Web Based Adaptive Integration Method of College Students' Comprehensive Quality Evaluation Data

Wenjing Liu[1](✉) and Haidi Yuan[2]

[1] Student Affairs Office, Fuyang Normal University, Fuyang 236000, China
dsd232w1@163.com

[2] Anhui Sanlian University, Hefei 230601, China

Abstract. In order to quantitatively analyze the comprehensive quality of college students, an adaptive integration method of college students' comprehensive quality evaluation data based on Web is proposed. Build a Web network model to simulate the evaluation process of college students' comprehensive quality and obtain quantitative evaluation data. After the evaluation data is cleaned and transformed, the random forest algorithm is used to determine the evaluation data type, and the adaptive integration result of the comprehensive quality evaluation data of college students is obtained. The experimental results show that the integrity coefficient of the integration results of the proposed method is about 0.047 higher than that of the comparison method, while the redundancy coefficient is reduced and the reliability coefficient is significantly improved. Applying it to the retrieval of evaluation data can effectively speed up the data retrieval.

Keywords: Web Network · Comprehensive Quality of College Students · Quality Evaluation Data · Adaptive Integration

1 Introduction

The comprehensive quality evaluation of college students refers to an evaluation task organized by secondary schools all over the country to evaluate the overall comprehensive quality and ability of all students at the end of each semester or academic year [1]. Due to the large number of college students and the large number of comprehensive quality indicators to be evaluated, the evaluation results are characterized by large amount of data and complex types. In order to achieve rapid retrieval and efficient management of the comprehensive quality evaluation data of college students, an adaptive integration method for the comprehensive quality evaluation data of college students is proposed.

Data integration is a data integration method that collects, sorts, cleans and converts data from different data sources into a new data source, providing data consumers with a unified data view. At this stage, more mature data integration methods include: data integration methods based on SOA software architecture, data integration methods based on

B. Wang et al. (Eds.): ICMTEL 2023, LNICST 532, pp. 174–189, 2024.
https://doi.org/10.1007/978-3-031-50571-3_13

sample weight update, and data integration methods based on wavelet transform. However, when applying the above traditional data integration methods to the integration of college students' comprehensive quality evaluation data, there are problems of poor integration quality, mainly reflected in incomplete evaluation data integration The poor redundancy of integrated data will ultimately affect the retrieval efficiency of comprehensive quality evaluation data. In order to solve the problems of the above integration methods, the Web network is introduced.

The hypertext transfer protocol in the Web network can complete data integration with higher quality. Therefore, this paper proposes Liu Wenjing's adaptive integration method of college students' comprehensive quality evaluation data based on Web. Apply Web network and related technologies to the adaptive integration of college students' comprehensive quality evaluation data in order to improve the data integration effect and application performance..

2 Design of Adaptive Integration Method for Comprehensive Quality Evaluation Data

Users have different requirements for real-time, consistency, query efficiency, etc. of different data information acquisition, so different data integration methods need to be used to meet users' needs. Figure 1 shows the principle block diagram of data integration of college students' comprehensive quality evaluation.

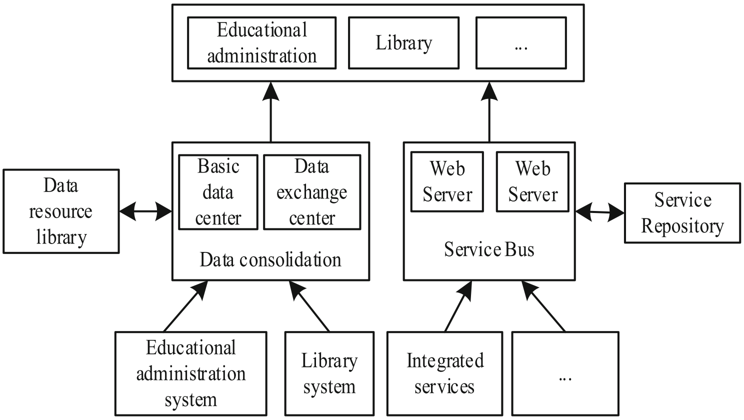

Fig. 1. Principle block diagram of comprehensive quality evaluation data integration

Data exchange and service invocation are adopted to realize data integration, and different application requirements adopt different methods.

2.1 Building a Web Network Model

The purpose of the Web network model is to provide equipment support for the collection and transmission of college students' comprehensive quality evaluation data. The

Web network is deployed in the storage and management environment of college students' comprehensive quality evaluation data, and the corresponding model is generated according to the operation mode and composition structure of the network. The adopted Web network is based on the three-tier structure of the browser server, which provides a unified interface for most end users. The workload of the browser side is less. Most of the processing of the system is carried out on the server side, making full use of the computing resources on the server side [2]. The composition structure of the Web network is shown in Fig. 2.

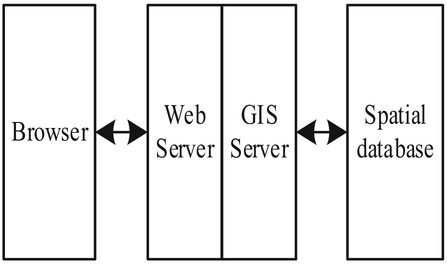

Fig. 2. Web network composition structure

The generating node of the comprehensive quality evaluation data of college students is taken as the Web network node, and each unit will have energy consumption. The energy consumption generated by the Web network node in the working state can be expressed as Formula 1:

$$E_i = E_{\text{pro}}(i) + E_{\text{tran}}(i) + E_{\text{perc}}(i) \tag{1}$$

where, $E_{\text{pro}}(i)$, $E_{\text{tran}}(i)$ and $E_{\text{perc}}(i)$ respectively represent the energy consumption of the processor unit, data transmission unit and data sensing unit in the Web network. In the Web network environment, TCP/IP protocol is used as the transmission protocol for data transmission. The working principle of this protocol is shown in Fig. 3.

It can be seen from Fig. 3 that under the constraint of TCP/IP protocol, the collection of college students' comprehensive quality evaluation data needs to go through three handshakes. The first handshakes: the client sets the flag bit SYN to 1, randomly generates a value seq = J, and sends the data packet to the server. The client enters SYN_ SENT status, waiting for server confirmation. The second handshake: After the server receives the data packet, the flag bit SYN = 1 knows that the client requests to establish a connection. The server sets the flag bit SYN and ACK to 1, ACK = J + 1, randomly generates a value seq = K, and sends the data packet to the client to confirm the connection request. The server enters SYN_ RCVD status [3]. The third handshake: After receiving the confirmation, the client checks whether the ack is J + 1 and ACK is 1. If it is correct, set the flag ACK to 1, ACK = K + 1, and send the data packet to the server. The server checks whether the ACK is K + 1 and ACK is 1. If it is correct, the connection is established successfully. The client and server enter the ESTABLISHED state, complete the three handshake, and then the client and server can start to transmit data. The working

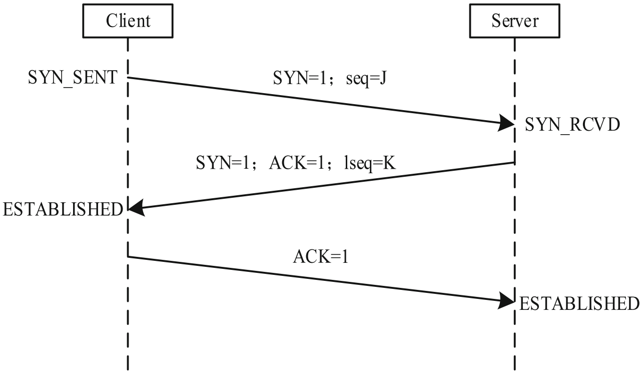

Fig. 3. Working principle of web network transmission protocol

mechanism of each node of the Web network is substituted into the network structure to complete the construction of the Web network model.

2.2 Simulate the Comprehensive Quality Evaluation Process of College Students

As the comprehensive quality of college students is a qualitative indicator, in order to obtain the comprehensive quality evaluation data of college students, quantitative test indicators need to be set, as shown in Table 1.

Among the above comprehensive quality indicators of college students, except for professional course scores and physical education scores, other indicators are evaluated by scoring. The evaluation results of professional course scores are shown in Formula 2:

$$\tau_{\text{achievement}} = \frac{\sum_{i=1}^{n} (F_i \times g)}{\sum_{i=1}^{n} F_i} \tag{2}$$

where, F and g represent course credits and grade points respectively. In the same way, we can get the calculation results of sports performance, and use the subjective scoring method to get the evaluation results of other indicators, which are marked as τ_{i}, and calculate the corresponding weight value of the evaluation indicators, which are marked as ω_{i}. Use Formula 3 to check the consistency of the initial calculated weight value.

$$\begin{cases} CR = \dfrac{CI}{RI} \\ CI = \dfrac{\lambda_{\max} - n_{\text{Evaluation}}}{n_{\text{Evaluation}} - 1} \end{cases} \tag{3}$$

In the formula, CI is the relative consistency indicator, RI is the integrity indicator, $n_{\text{Evaluation}}$ is the set number of quality evaluation indicators, and $\lambda_{\max}$ is the maximum

Table 1. Setting Table of Comprehensive Quality Evaluation Indicators for College Students

Level I indicators	Level II indicators	Level III indicators
Ideological and moral quality	Political quality	Political attitude
		Political theory competition
		The course of joining the party and its cultivation
	Ideological quality	Diligent and dedicated
		Style of study
		Voluntary service activities
	Moral quality	Family morality
		Professional ethics
		Compliance with disciplines and laws
Professional quality	Classroom quality	Public basic courses
		Professional basic courses
		Elective courses
	Second classroom quality	Social practice
Physical and mental health	Physical quality	Status of sports reaching the standard
		Physical condition
	Psychological quality	Self control ability
		Setback attitude
Humanistic quality	Quality of humanistic theory	Culture and art education
		Literary contests and works publishing
	Humanistic practice quality	Aesthetic quality
Competence	Scientific and technological innovation ability	Scientific research activities
		Science and technology competition
	Logical expression ability	Logical thinking ability
		Oral expression ability

characteristic value of the evaluation indicators. Finally, *CR* is calculated with satisfactory consistency, which proves that the calculated weight is objective and acceptable [4]. The final result of the comprehensive quality evaluation of any student in the university is Formula 4:

$$p = \sum_{i=1}^{n_{\text{Evaluation}}} \tau_i \cdot \omega_i \tag{4}$$

Put the relevant data into Formula 4 to complete the evaluation of college students' comprehensive quality, and store the evaluation data in the storage database.

2.3 Mining the Comprehensive Quality Evaluation Data of College Students

According to the evaluation process of college students' comprehensive quality, in the Web network environment, the evaluation data is mined according to the flow in Fig. 4.

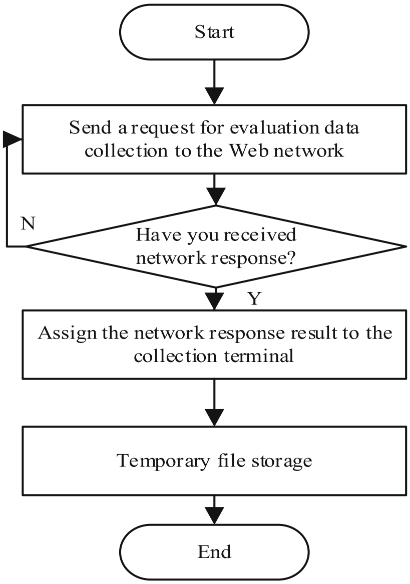

Fig. 4. Data mining flow chart of student comprehensive quality evaluation

For fixed information, when writing code, write keywords into the program. When extracting quality evaluation data, just intercept the content near the keywords.

2.4 Use the Web Network to Transmit Quality Evaluation Data

The real-time collected student comprehensive quality evaluation data is transmitted through the Web network to ensure that the collected evaluation data can be stored in the same device [5]. The evaluation data sender always keeps a variable β, which is used to evaluate the marking of data packets and is updated in each RTT, as shown in Formula 5:

$$\beta = (1 - \varpi) \times \beta + \varpi \times \kappa_{\text{proportion}} \tag{5}$$

where, ϖ is the transmission channel weight, and $\kappa_{\text{proportion}}$ is the proportion of marked evaluation data in all evaluation data. The receiver of the Web network adjusts the congestion window according to the data marking. The adjustment result is shown in Formula 6:

$$\delta = \delta \times \frac{1-\beta}{2} \tag{6}$$

where, δ is the congestion coefficient of the data transmission channel. The calculation result of Formula 5 is substituted into Formula 6, and the congestion coefficient of the Web network data transmission channel is adjusted to ensure that the real-time collected college students' comprehensive quality evaluation data can be stably input to the implementation equipment of the integration method.

2.5 Cleaning and Conversion of College Students' Comprehensive Quality Evaluation Data

The data cleaning process is different according to different task requirements and environmental characteristics. According to the summary of general cleaning tools, the general process of data cleaning can be divided into four parts, and its implementation principle is shown in Fig. 5.

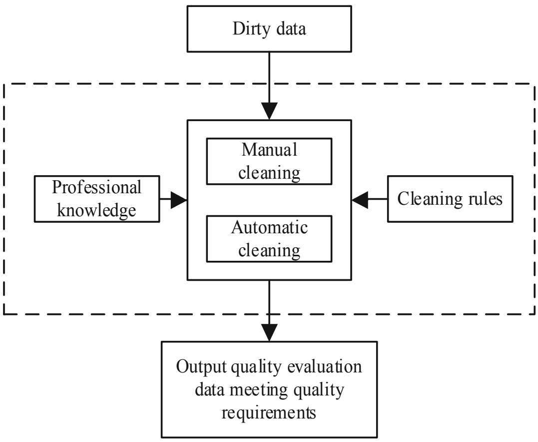

Fig. 5. Schematic Diagram of Data Cleaning for Student Comprehensive Quality Evaluation

The principle of data cleaning is to analyze the causes and existing forms of "dirty data", use existing technical means and methods to clean "dirty data", and convert "dirty data" into data meeting data quality or application requirements, so as to improve the data quality of the dataset [6]. Data cleaning mainly uses the idea of backtracking to analyze data from the source of "dirty data", inspect each process of data set, and extract rules and strategies for data cleaning. Finally, apply these rules and policies to the dataset to discover "dirty data" and clean "dirty data". The strength of these cleaning rules and strategies determines the quality of data after cleaning. There are two main types of data quality problems. One is related to data patterns, that is, pattern level data quality problems. The other is related to data itself, that is, instance level data quality problems. The objects and methods of data cleaning are also different at the schema level and instance level. Schema level data quality problems are mainly caused by unreasonable structure design and lack of integrity constraints between attributes. It mainly includes naming conflict and structure conflict. Naming conflict mainly refers to homonymy and synonymy. The former refers to that the same name represents different objects, while the latter refers to the opposite. Different names represent the same object. Structure conflicts are mainly caused by different object representations in different data sources. For example, type conflict, dependency conflict, keyword conflict, etc. The instance level dirty data cleaning method is mainly divided into three parts: null value cleaning, error data cleaning, and duplicate data cleaning. Null value is a common problem in data cleaning [7]. The general null value problem can be divided into two types: one is missing value, the other is null value. Missing value means that the value actually exists but is not stored in the field to which the value belongs. Incorrect data refers to the inconsistency between the comprehensive quality evaluation data of college students and the original evaluation data in the process of transmission or collection, while duplicate data refers to the data repeatedly collected or transmitted. The compensation result of missing data in the comprehensive quality evaluation of college students is shown in Formula 7:

$$x = \frac{x_{t-1} + x_{t+1}}{2} \tag{7}$$

In the formula, x_{t-1} and x_{t+1} represent the collected data at the last time and the next time of missing data respectively. If the missing evaluation data is not unique, you need to supplement the missing data one by one until all evaluation data are supplemented. The abnormal data in the comprehensive quality evaluation data of college students is mainly caused by the noise in the data acquisition and transmission environment, so wavelet denoising is used to process the abnormal data in the evaluation data. The wavelet domain denoising method uses the different characteristics of the wavelet coefficients of data and noise in the wavelet domain. The amplitude of the wavelet coefficients of data and noise varies with the scale. With the increase of the scale, the wavelet coefficients of noise decay quickly, while the wavelet coefficients of data are basically unchanged. It can also be described as follows: the noisy data is decomposed on multiple scales, and then according to the characteristics of the wavelet coefficients of data and noise on different scales, corresponding rules are constructed to deal with the wavelet coefficients nonlinearly, The purpose is to retain the wavelet coefficients of the data to the maximum extent, eliminate the wavelet coefficients of the noise, and finally reconstruct the processed wavelet coefficients [8] using the inverse wavelet transform to restore the effective data. The filtering process of abnormal data can be quantified as Formula 8:

$$x' = \begin{cases} x, \ |x| \geq \sqrt{\sigma^2 \ln x_{\max}} \\ 0, \ |x| < \sqrt{\sigma^2 \ln x_{\max}} \end{cases} \tag{8}$$

where, σ is the standard deviation of the collected data, and $x_{\max}$ is the maximum value in the comprehensive quality evaluation data. In the process of processing repeated quality evaluation data, first use Formula 9 to measure the similarity between any two evaluation data.

$$s = \frac{\|x_i\|^2 \|x_j\|^2}{\left(\|x_i\| \|x_j\|\right)^2} \tag{9}$$

where, x_i and x_j are the i and j evaluation data in the collection results respectively. If the calculated value of s is higher than the set threshold value s_0, then x_i and x_j are considered to be duplicate data, and either of them is deleted; otherwise, they are considered to be non duplicate data, and the similarity measurement of the next group of data is performed until all the data collected are measured and filtered. Finally, the finished student comprehensive quality evaluation data will be converted and processed, as shown in Fig. 6.

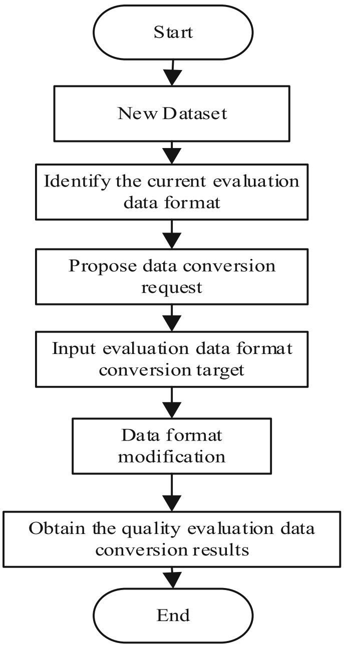

Fig. 6. Comprehensive Quality Evaluation Data Conversion Process

After the processing in Fig. 6, ensure that the collected comprehensive quality evaluation data format is the same.

2.6 Self Adaptively Divide the Data Type of Students' Comprehensive Quality Evaluation

The random forest algorithm is used to classify and process the collected and processed comprehensive quality evaluation data of students. The random forest is a method proposed to solve the problem of over fitting of decision trees. This method adopts the

Bagging integrated learning idea and the advantages and characteristics of the random subspace algorithm.

The random forest algorithm [9] includes two steps: training and decision-making. First, it needs to preprocess the given sample data, and then divide the processed samples into two parts according to a certain proportion for model training and result testing. In the training process, the Bootstrap sampling technology is used to extract equal large k-subsets from the total sample set, and the decision tree is constructed for each subset. The decision tree needs to select the optimal attribute for each node according to some rules to classify. This step requires that all training samples repeated to the node are of the same type, and the training process is completed at this time. The decision-making formula is Formula 10:

$$f(x) = \arg\max_{C} \sum_{i=1}^{k} h(r_i(x) = C) \tag{10}$$

In the formula, x refers to the collected and processed evaluation data samples, C refers to the output variable, that is, the classification label, and $h(x)$ and r_i correspond to the indicative function and a single decision tree. In the test process, the data set without type is input, and the classification results of k decision trees can be obtained through the trained random forest algorithm. Vote the k results to complete the classification prediction of samples. Stochastic forest algorithm optimizes the overall performance of the classification system mainly through the comprehensive optimization of several weak classifiers. The advantages of random forest algorithm lie in its fast algorithm speed, strong anti noise ability, difficulty in over fitting, etc. It can generalize error, balance error input, quickly maintain classification accuracy, and can be used in unsupervised learning tasks. Determine the type of students' comprehensive quality evaluation data according to the above formula.

2.7 Realizing Adaptive Integration of Students' Comprehensive Quality Evaluation Data

According to the classification results of students' comprehensive quality evaluation data, use Formula 11 for adaptive integration of evaluation data:

$$W = \frac{\gamma \times \varsigma_{\text{Statistics}}}{f(x) \times \omega_{\text{state}}} \oplus A_{\text{integration}} \oplus g_{\text{integration}} \tag{11}$$

where, γ refers to the correlation between integrated data, $f(x)$ refers to the data classification processing result, $\varsigma_{\text{Statistics}}$ and ω_{state} correspond to the statistical characteristics and status weights between evaluation data, $A_{\text{integration}}$ refers to the data integration range, and $g_{\text{integration}}$ refers to the data integration rules [10]. By substituting the relevant data into Formula 11, the adaptive integration result of the comprehensive quality evaluation data of college students can be obtained.

3 Experimental Analysis of Integrated Performance Test

In order to test the data integration performance of the Web based adaptive integration method of college students' comprehensive quality evaluation data and the application performance of the integration method in data retrieval, the comparative test method is adopted, that is, the traditional data integration method based on SOA software architecture and the data integration method based on sample weight update are set as the experimental comparison method The analysis of redundancy and the statistics and comparison of the evaluation data retrieval speed after the application of different integration methods reflect the advantages of the optimization design method in the integration performance and application performance. Among them, the data of the data integration method based on SOA software architecture is accessed through the integration layer, and the service implementation itself is responsible for defining and supporting the verification, storage and retrieval rules for special data sets. The data integration method based on sample weight update indirectly increases the weight of minority samples by SMOTE on minority samples according to the prediction results of the base classifier during the boosting process, and uses the updated FocalBoost algorithm to achieve data integration.

3.1 Configuration Integration Method Operation and Test Environment

The optimized Web based adaptive integration method of college students' comprehensive quality evaluation data is developed under Windows 7 operating system. The basic functions are implemented in Java language to meet the portability and good cross platform performance of the system. Eeclipse 3.6.2, an open source Java based extensible development platform, and its visual programming plug-in are used. The Eeclipse development environment supports Java development well. The database management system used is Oracle 11G, which uses JDBC to access Oracle database. Use Java's XML API (DOM4J) to complete XML document parsing. In order to ensure the normal operation of the design integration method, it is also necessary to configure the hardware environment, embed 2 GHz CPU and 256 M memory in the main test computer, and finally complete the operation and debugging of the integration method on Jbuilder 2005.

3.2 Prepare Data Samples for Comprehensive Quality Evaluation of College Students

The experimental data used in this experiment is the test data generated by the data generator compiled by the Febrl system. Febrl provides an open source data connection framework based on the teaching field, which is mainly used to standardize and clean the data in the field of students' ideological and moral education. The data samples of students' daily behavior tracks generated in it are shown in Fig. 7.

In addition, the data generated by the test data generator includes name, address, age, contact number, postal code, ID number, college students' Ideological and political education, daily behavior data, mental health education data, etc. the original data information is from the student information management platform of a college. The program can control various situations in which the generated duplicate records introduce errors,

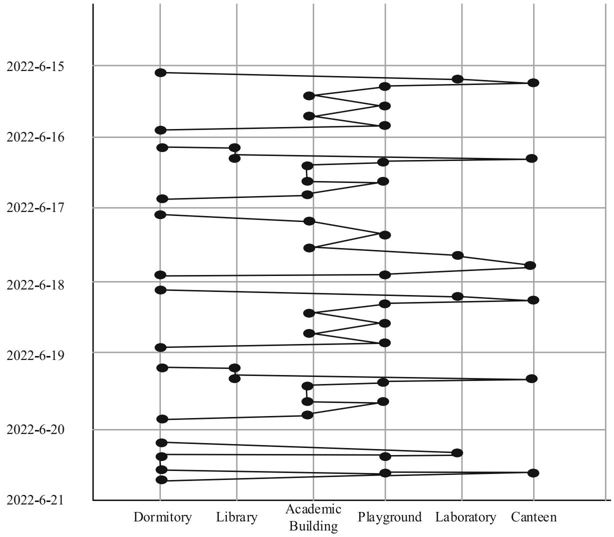

Fig. 7. Sample Generation Results of Students' Daily Behavior Trajectories

including the number of errors introduced by each record and the number of errors introduced by each field. In addition, the size of the original data generated, the number of duplicate records, the maximum number of duplicate records generated for each record, the proportion of introducing a single character error, setting a field value to null, and inverting a field value can also be controlled. The advantage of this generator is that the location and type of errors introduced are designed according to the research on real world typesetting and related errors, which can simulate real world data well. The test data generated by the generator is an excel file. In the experiment, SQL Server 2000 is used to import it as a data table.

3.3 Setting Integration Performance Test Indicators

Set data integration integrity coefficient, redundancy coefficient and reliability coefficient as quantitative test indicators to evaluate data integration performance. The numerical results of data integration integrity coefficient are shown in Formula 12:

$$\mu_{complete} = \frac{N_{integration}}{N_{sample} - \frac{1}{2}N_{redundancy}} \tag{12}$$

where, $N_{integration}$, N_{sample} and $N_{redundancy}$ respectively represent the integrated output of comprehensive quality evaluation data, the amount of sample data prepared and the amount of redundant data in the set samples. In addition, the test results of data redundancy coefficient and reliability coefficient are shown in Formula 13:

$$\begin{cases} \mu_{redundancy} = \frac{\frac{N_{repeat}}{2}}{N_{integration}} \\ \mu_{reliable} = \frac{N_{integration} - k_l}{\vartheta_{difference}} \times 100\% \end{cases} \tag{13}$$

where, N_{repeat} is the amount of duplicate data in the integration result, and k_l and $\vartheta_{\text{difference}}$ correspond to the data integration number and difference. Finally, the higher the integrity coefficient and reliability coefficient, the lower the redundancy coefficient, which proves that the better the integration performance of the adaptive integration method of the corresponding college students' comprehensive quality evaluation data. In addition, the data retrieval delay is set as the test index of the application performance of the integration method, and the numerical result is Formula 14:

$$\Delta t = \left| t_{\text{output}} - t_{\text{input}} \right| \tag{14}$$

In the formula, t_{input} represents the input time of the student's comprehensive quality evaluation data sample, and t_{output} represents the output time of the integrated results. The higher the value of calculation index Δt, the better the application performance of the corresponding integration method.

3.4 Experimental Process and Result Analysis

3.4.1 Adaptive Integration Performance Test of Evaluation Data

Under the configured experimental environment, complete the development and operation of the optimization design method, and substitute the prepared data samples of college students' comprehensive quality evaluation into the integration program to obtain the integration results, as shown in Fig. 8.

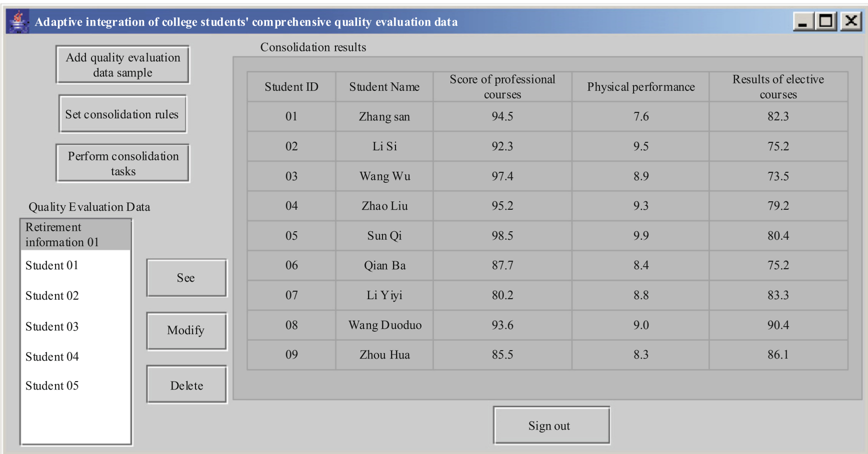

Fig. 8. Adaptive Integration Results of Comprehensive Quality Evaluation Data

Similarly, the development and operation of the comparison method can be completed, and the corresponding integration results can be obtained. Through the volume of relevant data, the test results of data integration integrity coefficient indicators are obtained, as shown in Table 2.

Table 2. Data Table of Data Integration Integrity Factor Test

Number of evaluation data samples/GB	Number of redundant data samples/GB	SOA software architecture Integrate data volume/GB	Sample weight update Integrate data volume/GB	Web network method to integrate data volume/GB
68.4	0.8	62.8	63.4	66.8
75.2	0.4	72.6	72.8	75.0
55.6	0.2	54.4	54.2	55.3
38.1	0.6	35.3	35.5	37.6
44.5	0.4	43.0	43.2	44.1
50.6	0.6	47.2	47.6	50.2
37.4	0.5	33.8	35.2	37.0
65.7	0.5	61.4	61.7	65.3

By substituting the data in Table 2 into Formula 12, the average data integration integrity coefficients of the comparison method are 0.945 and 0.954, respectively, and the average integrity coefficients of the optimization design method are 0.996. In addition, the test comparison results of data redundancy coefficient and reliability coefficient are obtained through the calculation of Formula 13, as shown in Fig. 9.

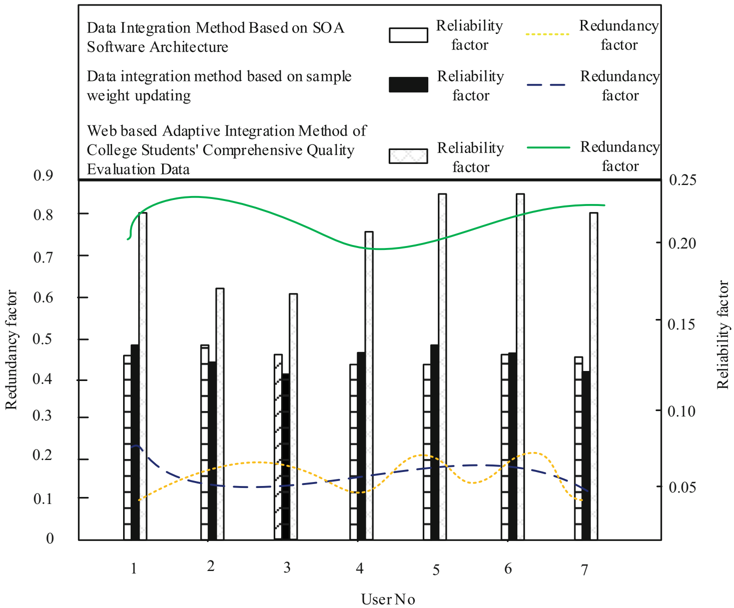

Fig. 9. Test results of data integration redundancy and reliability factor

It can be seen intuitively from Fig. 9 that compared with the traditional integration method, the optimization design integration method has lower redundancy coefficient and higher reliability coefficient, that is, the optimization design method has higher integration performance.

3.4.2 Evaluate the Application Performance of Data Adaptive Integration Method

Apply the integration method of comprehensive quality evaluation data to data retrieval, record the input time of search words and the output time of search results, and obtain the test results reflecting the application performance of the integration method through the calculation of Formula 14, as shown in Fig. 10.

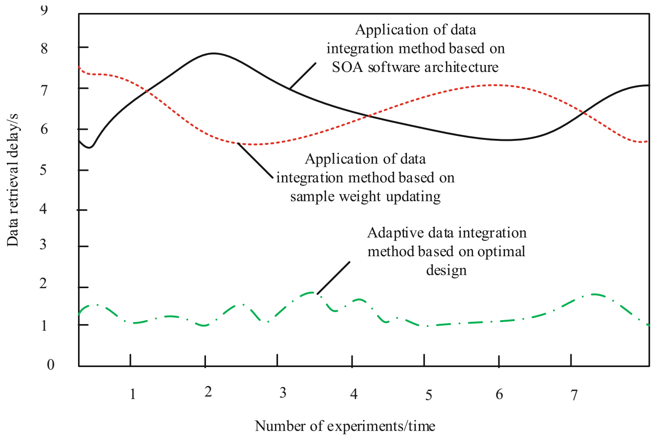

Fig. 10. Application performance tetst results of evaluation data integration method

Through the average value calculation, it can be concluded that the average value of data retrieval delay under the two comparative integration methods is 7.4 s and 6.8 s respectively, while the average data retrieval delay obtained by the adaptive integration method of Web based comprehensive quality evaluation data of college students using optimal design is 1.7 s, that is, the optimal design integration method has higher application performance.

4 Conclusion

The comprehensive quality of college students is the basis for students to establish correct values and world outlook, and also lays the foundation for students' learning. Through the evaluation of the comprehensive quality of college students and the analysis of the evaluation data, it can not only reflect the basic quality of students, but also provide reference for the development of ideological and political education of college students, with high research value. The next step is to apply this method to more colleges and universities for verification, and further analyze the integration effect of the proposed

Web-based adaptive integration method for college students' comprehensive quality evaluation data. And find out the deficiencies in the integration in the experimental test to further improve the application scope of this method.

References

1. Zavalina, O.L., Burke, M.: Assessing skill building in metadata instruction: quality evaluation of dublin core metadata records created by graduate students. J. Educ. Library Inform. Sci. **62**(4), 423–442 (2021)
2. Vitali, E., Gadioli, D., Palermo, G., et al.: An efficient monte carlo-based probabilistic time-dependent routing calculation targeting a server-side car navigation system. **9**(2), 1006–1019 (2021)
3. Durgadevi, P., Srinivasan, S.: Resource allocation in cloud computing using SFLA and cuckoo search hybridization. Int. J. Parall. Programm. **48**(3), 549–565 (2018). https://doi.org/10.1007/s10766-018-0590-x
4. Li, L., Dong, J., Zuo, D., et al.: SLA-aware and energy-efficient VM consolidation in cloud data centers using host state 3rd-order markov chain model. Chin. J. Electron. **29**(6), 1207–1217 (2020)
5. Guo, T., Shi, S., Yuan, J.: Missile data acquisition storage device design. J. Ordnance Equip. Eng. **41**(6), 160–163 (2020)
6. Hao, G., Haibin, L., Jiao, F., et al.: Ship AIS data quality evaluation algorithm based on big data processing. Comput. Simul. **39**(2), 298–303 (2022)
7. Rahul, K., Banyal, R.K.: Detection and correction of abnormal data with optimized dirty data: a new data cleaning model. Int. J. Inform. Technol. Decision Making **20**(02), 809–841 (2021)
8. Nagaveni, K.: Haar wavelet collocation method for solving the telegraph equation with variable coefficients. Int. J. Appl. Eng. Res. **15**(3), 235–243 (2020)
9. Bedolla-Ibarra, M.G., del Carmen, M., Cabrera-Hernandez, M.A., Aceves-Fernández, S.-A.: Classification of attention levels using a random forest algorithm optimized with particle swarm optimization. Evol. Syst. **13**(5), 687–702 (2022). https://doi.org/10.1007/s12530-022-09444-2
10. Mekala, M.S., Jolfaei, A., Srivastava, G., et al.: Resource offload consolidation based on deep-reinforcement learning approach in cyber-physical systems. IEEE Trans. Emerg. Topics Comput. Intell. **6**(2), 245–254 (2020)