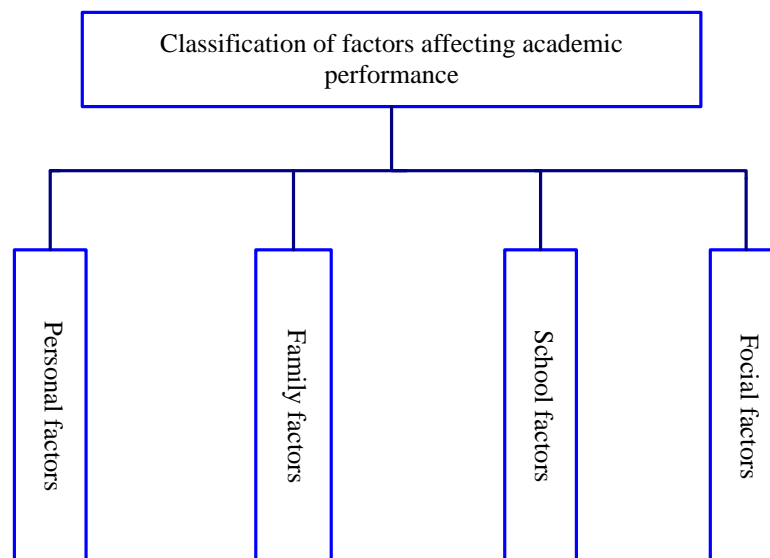


Figure 2: Classification of influencing factors.

3.3 QUALITATIVE ANALYSIS OF INFLUENCING FACTORS

The statistical analysis results of the questionnaire are shown in Table 1 (with influencing factors ranging from high to low). From the numerous influencing factors, the top five factors in each category are statistically analyzed. From an individual perspective, interest is the best teacher, which has formed a consensus among students that learning initiative can achieve better results. In everyone's impression, girls perform more prominently; From the perspective of family factors, the education level of parents has a significant impact on their children, which is commonly referred to as parents being the first teachers of their children. Students in better family economic conditions and more developed areas are more likely to receive good education; From the perspective of school factors, teachers are the greatest asset of the school. Good teachers have a great impact on students' academic performance, and rich curriculum resources also provide assistance for learning; From the perspective of social factors, the demand for social work positions also has an impact on students' learning, and salary and social status are also factors that students consider.

Table 1: Statistical analysis results of influencing factors (top five).

influence factor	Personal factors	Family factors	School factors	social factors
1	Interest in learning	Parental education level	Teacher level	employment rate
2	Learning Initiative	Educational expectations	Course resources	Pay level
3	Learning self-discipline	Home location	Library resources	Social recognition
4	Gender	Family economic conditions	Dormitory environment	Research environment
5	Degree of internet addiction	Family atmosphere	Class environment	Competition environment

IV. DATA COLLECTION AND PREPROCESSING

Data collection. In the face of the massive data accumulated by the smart campus, the data needs of various factors were statistically analyzed according to the questionnaire survey. The research subjects were selected from all students of 2017 and 2018 in a college of a university, and the corresponding data of various influencing factors were selected. Specifically, among personal factors, learning interest was selected as the first choice for college entrance examination, learning initiative was selected as the self-study duration, and gender was taken from the basic information table of students, Learn self-discipline Sexual selection and finish the homework at ordinary times; Family factors such as parents' education level, family location, and family economic conditions are taken from the basic information table of students' families, and educational expectations are selected from the intention table for postgraduate entrance examination; The teacher level, curriculum resources, library resources, dormitory environment, and class environment in school factors are taken from the teacher information table, curriculum resource table, library resource table, dormitory allocation table, and class list, respectively; The employment rate in social factors affects the annual employment situation table, the salary level affects the salary table, and the research and competition environment of the selected school's research and competition situation table.

Data integration. Consolidate the files or data from various data sources together, using the student ID as the primary key for connection, for the convenience of subsequent data mining analysis and processing. The

main task of this process is to solve the contradiction problem of multiple data sources, such as inconsistency in word meaning, type, name, etc., which requires unified and standardized processing of these data to form initial data suitable for data mining.

V. QUANTITATIVE STUDY

5.1 SELECTION OF DATA MINING ALGORITHMS

Research on the influencing factors of student performance, combined with literature review analysis, summarizes the influencing factors of academic performance into four categories: personal factors, family factors, school factors, and social factors. The overall structure of the impact factor system is shown in Figure 2.

After preprocessing student performance data and influencing factors, in order to quantitatively analyze the relationship between student performance and various influencing factors, and to further explore key influencing factors of student performance, this article uses the Apriori algorithm to mine association rules for student influencing factors[5]. The two main indicators of the Apriori algorithm are support and confidence. Support is the ratio of the number of times two data items appear simultaneously to the total number of times; Confidence is the ratio of the total number of occurrences of two data items at the same time to the number of occurrences of the first item, which is the Conditional probability. The mining algorithm of Apriori algorithm generates frequent itemsets and Strongly correlated material rules according to the minimum support and confidence set. The mining process mainly includes the following two steps:

(1) To generate a frequent itemset, first scan all transactions one by one to generate candidates, then set the minimum support level, and then filter candidates based on their support level greater than or equal to the minimum support level. All itemsets that meet the conditions are found, which is the frequent itemset.

(2) Generate Strongly correlated material rules, use frequent item sets, set the minimum confidence level, filter candidate conditions according to their confidence level greater than or equal to the minimum confidence level, scan all transactions one by one, and find the associations of all rules that meet the conditions, which are also called Strongly correlated material rules.

Divide students into two groups (good and bad) based on the average of the influencing factors table for the primary key connection of student numbers. Initially set the minimum support and minimum confidence of association rules for extraction, conduct multiple experiments and adjust the values of the minimum support and minimum confidence until satisfactory results are obtained. When the minimum support is 0.61 and the minimum confidence is 0.70, satisfactory results can be obtained, as shown in Table 2. Due to the limited number of academic groups, student performance groups were further increased, and they were divided into five groups based on their grades. The student influencing factor table was screened again based on their best and worst grades, and deep mining was conducted to analyze the main influencing factors of students with the best and worst grades. When the minimum support was 0.71 and the minimum confidence was 0.78, satisfactory results could be obtained, as shown in Table 3.

Table 2: Association rules for influencing factors of student grades.

Related items	Confidence level (%)
Learning self-discipline → good	82
Teacher level → good	80
Parents' education level → good	77
Learning self-discipline and teacher level → good	75
Employment rate → good	71

Table 3: Deep mininh of Factors Influencing Student Performance.

Related items	Confidence level (%)
Learning interest → Best	90
Teacher level → best	88
Learning self-discipline → best	85
Learning Initiative → Best	84
Parents' education level → best	82
Learning interest, parents' education level → best	80
Employment rate → best	78

5.2 RESULT ANALYSIS AND APPLICATION

Student performance is influenced by many factors such as individuals, families, schools, and society. From the results of Table 2, it can be seen that self-discipline in learning is the most influential among individual factors. If one wants to achieve good grades, they must comply with school rules and regulations, and the specific requirements of teachers. Among family factors, the education level of parents has the greatest impact, which is consistent with the previous questionnaire survey. Among school factors, the level of teachers has the greatest impact, as the saying goes, 'strict teachers lead to high students', The employment rate among

social factors greatly affects students' learning emotions. In order to further explore the influencing factors of student performance, we selected the two types of students with the best and worst grades for analysis. From Table 3, it can be seen that personal factors have the greatest impact on learning interest, which is consistent with the previous questionnaire survey. Family factors have the greatest impact on family location, while school factors have the greatest impact on teacher level, which is consistent with Table 2. Social factors such as employment rate greatly affect students' learning emotions, Also consistent with Table 2.

University teachers, as knowledge imparters, are also an important part of improving students' academic performance. By fully utilizing the factors that influence students' academic performance, they need to explain to students the role of learning this course in future professional courses and stimulate their interest in learning. In terms of school factors, on the one hand, teachers should continuously improve their professional level, and when giving lectures, they should focus on students, mobilize their enthusiasm, and encourage them to participate in classroom teaching. Before class, students should be assigned preview tasks, and homework should be left after class to improve their self-discipline in learning. Students should provide timely feedback on the completion of various tasks. Teachers cultivate good teacher-student relationships through communication and exchange with students, reflect on their teaching methods, gradually explain knowledge points, and ensure that every student can understand and master the knowledge taught. We should treat every student with sincerity and equality, respect every student who raises questions, patiently explain whether it is difficult or easy, and improve students' initiative in learning.

VI. CONCLUSION

The influencing factors of student performance include many factors such as personal factors, family factors, school factors, and social factors. Firstly, through literature review, questionnaire survey design, statistical survey results, qualitative analysis of the main factors of student performance, and then, based on the massive data of smart campus, select the dataset and use Apriori algorithm for association rule mining, Deeply mining the main influencing factors of students' grades and conduct quantitative analysis to identify the main factors that affect students' grades. The research results not only indicate the direction for students to improve their grades, but also provide reference for university teachers in teaching.

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