Improved Fuzzy Algorithm for College Students’ Academic Early Warning

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Received 25 January 2022; Revised 7 March 2022; Accepted 19 March 2022; Published 15 April 2022

Academic Editor: Naeem Jan

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The existing fuzzy clustering algorithms are mostly fuzzy comprehensive evaluation algorithms based on specific elements, but the main problem of such fuzzy algorithms is the lack of overall research on the responsible individuals and the lack of hierarchy in the algorithms. It is suitable for data mining of academic early warning systems. Therefore, an improved fuzzy algorithm based on fuzzy performance evaluation based on composite elements is proposed, and it is applied to the performance evaluation system to solve the complex problems in performance evaluation. In the process of building smart campuses in colleges and universities, academic prewarning, as the main part of smart campuses, mainly uses data mining technology to ensure students complete their studies smoothly and at the same time provides certain decision-making support for colleges and universities. Based on the research topic of the relevant departments of a certain school, this paper aims to build an academic early warning system suitable for the school to ensure that students can successfully complete their studies. The main research contents are divided into two parts: “study early warning model research” and “design and implementation of an academic early warning system.” Through analysis and experiments, it is proved that the model evaluation effect based on the algorithm improvement is the best, with recall reaching 85%, precision reaching 78.96%, and AUC reaching 80.25%.

1. Introduction

According to the China Education Development Report, there are about 500,000 college students who drop out of school every year, and the ratio is about 0.75 of the students in school. There are problems to be solved in the field of modern education. At present, the academic early warning of domestic colleges and universities is mainly the early warning of academic performance, and the student status can only be dealt with if the course fails. However, there is a lag in this early warning method, the early warning response is not sensitive, and the early warning and assistance are out of touch [1–3]. It is imperative to reform the early warning mechanism and early warning. Improving the accuracy and effectiveness of an early warning is a problem to be solved. In terms of academic counseling, it is crucial to help students adjust to their studies by guiding them to be “mindful” while ensuring study time and participating in more extracurricular activities that can enhance their interest in learning.

Students’ daily behaviors, mental health, participation in activities, ideals, beliefs, etc. are assisted in many aspects, so as to realize the diversification of academic assistance and enhance the initiative of assistance work. Some teachers think that the lack of time investment is the main problem, and they should concentrate on their studies without distractions. Can students with learning difficulties be able to serve as student leaders and participate in extracurricular activities? This is a question that needs to be demonstrated [4–6].

With the increasing enrollment scale of colleges and universities, higher education has changed from elite to popular, and the current learning ability of college students is obviously different from that of the elite education era. At the same time, contemporary college students have distinct characteristics of the times. Faster Internet speed and more traffic make it easier for students to indulge on the Internet and have academic difficulties. It is particularly necessary to establish an efficient academic early warning system to warn
students in time and prevent them from deviating from the correct learning track. Through data analysis, the characteristics of students with academic difficulties can be found out, which can give early warning of learning difficulties and improve the efficiency of academic assistance [7–10].

With the continuous expansion of the enrollment scale of colleges and universities, the quality of students in ordinary colleges and universities has been declining year by year, and the accumulation of students’ failing grades has become increasingly serious, and there are phenomena such as repeating grades, dropping out, or even losing the qualification for obtaining degree certificates [11–13]. Therefore, students are guaranteed to complete their studies normally. Academic achievement has become a topical issue facing higher education. This research is based on the research topic of a relevant department of a certain school and uses data mining technology to build an academic early warning system for undergraduates in a certain school to ensure that students complete their studies normally and provide certain decision-making support for colleges and universities [14–16]. Big data is of great significance to all walks of life, and the education industry is no exception. For example, through data mining techniques, it is possible to clearly and accurately know in advance which students will repeat or even drop out of school due to the accumulation of failed grades and overcome traditional academic management. By counting the lag in the cumulative credits of failed courses, it can effectively improve students’ academic attention, reduce the failure rate of students, improve the teaching quality of the school, ensure that students complete their studies normally, and promote the construction of the school’s digital campus and smart campus [17–20]. At present, more and more colleges and universities have formulated their academic early warning systems and achieved certain results, but there are still many problems in the process of implementation. For example, the data used to establish academic early warning models is single, and there is no suitable academic early warning system that can effectively combine students, teachers, and administrators [21, 22]. Therefore, this paper conducts research based on the relevant data of undergraduate students in a certain school, such as students’ historical performance data, one-card consumption data, and library card swiping record data, combined with four commonly used machine learning classification algorithms, to build an academic early warning model and build academic early warning system to ensure that students complete their studies normally. It is of great significance to promote the construction of smart campuses and digital campuses [23–26].

Based on the research topic of the relevant departments of a certain school, this paper aims to build an academic early warning system suitable for the school to ensure that students can successfully complete their studies. The main research contents are divided into two parts: “Research on the Academic Early Warning Model” and “Design and Implementation of the Academic Early Warning System.” Data and library swipe records are used to predict whether they will be repeated after the fourth semester. Firstly, in data preprocessing, a heuristic missing value filling method is proposed to obtain data features that can be used for grade repetition prediction. Then, the correlation between different features and grade repetition is analyzed to screen features and form different feature sets [27–30]. Four commonly used machine learning classification algorithms, random forest, decision tree, support vector machine, and logistic regression, are used to construct an academic early warning model, and comprehensive evaluation then selects the early warning model with the best prediction effect. Finally, in order to solve the overfitting problem of the selected model in the prediction process and improve the prediction effect of the model, an improved model based on genetic algorithm and a model combination optimization method based on voting ensemble are proposed. The model evaluation effect of the improved algorithm is the best. In the process of design and implementation of the academic early warning system, according to the software requirements of the relevant departments of a certain school, on the basis of the academic early warning model, the Zhima Hypertext Preprocessor (PHP) framework is used, the PHP programming language and the Python programming language are used, and the academic early warning is realized based on the MySQL database system. The system realizes the function of score query and data export and can carry out academic early warning functions from multiple dimensional data of students, so as to ensure that students complete their studies normally and provide certain decision-making support for colleges and universities.

Helping students with learning difficulties in colleges and universities is a complex and important task. The accuracy and effectiveness of empirical assistance are not good. Analyzing the characteristic data of students, identifying students to focus on, and finding key factors related to academic performance is the key to improving effective ways to help. Identify students who need to be focused on before the exam. Some students are prone to learning difficulties due to family factors, learning foundation, educational environment, behavior habits, etc. Reforming the traditional experiential assistance method, adopting the method of data analysis, and finding out the factors that are significantly positively correlated with the students’ performance will help to improve the accuracy of assistance. Students taking the initiative to undertake class affairs can increase their sense of social responsibility, and participating in activities can help students deepen their understanding of professional knowledge, enhance their professional interest, and stimulate their enthusiasm for learning. By strengthening students’ ideological and political education, it can improve students’ ideological awareness, help to establish lofty ideals, and improve students’ confidence.

In the work of early warning and assistance, teachers are the main body of data analysis, management, and implementation of early warning and assistance. They are responsible for data analysis and management, improving the early warning system, formulating assistance measures, maintaining communication with students, providing information feedback, and providing data support for early warning and assistance work. The analysis of student behavior and characteristic data provides the basis for
individualized assistance and precise guidance for students and is an effective means of student education and training. Improving education and teaching methods based on data analysis is an important direction of higher education reform, which is conducive to the continuous improvement of teaching. The effect is to concretize the abstract teaching experience and solidify the good practice. Linking the early warning system with the assistance mechanism based on the database will improve the pertinence of academic assistance, effectively reduce the phenomenon of failing grades, and improve the efficiency of academic assistance. Data analysis of students' characteristics and behavior is an important basis for studying the characteristics of contemporary students. Based on the characteristics of students, the corresponding educational methods are formulated to promote the dynamic matching of educational resources and students' characteristics, which is conducive to continuous improvement of the quality of personnel training and better completion of the “establishment of colleges and universities.” Establishing moral education is the basic mission.

This paper is organized as follows: Section 1 mainly introduces the research background and significance of academic early warning in detail. Section 2 is construction of a linkage mechanism between academic early warning and academic assistance based on big data analysis. Section 3 deals with fuzzy algorithm design. Section 4 is experiment design and analysis. Section 5 is conclusion.

2. Construction of a Linkage Mechanism between Academic Early Warning and Academic Assistance Based on Big Data Analysis

The academic early warning should not be just “fixing sheep after sheep,” but “preparing for a rainy day” in advance. There is a lot of data related to student’s academic status. Students' first-class grades, second-class points, behavior data, and basic characteristics are significantly correlated with their learning conditions. The dynamic matching of the early warning system is very important. The data should be updated in real time, and the index system should be continuously adjusted so that the early warning system is always consistent with the characteristics of college students.

Academic assistance does not require students to study “without distractions,” but to guide students to improve their abilities in an “eclectic” way. The helper needs to help students in terms of state of mind, learning attitude, self-care health, living habits, and participation in activities. Improving comprehensive ability is fundamental not only to improve the score as the goal but also to encourage students to participate in activities, serve as student leaders, improve their ideological awareness, help adjust their mentality, enhance their interest in learning, and establish learning goals, so that they can benefit for life.

Through the analysis of the causes of learning difficulties, the key points and difficulties of academic assistance are clarified. Academic early warning and assistance should be based on the database formed by students' grades, second-class points, behavior data, and characteristics, and assistance should be provided according to the characteristics of students’ support work. Combined with data analysis, it is necessary to establish a linkage mechanism between academic early warning and academic assistance supported by big data analysis, with teachers and students as the center.

In China, due to the relatively late start of research in the education industry, academic early warning has not been paid much attention. However, as the country continues to expand enrollment, the phenomenon of students failing courses is becoming more and more serious, and the country is paying more and more attention to the education of colleges and universities. Therefore, major colleges and universities actively responded to the call, established their own academic early warning mechanism, and made great progress in academic early warning research. It mainly analyzes the behavior characteristics of students based on the consumption data of students' one-card cards, establishes an indicator database based on the basic information of students and course information, builds the best feature set based on grades and behavior data, uses five data mining algorithms for early warning, and finally optimizes through model combination. Improve the model to improve the prediction effect of the model. Some scholars have proposed a student academic early warning model, which helps students improve their academic level from the perspective of technology and methods and builds a model based on students' course performance to predict students' failure and graduation. Some people also proposed a DBSCAN algorithm based on distance optimization for the traditional DBSCAN algorithm and analyzed it based on the relevant data of students. An abnormal N-AdaBoost algorithm based on a multi-classifier is proposed to predict grades. The experimental results show that the use of this method to predict grades has significantly improved the prediction effect. The prediction accuracy of pass and fail is 73.29%, excellent and bad. The non-excellent prediction accuracy reached 73.74%, and the excellent and failed prediction accuracy reached 81.36%. Based on campus multi-source heterogeneous data, combined with Wi-Fi positioning technology, trajectory data mining technology, social network analysis technology, machine learning, and deep learning technology, build student personal behavior portraits and social behavior portraits, design a deep learning network combining various factors Predict students’ academic performance, and design and implement an academic early warning and social analysis system. Based on the online data of college students, the concept of the contribution of websites to professional learning is proposed, the calculation method is given, the learning behavior analysis model is constructed, and the academic early warning system is realized. Good learning status helps college students graduate smoothly. Based on the above analysis, more and more scholars at home and abroad have discovered the significance of academic early warning and fully tapped the potential knowledge of student data. This is also the starting point and ultimate goal of this project. Students complete
their studies normally and promote the construction of campus informatization and digital campus.

3. Fuzzy Algorithm Design

Most of the existing fuzzy clustering algorithms are fuzzy comprehensive evaluation algorithms based on specific elements, but the main problem of this type of fuzzy performance evaluation algorithm is as follows: employee performance evaluation is a multi-element, multi-level evaluation system, and the elemental fuzzy comprehensive evaluation algorithm. There is a lack of overall research on responsible performance evaluation, and the algorithm lacks hierarchy, so the above two types of algorithms are not suitable for data mining of complex employee performance evaluation systems. Machine learning algorithms are regarded as the core of artificial intelligence and the basis for building academic early warning models. Next, we mainly introduce the machine learning algorithms involved in the study of the academic early warning model, including support vector machines, logistic regression, random forests, and decision tree machine learning algorithms.

The fuzzy comprehensive weighted evaluation algorithm for composite elements is as follows:

1. First, the factors that affect the evaluation are classified according to their attributes, and different levels of factors are correspondingly different. After classification, various factors will be reduced. The advantage is that the weight is easy to allocate reasonably, and the weight coefficient will not be too small, so there will be no situation where the fuzzy evaluation “data” of specific elements is submerged. For example, in the performance evaluation system of Hengyang An’s company, four factors are divided into one part, which is consistent with the number of evaluation grades, which can achieve the “accuracy” of fuzzy algorithm calculation to the greatest extent.

2. The fuzzy comprehensive evaluation of specific elements is carried out gradually from the bottom-level factors to the high-level factors. After the evaluation factors are divided into multiple levels, the factors at the lowest level are more specific, and the evaluation results tend to be more reasonable.

3. Comprehensive evaluation is carried out layer by layer according to various factors, and the second, third, ..., n-level fuzzy comprehensive evaluation is obtained at one time.

4. The design idea of “weighting” is introduced because it needs to be designed according to different evaluators such as customers, inspection teams, etc. These evaluators with different identities will have different weights on the evaluation results, so the membership degree is calculated. When adding these weights first, the accuracy of the evaluation can be improved. In the system design, a concept of weighting the evaluation results is defined. The purpose is to avoid the same membership degree in the evaluation results, so that the evaluation results can determine the specific quantitative number. For convenience, we ranked Hengyang A’s employees using the same rank, and the frame of the fuzzy algorithm can be seen in Figure 1.

The weighted specific element evaluation matrix constructed in the improved algorithm must have the same evaluation factors for evaluators with different identities before they can evaluate. Using this system can ensure that the evaluation factors of each employee of Hengyang A can be the same. The algorithm is more accurate for the performance evaluation of the company’s employees. However, when this algorithm encounters a particularly complex evaluation system, the demand for data will be very large, multiple matrix operations will be required, and the efficiency of the program will be significantly reduced. However, with the continuous development of computer hardware, the efficiency of software execution will also increase and will continue to improve. The performance evaluation algorithm based on the fuzzy algorithm is an important problem in knowledge discovery and feature extraction in the performance management system. This paper presents a fuzzy evaluation algorithm based on compound elements. The experimental results in this paper verify the feasibility and effectiveness of the algorithm. This algorithm consumes a lot of time. The next step is to find a method to reduce the time consumption of the calculation method of the complementarity between attributes, and at the same time, the method should be extended to incomplete and inconsistent systems.

The data used in this article were provided by a school information center, and it provided the Oracle database view related to students after desensitization, mainly including the student’s historical score view, student status information view, school department code view, student status exception view, course arrangement, information view, substitute teacher information view, one-card consumption record view, 4 and 6 grades’ view, family situation view and library entry information view, etc. First, the required data are queried through SQL statements and tables and imported into the academic early warning related database to provide data support for the academic early warning model research and academic early warning system.

4. Experiment Design and Analysis

The purpose of this research is to use data mining techniques to build an academic early warning system to ensure that students can successfully complete their studies. Use students’ historical grade data, one-card consumption data, and library card swiping record data to comprehensively predict whether students will be repeated after the fourth semester. Therefore, it is very important to effectively use historical grade data, one-card consumption data, and library card swiping record data, so it is necessary to further process the relevant data of students.
Find as many bugs in the software as possible before it goes into production. The purpose of testing is the process of executing a program in order to find bugs in the program. A good test plan is the one that has a high probability of finding hitherto undiscovered bugs. A successful test is the one that finds a hitherto undiscovered bug. Designing a test plan is a key technical issue in the testing phase. The so-called test scenarios include functions that are predetermined to be tested. There are two methods of testing: black-box testing and white-box testing. Black-box testing, also known as functional testing, is performed at the program interface and only checks whether the program functions can be used correctly in accordance with the specifications, whether the program can properly receive input data and generate correct output information, and whether it is able to maintain complete external information. White-box testing is also called structural testing, which fully understands the structure and processing of the program. This method tests the program according to the logic inside the program to check whether each path in the program can work correctly according to the predetermined requirements.

In the design of the fuzzy performance evaluation system, the weight of the evaluation index is the main core data. The weight of the evaluation index reflects the evaluation content of the employee’s performance under different factors. It is the main responsibility of the company to conduct objective, fair, and impartial performance appraisal for employees, in which each weighted indicator directly affects the comprehensive evaluation results of employees and also plays a very important role in the evaluation and decision-making of employees. To a certain extent, the weight is assigned based on the manager’s experience, which has a certain degree of subjectivity, but through the subjective comprehensive evaluation of different evaluators, it can more objectively reflect the actual situation.

4.1. Calculating the Average Grade of the Course. The average grade of the course usually represents the overall level of the student’s learning, so it is necessary to calculate the average grade of the student’s course. The calculation of the average grade of the course is shown in the following formula:

$$AVG = \frac{\sum_{i=1}^{n} C_{ji}}{n},$$  \hspace{1cm} (1)

$$C_{ji} = \text{mean}(C_1, C_2, C_3, \ldots, C_n),$$  \hspace{1cm} (2)

![Figure 1: Diagram of the fuzzy-based algorithm.](image-url)
mean \( (a, b, c) = \frac{(a + b + c)}{3}. \) \( (3) \)

4.2. Calculating the Credit Acquisition Rate. The credit acquisition rate reflects the percentage of the student’s cumulative credits passing the course examination to the total credits of all the students’ courses. To a certain extent, it reflects the student’s excellent performance. As a result, the student’s credit acquisition rate must be calculated. Equation (4) shows how to calculate the rate.

\[
P_c = \frac{\sum_{j=1}^{n} XFP_j}{\sum_{j=1}^{n} XF_j} \tag{4}
\]

\[
XFP_j = \max(XFP_{j1}, XFP_{j2}, XFP_{j3}, \ldots, XFP_{jn}), \tag{5}
\]

\[
XF_j = \sum_{j=1}^{n} XFP_j, \tag{6}
\]

4.3. Calculating the Grade Point Average for All Courses. The grade point average uses grade points and credits as units of calculation to measure the quality and quantity of student learning. In the course grade data, it can be found that the grade point data corresponding to the student’s course grade has been entered, so there is no need to calculate the grade point corresponding to the course grade. The GPA is calculated as shown in the following equation:

\[
GPAXF_{AVG} = \frac{\sum_{j=1}^{n} GPA_j \timesXF_j}{\sum_{j=1}^{n} XF_j} \tag{7}
\]

By analyzing the student data used in the study of the academic early warning model, including historical grade data, one-card consumption data, and library card swiping data, the field information is understood, and the data are sorted, counted, and preprocessed. Among them, for the students’ historical test scores, it introduces in detail how to deal with missing values of students’ historical scores and how to calculate students’ credit acquisition rate, cumulative passing credits, and average grade point average. For the one-card consumption data, query the data in the table, and sort out the annual consumption indicators of students’ daily consumption. For the library card swiping record sheet, count the number of times each student enters and exits the library, the average entry time, and the total time. At the same time, the characteristic distribution of library card swiping record data and one-card consumption data on average per semester, as well as the potential relationship with academic performance, is analyzed separately. Provide data support and theoretical basis for subsequent model research.

In this study, based on the sample data of undergraduates in the first three semesters of a certain school, it is predicted whether students will be at risk of repeating grades at the end of the fourth semester. However, the cumulative failing grades of a student have a strong correlation with whether or not they are repeated. According to the relevant policies issued by a certain school, after the end of each semester, each college will count the students’ credits and calculate the students’ cumulative total credits. If it is equal to 10 points, an academic warning will be given, and the student’s department will notify the student and their parents (guardians) in a timely manner and track their learning situation. When we conduct the academic year academic status review, those who have failed to pass the exam status will be added to the cumulative failed credits, and finally each student’s cumulative failed credits for the first three semesters will be obtained. Establish a weighted specific element evaluation matrix: first determine the degree of membership of a single factor’s evaluation level on performance, where factor \( u \) results in a fuzzy subset; if the evaluation group formed has \( k \) members, each member will give each factor a rating; if the evaluation factor \( u \) is normal level,

\[
R_i = \left( \frac{ki_1}{k}, \frac{ki_2}{k}, \ldots, \frac{ki_l}{k} \right). \tag{9}
\]

\[
kil = \frac{bi}{\sum_{i=1}^{m} bi}. \]

As shown in formula (8), \( Tc \) represents the semester in which the student took the course exam for the first time. When \( T < 3 \), it means that the student took the exam for the first time in the first three semesters, and then judge the student’s exam status of the course according to the BZ field. If the exam status of the course is “Failed,” the course credits will be added to the cumulative failed credits, and finally each student’s cumulative failed credits for the first three semesters will be obtained. Establish a weighted specific element evaluation matrix: first determine the degree of membership of a single factor’s evaluation level on performance, where factor \( u \) results in a fuzzy subset; if the evaluation group formed has \( k \) members, each member will give each factor a rating; if the evaluation factor \( u \) is normal level,
drawn as abscissa and ordinate, respectively. And the ROC curve was obtained, where the horizontal axis is the false positive rate (FPR) and the vertical axis is the true positive rate (TPR), as shown in Figure 2. Figure 2 is for the standard ROC curve, the horizontal axis is the FPR, and the value of AUC (area under the curve) is the area under the ROC curve, generally the higher the AUC, the better the discriminatory ability of the model.

This paper is based on the research topic of a relevant department of a certain school and aims to use data mining technology to build an academic early warning system to ensure that students successfully complete their studies and avoid repeating grades and losing their degree certificates. Based on the student's historical grade data, one-card consumption data, and library card swiping record data, the study forms different feature sets and uses support vector machine, logistic regression, random forest, and decision tree, 4 common machine learning classification algorithms, to construct students’ academic early warning model and evaluates it. In the experiment, three feature combination methods were selected for repeat prediction, which are as follows:

1. Use only 5 historical performance features for grade repetition prediction.
2. Use 5 historical scores combined with 2 one-card consumption characteristics to predict grade repetition.
3. Use 5 historical achievement features combined with 2 library card swiping features to predict grade repetition.

In order to intuitively represent the effect of grade repetition prediction of three feature combinations, select the best early warning model, calculate the average values of recall, precision, and AUC for grade repetition prediction based on four classification algorithms for different feature sets and compare them, as shown in Figure 3.

As shown in Figure 3, data 1 is to use only the student’s historical grades for grade repetition prediction; data 2 is the student’s one-card consumption index combined with the student’s historical grade index to carry out grade repetition prediction; data 3 is the student’s library credit card data combined with the student’s historical grade data. The comprehensive model evaluation result of data 1 is about 71%, and the comprehensive model evaluation result of data 2 is about 62%. After introducing the students’ one-card consumption data, although the correlation analysis selects the attributes with greater correlation, the prediction effect is better than the introduction of all consumption characteristics. The grade repetition prediction effect has improved, but the effect of grade repetition prediction based only on students’ past performance characteristics has decreased. It shows that the correlation between the students’ one-card consumption index and grade repetition is low, and there are many misjudgments in the prediction process, which leads to the decline of the prediction effect of the model. The comprehensive evaluation results of the model in Experiment 3 are all greater than 72%. Compared with only using students’ historical grades for grade repetition prediction, the evaluation effect of the grade repetition prediction model based on the library card swiping record information is improved. To sum up, as shown in Figure 3, it can be found that the feature set composed of the historical grade data of data 3 middle school students and the credit card record information of the library is based on the decision tree algorithm for grade repetition prediction, and its model evaluation effect is the best, reaching 74.28%; the overall evaluation effect of logistic regression algorithm reached 73.32%; the overall evaluation effect based on support vector machine reached 73.02%; the overall evaluation effect based on random forest reached 73.05%.

As can be seen from Figure 4, the introduction of library card swiping record data for grade repetition prediction has improved the evaluation effect compared to only using the student’s historical score data model. The recall based on the support vector machine algorithm reaches a maximum of 68%, and the other three algorithms are different. The decision tree-based algorithm had the highest accuracy of 74%, followed by the random
forest algorithm reaching 70%, the logistic regression algorithm reaching 75%, and the support vector machine algorithm with the worst evaluation of 62%. The AUC indicators of the four models are all greater than 88%, of which the AUC indicator based on the decision tree algorithm reaches 73%. Although the effect of grade repetition prediction has been improved, the effect is still not ideal. It is hoped that the follow-up work can propose better methods for predicting grade repetition and improve the model’s grade repetition prediction results.

5. Conclusion

This paper aims to use machine learning algorithms to build an academic early warning model and an academic early warning system. However, there are still areas that need to be improved in the research process. Therefore, the next research includes the following points: historical grade data, one-card consumption data, and library card swipe record information, but other student information such as students' work and rest data, and students' mental health data have not been studied. As a result, it is vital to continue to increase the use of data mining technology in other academic data, such as employing multi-dimensional data to research and assess students' academic performance. An academic early warning model is constructed, but the prediction effect of the model needs to be improved, and the research methods need to be innovated. Due to a lack of experience in the software development process, there may also be some shortcomings and deficiencies in the design and implementation of the academic early warning system.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

Acknowledgments

This study was supported by the Department of Education Foundation of Anhui Province (no. 2020jyxm0034).

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