Design and Implementation of Student Management Information Algorithm Based on Cloud Computing

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Abstract: This paper will design and implement a cloud-based student management information platform, aiming to provide efficient and intelligent decision support for school management. In order to allow the school to integrate students' grades, attendance and other data based on the cloud computing platform, to achieve unified management and real-time analysis of data. In this paper, this paper first constructs a student management informatization algorithm framework based on cloud computing and intelligent algorithms, further strengthens and improves the framework, and finally uses the algorithm framework to carry out real-time prediction and evaluation based on cloud computing. The results of the experiment showed that after using the platform, the attendance rate of students increased significantly, especially those with behavioral problems, with an average increase of 10% in academic performance and a 20% reduction in disciplinary action. Comprehensive analysis shows that the platform can greatly improve the management efficiency of schools and provide accurate data support for teaching and management decision-making based on effective integration of student information and intelligent intervention. It can be seen that the design and implementation of student management informatization algorithm based on cloud computing has reliability and practicability.

1 INTRODUCTION

The student management information platform is a key research field in the current education management, and schools are basically faced with the problem of scattered student data and inability to obtain comprehensive information in time. In order to solve these problems, some researchers have proposed that centralized databases can be used to solve the problems, but these methods are not enough to achieve real-time monitoring and dynamic management. Some researchers also proposed that big data analysis technology can be used to achieve effective problem solving by combining various information platforms of the school. However, these methods have poor platform integration and insufficient prediction accuracy. In the existing research, although some methods can achieve the initial integration of data, they do not have enough reliable performance in intelligent intervention and real-time prediction. To this end, this paper uses an intelligent algorithm based on cloud computing to study the student management information platform, which is based on the powerful processing power of the cloud computing platform to fully integrate the multi-dimensional data of students. At the same time, this paper also applies gradient boosting decision tree and other algorithms to achieve accurate prediction and behavioral intervention for students' performance. The advantage of this approach is that the data can be updated in real time and the management recommendations can be tailored to the individual needs of the students. It is hoped that the research in this paper can help schools to greatly improve their management efficiency. At the same time, the advantages of cloud computing are introduced, and the design and implementation of student management information algorithms based on cloud computing are proposed.

2 RELATED WORKS

2.1 Service Details of Cloud Computing

Cloud computing is a framework that provides computing resources based on the Internet, mainly including computing power, storage capacity, and

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network services, and can dynamically allocate resources based on demand (Chen, 2022). Cloud computing is mainly Infrastructure-as-a-Service IaaS, Platform-as-a-Service PaaS, and Software-as-a-Service SaaS. In the student management information platform, the cloud computing platform can provide efficient data processing and storage capabilities, and realize real-time analysis and processing of large-scale data based on distributed computing and elastic expansion. In the midst of this, the elastic scalability of cloud computing (Han, Long, et al 2024) will be able to dynamically adjust resources according to changes in the amount of student data, and then keep the platform running at its best. Using APIs and interfaces, cloud computing can also provide a convenient way to integrate student management platforms (Li, 2023), which in turn enables school administrators to obtain data in real time and make timely decisions.

2.2 Gradient Boosting Decision Tree Prediction Ability in Terms of Students' Multi-Dimensional Features

Gradient Boosting Decision Tree (GBDT) is an ensemble learning algorithm that is based on progressively strengthening multiple decision trees and combining their results to form a powerful prediction framework (Wu, 2023). Based on the iterative optimization loss function, GBDT reduces the error step by step, and each new tree fits the residuals of the previous iteration to continuously improve the prediction accuracy (Xiang, Shuai, et al 2022). In the student management information platform, GBDT can build a prediction framework based on the multi-dimensional characteristics of students, such as grades, attendance, behavior records and other characteristics, so that managers can predict students' future performance in real time. GBDT has excellent generalization capabilities, can handle nonlinear relationships, and provides stable performance in the face of large amounts of data (Xu, Chen, et al 2022).

3 METHODS

3.1 The Overall Architecture of The Student Management Information System Based on Cloud Computing

In this platform, there are several functional elements that need to be included, and each functional element is responsible for its own part. Specifically, the data collection function can collect students' basic information, grades, attendance, behavior data, etc. based on different data sources. These data sources include student management platforms, learning platforms, electronic attendance platforms, etc. With this feature, the platform can automatically integrate various data to provide the basis for subsequent analysis and prediction (Xu, Huang, et al 2022). For example, when a student takes a course, the platform will automatically record their learning behavior and grades. The data preprocessing function is mainly responsible for cleaning and sorting the collected raw data, such as processing missing values, filtering abnormal data, and standardizing data formats. In this way, the data can be consistent and complete, and then the subsequent enhancement of the framework, as well as optimization and prediction, will have high-quality inputs. Feature extraction and selection function to extract important features that have an impact on student performance from the preprocessed data. These characteristics may include test scores, attendance, assignment completion, and more. Based on the distributed processing power of the cloud computing platform, it is possible to quickly select the features that are most useful for the framework prediction. For example, when analyzing student performance, the platform automatically extracts students' performance in different subjects and uses them to predict their overall academic progress.

Framework hardening functional device, which can use large-scale data on the cloud computing platform to carry out distributed framework hardening. The GBDT algorithm is used to enhance the prediction framework to achieve accurate prediction of students' future performance. The parallel computing capability based on cloud computing can significantly improve the hardening efficiency of the framework and shorten the hardening time. For example, the platform is enhanced based on large-scale student achievement data to predict students' next test scores. The real-time prediction and assessment feature can make real-time predictions of newly entered student data based on an enhanced framework. For example, after a student submits an assignment or exam, the platform automatically predicts their future learning performance and the required interventions. This feature can also evaluate the accuracy of predictions and the generalization ability of the framework to provide feedback for subsequent framework optimization. Based on this, school administrators are able to monitor students' academic dynamics in real

time and make data-driven decisions based on them. Security and rights management features that will protect the security and privacy of student data on the platform. Based on the security tool of the cloud computing platform, this functional device can ensure that the data is encrypted during transmission and storage, and that only authorized users can access and manipulate the data. If school administrators only have access to student data that is limited to their area of authority, they can prevent unauthorized persons from viewing sensitive information.

3.2 Design of Student Management Informatization Algorithm Framework Based on Cloud Computing

The goal of feature engineering is to extract and select important features from a large amount of student data that are effective in predicting student performance and management. On the cloud computing platform, based on the collection of students' student status information, achievement data, attendance records, and behavior data, feature selection algorithms, such as mutual information methods, can be used to determine which features can best influence the target variables. For this, see Eq. (1).

$$F_{\text{selected}} = argmax \quad _F (\text{Info}_{\text{Gain}}(F, Y)) \tag{1}$$

F_{selected}Represents the selected set of traits such as student attendance, course engagement, etc., which will have a direct impact on the student's academic performance. FRepresents a collection of all available traits, such as a student's gender, age, grades, etc. $\text{Info}_{\text{Gain}}(F, Y)$ Representation indicates the influence of a characteristic on the target variable, i.e., the contribution to student achievement and management decision-making.

Decision tree initialization is the step that provides the basic structure to the framework. On the cloud computing platform, multiple weak learners, that is, decision trees, can be generated in parallel. Each tree represents a simple prediction framework. For example, the split point of the tree can be a student's test scores, such as math and English scores above a certain threshold. For this, see Eq. (2).

$$h_m(x) = argmin \quad _h \sum_{i=1}^{n} L\,(y_i, h(x_i)) \tag{2}$$

In this formula,$h_m(x)$ represents $m$the output of the first decision tree, which also refers to the prediction according to the current framework. $L(y_i, h(x_i))$

x_iRepresents the loss function, which is used to measure the prediction error of each decision tree. Data characteristics that represent $i$the first student, such as that student's attendance, test scores, etc.

Based on multiple iterations of optimization, the predictive performance of the framework can be improved. In each iteration, the newly generated decision tree is designed to fit the residuals of the previous tree, thereby gradually reducing the prediction error of the overall framework. For this, see Eq. (3).

$$\hat{y}^{(m)} = \hat{y}^{(m-l)} + \eta h_m(x) \tag{3}$$

In this formula,$\hat{y}^{(m)}$ is the prediction of the framework after the first iteration is described$m$, such as predicting a student's final grade. ηRepresents the learning rate, which controls the degree to which each new tree contributes to the overall prediction of the framework. $h_m(x)$ represents $m$the output of the first decision tree, representing the fitting of the residuals of the previous iteration. Based on iteration, the framework can gradually improve the accuracy of predicting students' performance, such as future performance and management needs, and help schools intervene and adjust teaching and management strategies in a timely manner.

3.3 Further Implementation of the Cloud-Based Student Management Information Algorithm Framework

Frame hardening is the process of adjusting frame parameters based on large-scale data reinforcement to more accurately reflect the characteristics of student data. In the student management information platform, the reinforcement data comes from years of student performance, behavior, attendance data, etc. Based on optimization algorithms such as gradient descent method, the prediction error can be further minimized, and the framework can be more accurate.

Framework optimization is a step to improve the performance of a framework after hardening. In the student management information platform, the optimization framework can ensure that it can maintain efficient prediction and management capabilities in various data environments.

The purpose of hyperparameter optimization is to find the optimal framework hyperparameters, such as learning rate and depth of decision tree, so as to improve the applicability of the framework in the student management information platform. A cloud computing platform-based grid search approach that enables testing different combinations of

hyperparameters to find the configuration that works best for the framework. See Eq. (4) for details.

$$\lambda^* = argmin \quad _\lambda \mathrm{CV}(L(W, X, Y, \lambda)) \tag{4}$$

In this formula, $\lambda^*$is the optimal hyperparameter values such as learning rate and depth of the decision tree are described. $\mathrm{CV}(L(W, X, Y, \lambda))$ Represents the value of the loss function under cross-validation, the purpose of which is to measure the performance stability of the framework in different data segments. In the student management information platform, optimizing hyperparameters can ensure that the framework performs consistently in predicting different types of student data, such as different grades and courses, and avoids excessive prediction errors under some sober conditions.

Constraints are also necessary. In the student management information platform, the framework may overfit some specific student data, so it is necessary to limit the complexity of the framework based on constraints. For this, see Eq. (5).

$$L_{\mathrm{reg}}(W) = L(W, X, Y) + \frac{\alpha}{2}||W||_2^2 \tag{5}$$

In this formula, the $\alpha$is constraint setting coefficient is represented and the constraint setting strength is controlled so that the frame does not over rely on certain features. $||W||_2^2$is L2 norm represents the weight vector, which is intended to penalize too large frame parameters and keep the framework stable and concise.

Constraints prevent the framework from relying too heavily on irrelevant features, and ensure that it can make predictions and decisions on new student data.

Evaluating the framework with an independent validation set is a critical step in the optimization process to more effectively test its performance on unseen data. Specific evaluation indicators include accuracy, recall, etc., which can be quickly achieved based on the distributed computing of the cloud computing platform. See Eq. (6) for details.

$$\mathrm{Eval}(M) = \frac{1}{n}\sum_{i=1}^{n} \mathbb{I}\,(\hat{y}_i = y_i) \tag{6}$$

In this formula, $\mathrm{Eval}(M)$ represents the evaluation index of the framework, which can measure the accuracy and effect of the prediction. $\hat{y}_i$Represents the outcome of the first student predicted by the framework$i$. y_iRepresentation of actual student performance, such as real test scores, attendance records.

3.4 Cloud Service Interface and Platform Integration

The task of the cloud service interface is to integrate the functional components of the student management information platform into the existing school management platform, and transmit and share data in real time based on the API interface. It will leverage the standardized service interfaces provided by the cloud computing platform, such as RESTful API, SOAP API, to ensure interoperability between platforms to enable seamless integration of real-time prediction results. For example, when a student's attendance data is updated, the platform automatically invokes the cloud prediction service based on the API to generate the student's performance prediction results in real time and feed them back to the school administrator. In addition, the cloud service interface also supports real-time processing and dynamic adjustment of data streams, ensuring that the platform can quickly predict and update according to new student data (Li, 2023). Based on the cloud-based service-based architecture, the school management platform can not only obtain real-time analysis of student performance, but also automatically adjust management strategies based on the feedback from the framework. For example, when a student's performance warning is triggered, the platform can immediately notify the relevant teachers and parents and take timely interventions.

4 RESULTS AND DISCUSSION

4.1 Background of the Case

In the education management of a key high school in a city, the school faced the challenge of how to manage students' academic and behavioral performance more efficiently. The school has nearly 2,000 students, and their information, including student status, grades, attendance, extracurricular activities and other data, is stored on different platforms, making it difficult for administrators to obtain comprehensive information and make reasonable decisions in a timely manner.

Table 1: Former Student Data for Platform Use.

Student ID	grade	Attendance	Math grades	Behavioral problems
Analyze it.	Three	80%	72	be
Career information.	High school	85%	78	not

Employment intention.	High	90%	88	not
Development planning.	Three	75%	68	be
Causing changes.	High school	92%	85	not

The table shows academic and behavioural problems, in which students with lower attendance also perform poorly and have higher behavioural problems. The programming content of the information system is shown in figure 1.

```
        data: data.wordCounts,
        fill: false,
        backgroundColor: 'rgb(75, 192, 192)',
        borderColor: 'rgba(75, 192, 192, 0.2)',
      },
    ],
  };

  return (
    <div>
      <Line data={chartData} />
    </div>
  );
};

export default ProgressChart;
```

Figure 1: The programming process of information systems.

Through the same system analysis, student information can be regulated and classified to form a data set, which can be discussed and analyzed later. it can be found that the attendance rate of the 6 randomly selected students is generally low, generally only 75%~85%, which leads to their poor academic performance, which is generally concentrated in 68-78 points, and more than 90 points are almost non-existent. Based on this, the school decided to introduce a cloud-based student management information platform, based on the integration of various data, and the application of intelligent algorithms for analysis and prediction, so as to improve management efficiency and formulate new management strategies. Before the introduction of the platform, schools mainly relied on teachers to manually record and manage, and the scattered and lagging update of data seriously affected the timely management of students, such as failing to intervene in time with poor academic performance and behavioral problems.

4.2 Optimization Content of Informatization

Based on the use of this information platform, the school integrates students' academic and behavioral data into the cloud, and applies big data analysis technology to provide comprehensive and real-time student performance evaluation and personalized management suggestions for the school.

Table 2: Data for the first semester after the use of the platform.

Student ID	Attendance	Math grades	Science grades	Improvement in behavioural problems
Analyze it.	90%	80	85	be
Career information.	88%	82	87	not
Employment intention.	92%	90	92	not
Development planning.	85%	78	80	be
Causing changes.	95%	88	89	not

The table shows improvements in attendance, academic performance, and especially for students with behavioral problems. The data of the three tables, it can be seen that after the use of the platform, the attendance rate of students has increased significantly, especially those students with low attendance rates, such as student IDs 101 and 104, from 80% and 75% to 90% and above. These students' math scores also increased from 72 and 68 to 80 and 78. These students have seen significant improvements in their academic performance based on improved attendance. The continuity analysis of students' information design process is carried out to form an effective dataset as shown in Figure 2.

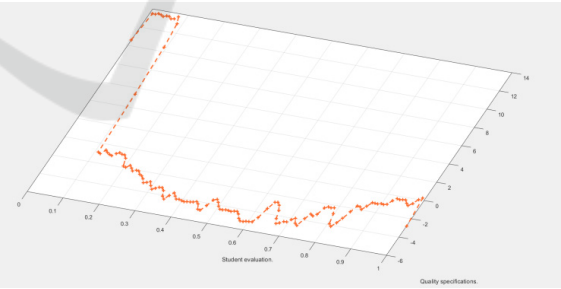

Figure 2: The content and ways of changes in student management information.

The platform effectively identifies and intervenes in students with behavioral problems based on behavioral management functional components, such as student IDs 101 and 104, and under the guidance of the platform, disciplinary actions and behavioral problems are significantly reduced.

4.3 Analysis of the Optimization Results of Student Information

The academic performance of such students has also improved significantly after using the platform, such as 80 points in mathematics and 85 points in science, indicating that behavioral improvement is helpful for academic improvement. In addition, in the second semester after using the platform, the overall academic performance of students continued to improve. The analysis content and conditions are shown in Table 3.

Table 3: Data for the second semester after the platform was used.

Student ID	Attendance	Math grades	English scores	Disciplinary actions are reduced
Analyze it.	95%	85	88	be
Career information.	92%	85	90	not
Employment intention.	95%	92	94	not
Development planning.	90%	82	85	be
Causing changes.	98%	90	91	not

The table shows that the platform continues to improve student attendance, academic performance, and the number of disciplinary actions for students with behavioral problems has also been significantly reduced. Continuously analyze the entire information optimization process and obtain the results shown in Figure 3.

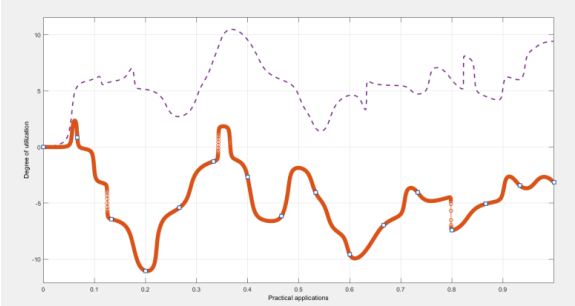

Figure 3: The optimization process of student information.

According to the data analysis in Figure 3, the process of learning information is consistent with the changing demands of cloud computing. students' scores in mathematics with IDs 101 and 105 have increased from 80 and 88 to 85 and 90, and their English scores have also improved. Based on the personalized teaching suggestions provided by the platform, schools can develop targeted academic plans for different students to effectively improve their overall academic performance.

5 CONCLUSIONS

In summary, it can be seen that the design and implementation of the student management informatization algorithm based on cloud computing studied in this paper has been successfully completed. To this end, this paper constructs a corresponding platform, which can effectively improve the management efficiency of schools, based on cloud computing and intelligent algorithms
Integrate and analyze students' multi-dimensional data in real time to achieve accurate prediction of academic and behavioral performance. The platform not only improves student attendance and academic performance, but also reduces the occurrence of disciplinary problems based on intelligent behavioral interventions. Based on the efficient data processing capability of the cloud computing platform, the school can also realize personalized management strategies and update them in real time, so as to provide strong technical support for student management informatization. In short, the platform can successfully solve many problems in traditional student management, such as data fragmentation and post-management, and greatly improve the quality of education in schools. However, the research in this paper still has the problem of insufficient data comprehensiveness, and it is expected that further improvements will be made in the future.

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