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Research Article

Analysis of Home-School Collaboration Mechanism and Psychological Impact Based on MultiSource Big Data Information Fusion

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Affected by the global epidemic, teachers and students need to study related courses online, which have become a new inevitable trend for the construction of online courses. Introduce new technologies and apply mature big data to the field of education. Through information fusion processing of multisource data, we can effectively integrate educational resources and improve educational level. The research results of this article show that (1) different identity roles have different needs and problems for home-school collaboration, which needs to be designed from reality. (2) $P < 0.01$ indicates that there are significant differences in parents' evaluation in different areas; $P > 0.05$ indicates that parents' evaluation has nothing to do with gender, and there is no overall difference. (3) Compared with BPNDA and SOFMDA, CNNMDA has the advantages of slow growth of error rate, high efficiency of data fusion, and 7.5% reduction of energy consumption of network nodes, showing excellent performance. (4) There is no abnormality in the function of user portrait after detection, the expected effect is over 80%, and the concurrent times per second are about 441 times. The final result of the experiment is very good. Meet our design and expectations. The follow-up work can also optimize the details.

1. Introduction

In recent years, our good scientific research ecology has stimulated the rapid development of high-tech in China, and today's scientific and technological wisdom is no longer comparable to that of the past. As the saying goes, "If you are new, you will be new every day." With the changes of the times, big data is widely used in all walks of life. It quietly enters every corner of people's life and work, constantly creating new values and opportunities. Using the special processing algorithm of multisource data fusion, it can effectively reduce the energy consumption of the network and solve the problems of data fusion efficiency and accuracy. Especially in recent years, due to the impact of the global epidemic, it has become the norm for most large, middle, and primary schools to complete their studies by using convenient online courses. Schools also need to supervise students' psychological and academic conditions and impart knowledge. In view of previous experiences and practical cases, this paper uses the technology of multisource big data information fusion, uses WeChat platform to serve home-school collaborative education, and pays attention to students' academic and psychological impacts. This paper discusses the trend and realization path of college education management in the era of big data [1]. To explore how adolescents' mental health, academic performance and illegal behavior are related to the protection of family and friends and risk factors [2]. This paper studies the shyness and psychological maladjustment in friendship choice through the Internet [3], to explore the influence of isolated environment on people's psychological and physiological health [4], improve the system and mechanism of home-school collaborative organization [5], constructing the "revolving door" of home-school resource education [6], constructing collaborative education mechanism with Chinese characteristics [7], Explore the connotation of moral education in universities, middle schools, and primary schools [8], and constructing collaborative education mechanism according to the

functions of college counselors and professional teachers [9]. Construct a three-dimensional cooperative education mechanism for the whole curriculum to train talents [10]. In the era of big data, colleges and universities build an information management platform to realize the use of government, industry, university, and research and analyze collaborative innovation problems and explore paths [11]. Using the big data association rule mining method, the information fusion of mathematics network teaching resources is realized [12]. Information fusion produces big data intelligence and creates a sustainable mechanism of big data intelligence innovation for public epidemic emergency management [13]. Based on the integration of big data and Internet of Things, the cooperation mode of information opportunities is mined and constructed [14]. In order to solve the problem of information loss in multisource information fusion, the multigranularity method of information fusion in multisource decision information system is studied [15].

2. Theoretical Basis

2.1. Home-School Collaboration. For the sake of students' future way out in society, students' academic and educational problems need to be treated with caution. It is a common phenomenon that students' families and schools need to cooperate and contact frequently. In the field of education, school education, family education, and social education are at the same level. The functions of the three of them intersect with each other. Among them, social education belongs to the biggest educational principle, and both school education and family education are included in social education. The functions of the three are interrelated. Family education is mainly guided by families. School teaching is a relatively standardized education. It lays the foundation for the education of the whole society. The two belong to a whole, perfect education. These three forms a collaborative system, which bears the great responsibility of teaching and educating people together. They are independent and influence each other and complement each other, as shown in Figure 1.

Generally speaking, in order to better target students in school, we omit the educational role of society, which mainly involves the educational factors of the cooperative relationship between family and school. The synergistic function of these two kinds of education is far greater than the role played by their respective functions, namely, during the epidemic period, studying at home raised the requirements of education. Students' mental health education has been highly valued. It provides a very good opportunity for the new situation of home-school cooperation, as shown in Figure 2.

Organizational system mechanism mainly refers to the construction and implementation of organizational systems such as parent-teacher associations and parent-teacher associations established by schools. Information communication mechanism refers to the communication between students and parents through various channels, mutual understanding, exchange, and exchange of opinions. Finally, the subject relationship mechanism mainly refers to the interpersonal relationship between teachers and parents.

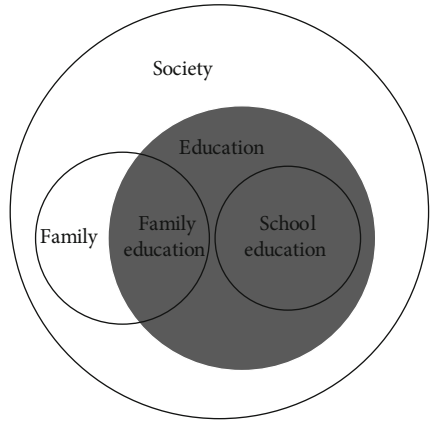

Figure 1: Family-school-society relationship diagram.

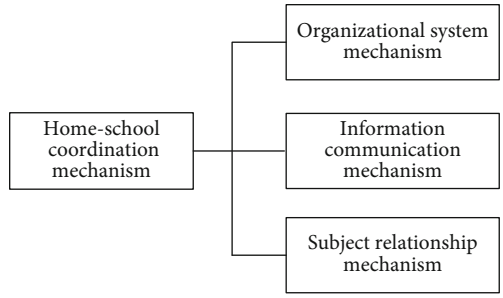

Figure 2: Content of home-school collaboration mechanism.

2.2. Student User Portrait. User portrait [16] is as follows: to explain it in simple words, that is to say, some features extracted from users by some science and technology are used, so as to construct the tagged model portrait of users as reasonably as possible. It is a way to collect and analyze a large number of users' behaviors, attributes, and other data from this method, which is the basis of practical application of big data technology.

In order to better deepen students, teachers, and parents' understanding of study and life, scientifically manage their own psychological state and find various problems that are usually missed and not paid attention to. We can build students' user portraits through big data mining technology. Show students' personal mental outlook from the digital level. It can provide scientific and objective basis for schools, parents, and teachers, comprehensively evaluate students' data, and find some hidden problems in students as early as possible, so as to solve the problems symptomatically.

After comparing the algorithms, different data mining algorithms get different models and different emphases. Through understanding the relevant information left by predecessors, we finally use several related algorithms to build student user portraits to complete this study: similarity [17], TF-IDF [18], Apriori [19], and regression analysis [20]. Similarity calculation can be used to find the connection between users or items; the TF-IDF algorithm is mainly aimed at extracting keywords from text data, and the

Table 1: Comparison of algorithm models.

Research proponent	Specific algorithm used
The user profile proposed by researchers such as Billsus D is a hybrid model (composed of users' long-term preferences and short-term preferences)	KNN algorithm (short-term preference), Naive Bayesian algorithm (long-term preference)
Zeng and other scholars proposed to build user portraits	Vector space model algorithm, Rocchio feedback algorithm, TF-IDF algorithm, and so on

importance of a word is directly proportional to the number of times it appears in the article; association analysis can be used to efficiently match the relationship between user and item information; regression analysis can be used for prediction analysis of continuous value correlation applications, as shown in Table 1.

2.2.1. Similarity Calculation

(1) Euclidean Distance [21].

$$E(x,y)=\sqrt{\sum_{i=1}^{n}(x_1-y_i)^2}, \tag{1}$$

$$\frac{1}{1+E(x,y)}. \tag{2}$$

From formula (1), we can know that Euclidean distance is a nonnegative number, and its value range is [-1, 1]. If we inverse it, the range of similarity results is converted to (0, 1). Finally, its expression is shown in Formula (2).

(2) Cosine Similarity [22]. The value range of this similarity is [-1, 1]. The included angle is equal to 0, and the cosine value is 1. When the included angle of vectors is equal to 90 degrees, the cosine value is 0. The included angle is 180 degrees, and the value of -1 is obtained.

$$\text{Cosine}(x,y)=\frac{\sum_{i=1}^{n}(x_i\times y_i)}{\sqrt{\sum_{i=1}^{n}(x_i)^2}\times\sqrt{\sum_{i=1}^{n}(y_i)^2}}. \tag{3}$$

(3) Pearson Correlation Coefficient.

$$\text{Pearson}(x,y)=\frac{\sum_{i=1}^{n}(x_i-\bar{x})\times(y_i-\bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i-\bar{x})^2}\times\sqrt{\sum_{i=1}^{n}(y_i-\bar{y})^2}}. \tag{4}$$

(4) Gerard Similarity.

$$\text{Jaccard}(x,y)=\frac{x\cap y}{x\cup y}. \tag{5}$$

2.2.2. TF-IDF. Because in the processing of student user portraits, there are many retrieval and utilization of text content; so, part of our focus lies in finding keywords of text content TF [23]. It refers to the term frequency IDF [24]. It refers to the reverse document frequency.

$$\begin{aligned}\text{TF}&=\frac{q}{p},\\ \text{IDF}&=\log\frac{N}{n+1},\end{aligned} \tag{6}$$

where p represents the total number of words in a certain text content, and q represents the number of times a certain keyword appears in the article. N refers to the total number of documents, and n refers to the number of times keywords appear in documents.

2.2.3. Apriori Correlation Analysis. The Apriori algorithm is shown in Figure 3.

Here, we set two data X and Y:

$$\begin{aligned}\text{Support}(X,Y)&=P(\text{XY})=\frac{\text{number}(\text{XY})}{\text{num}(\text{AllSamples})},\\ \text{Lift}(X\Leftarrow Y)&=P(X\mid Y)/P(X)=\text{Confidence}(X\Leftarrow Y)/P(X),\\ \text{Confidence}(X\Leftarrow Y)&=P(X\mid Y)=P(\text{XY})/P(Y).\end{aligned} \tag{7}$$

2.2.4. Regression Analysis. It is judged that x has a strong correlation with y and the linear regression equation of one variable:

$$y=ax+b. \tag{8}$$

Correlation coefficient is as follows:

$$r=\frac{\sum(x_i-\bar{x})(_i-\bar{y})}{\sqrt{\sum(x_i-\bar{x})^2-\sum y_i-\bar{y}^2}}. \tag{9}$$

Optimum parameter [25] is as follows:

$$\begin{aligned}a&=\frac{\sum(x_i-\bar{x})(y_i-\bar{y})}{\sum(x_i-\bar{x})^2},\\ b&=\bar{y}-a\bar{x}.\end{aligned} \tag{10}$$

Multivariate linear regression equation is as follows:

$$y=a_0+a_1x_1+a_2x_2+\cdots+a_nx_n+e. \tag{11}$$

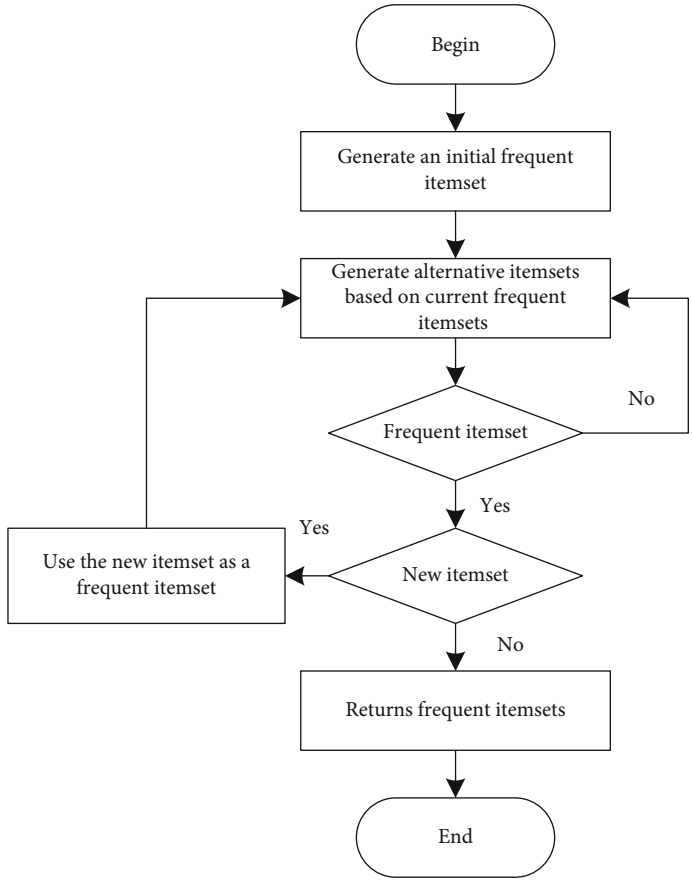

Figure 3: Apriori algorithm flow.

2.3. WeChat Platform and Multisource Big Data. With the continuous development of Internet information technology for many years, 5G network covers a wide area, and mobile terminal devices such as notebook computers, smart phones, and tablet computers are popular among the public. This provides a growing soil for the use of various software. WeChat is a social software, and its main function is communication. It can be used in various portable terminals. Whether it is used by various companies, units, or individuals, it can convey specific information through WeChat, push the messages that need to be transmitted, provide people with various functional services, and carry out big data mining. It is often necessary to analyze data information from multiple sources and different fields. These data all show different modes. This multimodal data from multiple sources is superior. More useful information can be found than single data, as shown in Figure 4.

The world is divided into physical world, human society, and information space. The physical world and human society produce various data including but not limited to sensors, websites, news, media, and other sources and transmit them to the information space for information fusion, integration, and analysis. Finally, the collated information is used for decision analysis and fed back to the other two worlds.

2.4. Research Method

(1) Literature research method: in order to fully understand and utilize the existing resources, we have consulted and browsed many materials, including but not limited to CNKI, Wanfang Literature Database, http://Vip.com, Baidu Academic, and other websites, as well as various related books in the library. Try to understand the previous research results as much as possible and provide effective and reliable theoretical basis and reference content for the theoretical writing of this paper

(2) Questionnaire method: before the research, we distributed online questionnaires to universities through the Internet. We need to proceed from reality, consider the feasibility of the study, and study what specific problems need to be solved, instead of playing freely without theoretical basis

(3) Expert interview method: the interview method is to obtain expert guidance and suggestions, which can better determine our research direction

(4) Action research method

(5) Case analysis

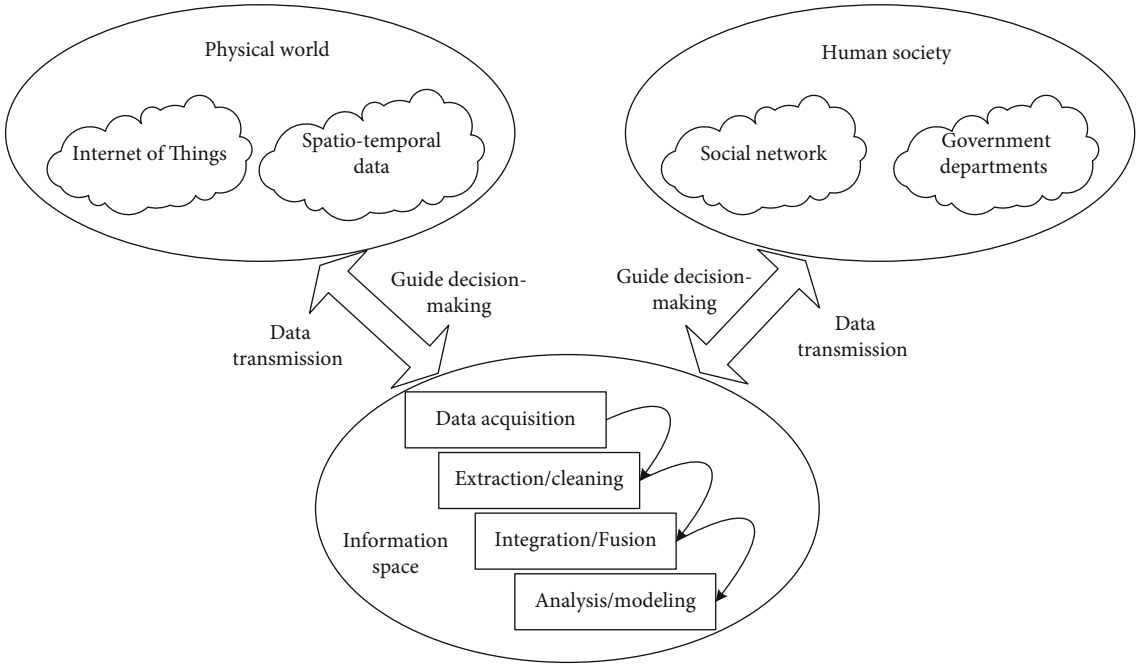

Figure 4: Data transmission and information integration logic.

3. Home-School Collaboration Mechanism and Psychological Analysis Based on WeChat

3.1. Correlation of Information Fusion Algorithms. Sensor nodes of the data fusion algorithm limit network resources: too much redundant data information and low processing efficiency. When encountering high-dimensional data, it is easy to deal with problems such as difficulties. Therefore, in order to solve these problems and make data fusion more efficient, we choose the widely used deep learning model, introduce WSNs data fusion technology, and realize the final CNNMDA algorithm according to the convolution neural network structure.

3.1.1. Deep Learning Algorithm Model. Deep learning is a very important branch of machine learning. Nowadays, there are breakthroughs related to it in many research fields. We use the convolution neural network (CNN) model.

(1) Convolution Pooling Process. The structure of convolution neural network is mainly divided into two parts. The first part is the convolution phase, as shown in Figure 5.

The weight of convolution kernel is w_{ij}. The J-th characteristic diagram is y_j. The i-th feature graph is x_i. The trainable bias is b_j. The excitation function is f, as follows:

$$y_j = f\left(\sum_i w_{ij} * x_i + b_j\right). \tag{12}$$

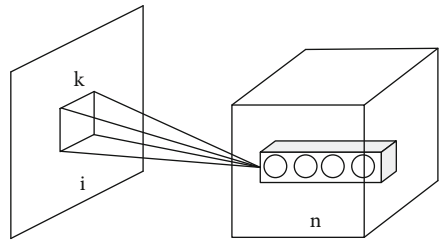

Figure 5: Convolution principle.

ReLU excitation function is

$$f(x) = \max(0, x), \tag{13}$$

pooling phase, as shown in Figure 6:

(2) Logistic Regression. Double rate function is as follows:

$$h_\theta(x) = \frac{1}{1 + e^{\theta^T x}}. \tag{14}$$

Class 0 probability is as follows:

$$P(y = 0 \mid x; \theta) = 1 - h_\theta(x). \tag{15}$$

Class 1 probability is as follows:

$$P(y = 1 \mid x; \theta) = h_\theta(x). \tag{16}$$

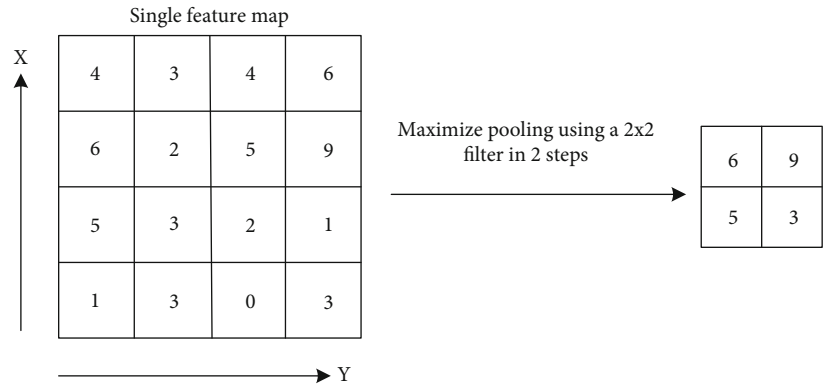

Figure 6: Principle of pooling.

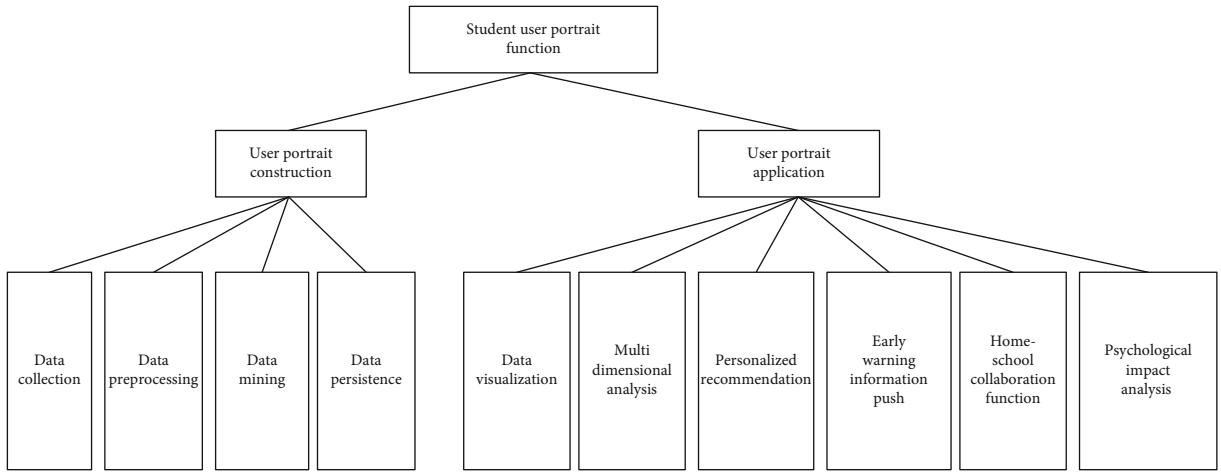

Figure 7: User portrait function.

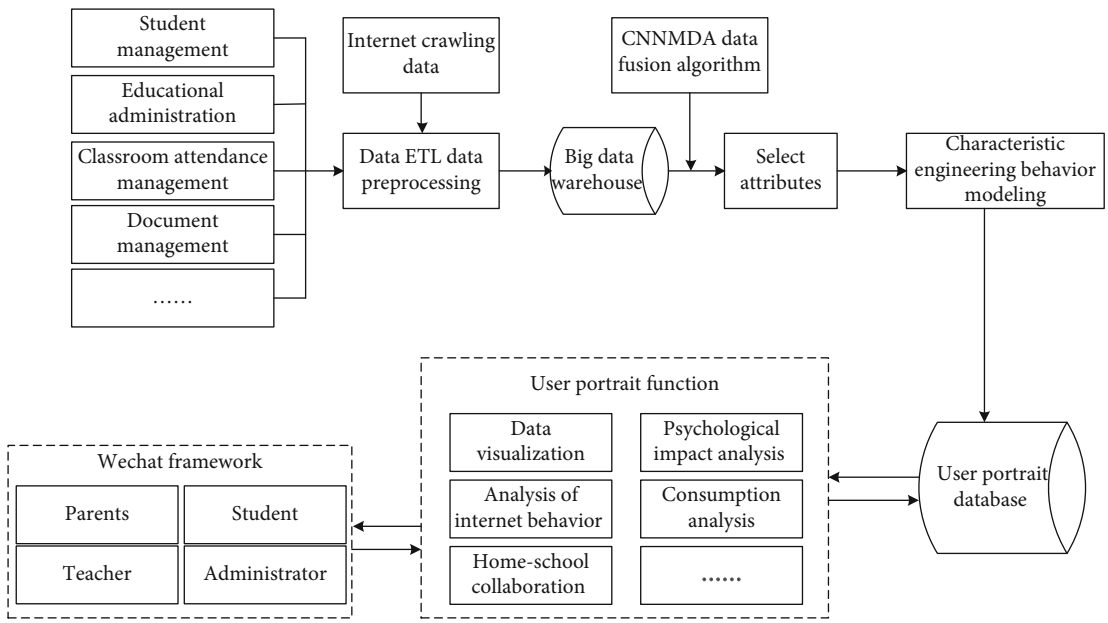

Figure 8: User portrait business process.

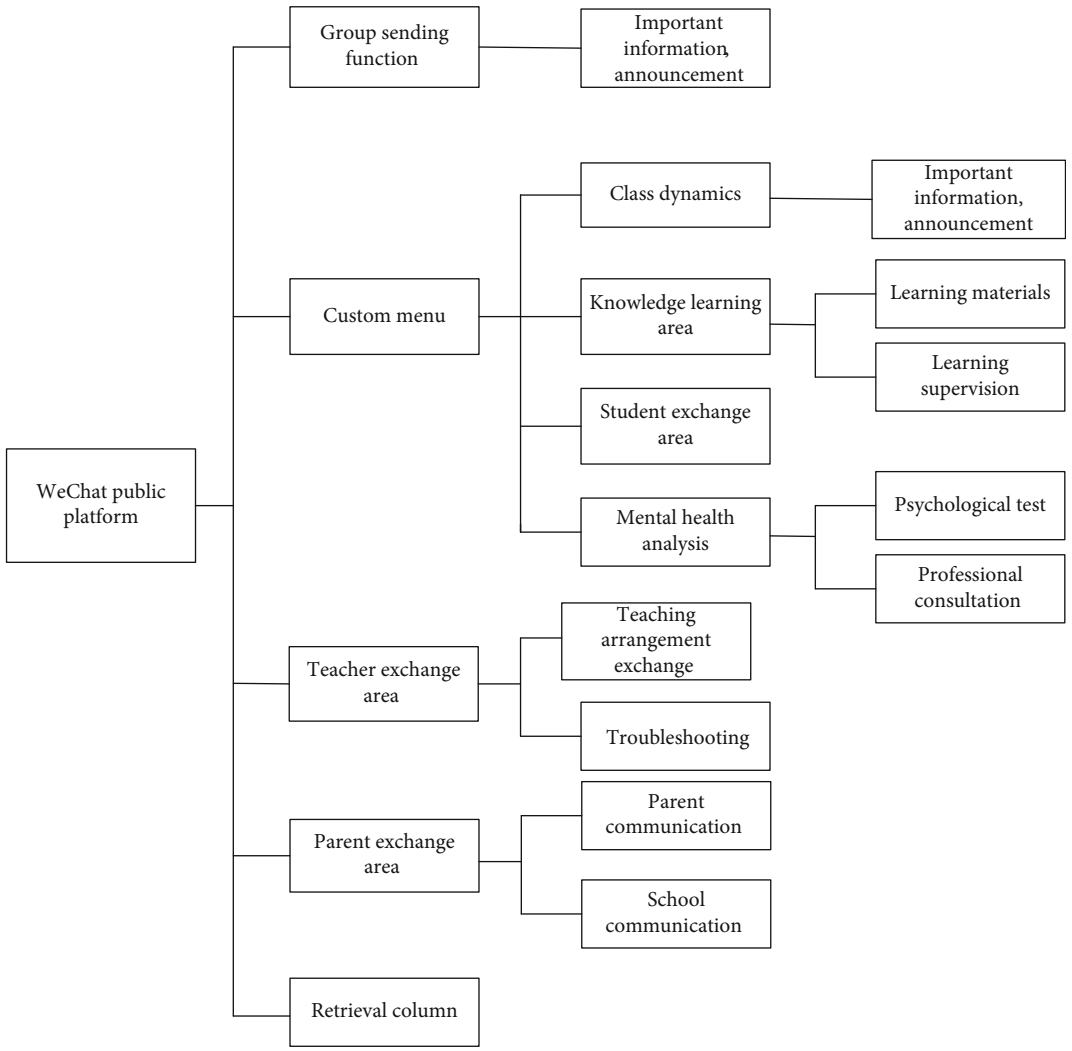

Figure 9: Functional planning.

3.1.2. CNNMDA Data Fusion Algorithm. CNNM loss function of training is as follows:

$$J(\theta) = -\frac{1}{m}\left[\sum_{i=1}^{m} y^{(i)} \ln h_\theta\left(x^{(i)}\right) + \left(1 - y^{(i)}\right) \ln\left(1 - h_\theta\left(x^{(i)}\right)\right)\right]. \tag{17}$$

Training objectives are as follows:

$$\theta_i = \theta_i - \alpha \frac{\partial}{\partial \theta} J(\theta). \tag{18}$$

To find the partial derivative $(\partial/\partial\theta)J(\theta)$, the convolution layer has

$$\delta_j^l = \beta_j^{l+1}\left(f'\left(u_j^l\right) \cdot up\left(\delta_j^{l+1}\right)\right). \tag{19}$$

Substitute δ_j^l into Equations (20) and (21):

$$\frac{\partial J}{\partial w_{ij}} = \sum_{u,v}\left(\delta_j^l\right)_{uv}\left(p_i^{l-1}\right)_{uv}, \tag{20}$$

$$\frac{\partial J}{\partial b_j} = \sum_{u,v}\left(\delta_j^l\right)_{uv}. \tag{21}$$

The result is then substituted into Equation (18):

$$\begin{aligned} z_j^l &= f\left(\beta_j^l \text{down}\left(z_j^{(l-1)}\right) + b_j^l\right), \\ \delta_l^l &= \sum_{j=1}^{M} \beta_l^{(l+1)} * k_{ij}. \end{aligned} \tag{22}$$

Figure 10: Client interface implementation.

Finally, the parameter update of pooling layer is completed:

$$\frac{\partial J}{\partial w_{ij}^{l}} = z_j^l * \delta_j^{(l+1)},$$
$$\frac{\partial J}{\partial b_j} = \sum_{u,v} \left(\delta_j^l\right)_{uv}. \tag{23}$$

The algorithm reduces the size of outgoing data through data fusion of incoming cluster nodes, thus greatly reducing energy consumption and improving network performance.

3.2. User Portrait Construction

3.2.1. Functional Design. The functions of home-school cooperation mechanism and psychological impact analysis are mainly reflected in the functional design of user portrait. The application part mainly uses the functions for users, as shown in Figure 7.

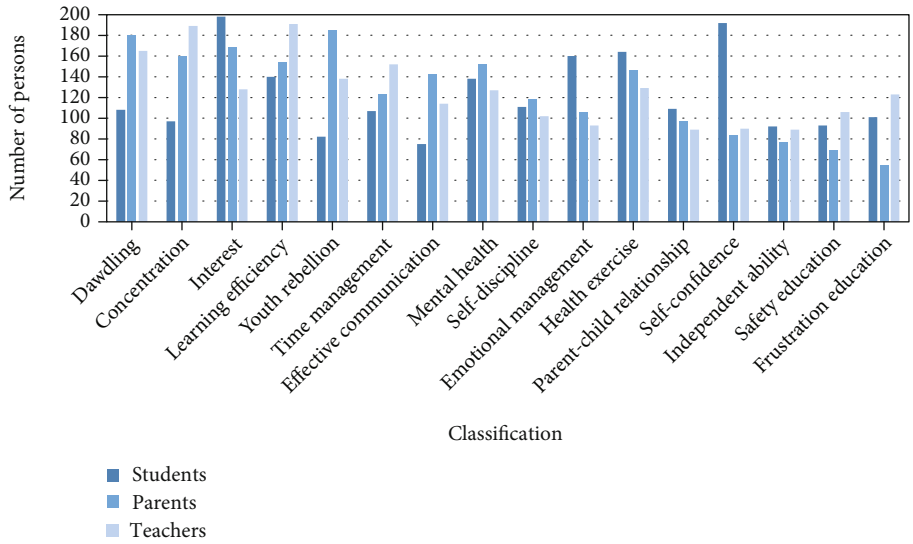

Figure 11: Key word analysis of school demand.

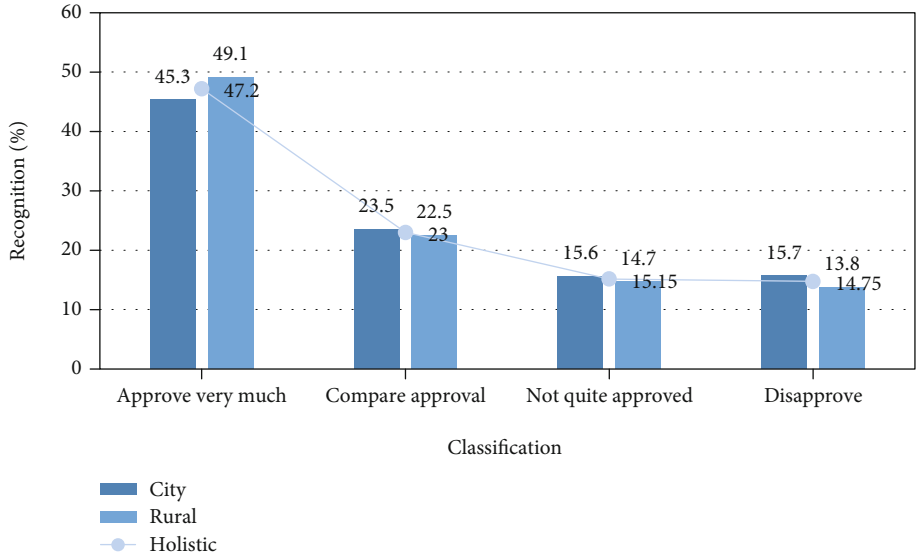

Figure 12: Analysis of parents' evaluation differences in different regions. $P > 0.05$, there was no significant difference between parents of different genders. Whether male or female, the evaluation of home-school coordination mechanism is similar, and the related construction should be further strengthened, as shown in Figure 13.

3.2.2. Business Process Design. After being collected and sorted out by big data warehouse, all kinds of information are fused and analyzed by the CNNMDA data fusion algorithm. According to the analyzed decisions, relevant attributes are selected to build user portraits. Finally, the home-school collaboration mechanism and the function of analyzing students' psychological state are realized based on WeChat framework, as shown in Figure 8.

3.3. Implementation of WeChat Platform. Activate WeChat subscription number, design a WeChat official account that conforms to the subject of this paper, and fully consider the needs. It gives full play to the function and role of home-school coordination mechanism. It saves a lot of trouble and makes work, study, and life more relaxed and comfortable, as shown in Figures 9 and 10.

4. Experimental Analysis

4.1. Psychological Analysis of Home-School Cooperation Mechanism

4.1.1. Needs of Parents and Teachers. Because parents and teachers have different roles, responsibilities, and ideas, they

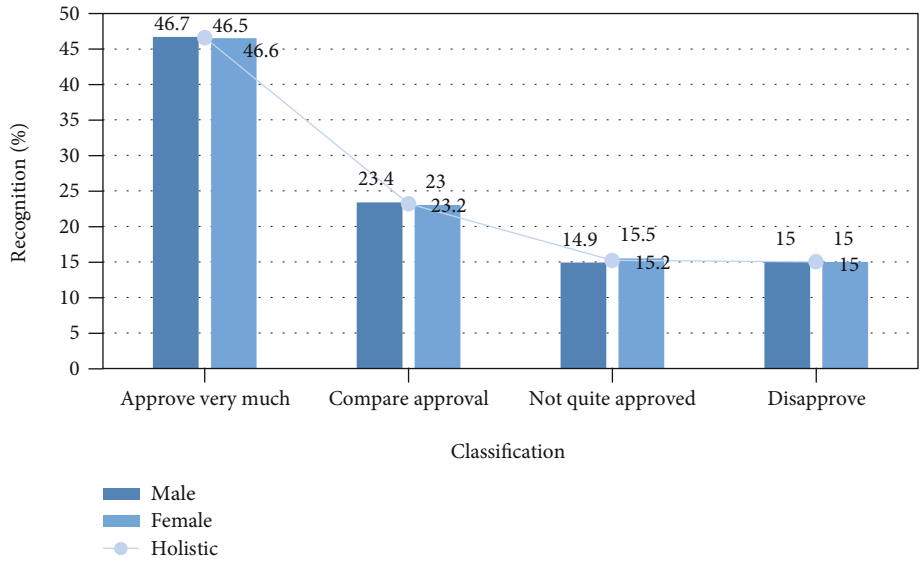

Figure 13: Analysis of parents' evaluation differences between different genders.

will have different expectations for students' academic and moral qualities. These 16 keywords are the most frequently mentioned high-frequency words after relevant investigation and statistics, in order to understand what parents and teachers are most concerned about among these 16 key words and students' own views. We invited about 200 volunteers for recognition evaluation, as shown in Figure 11.

In order to better analyze keywords, we divide the criteria: the number of people is more than 180, which we call the most concerned keywords. More than 160 people are called keywords of secondary concern. More than 140 people are called key words of concern. Students are most concerned about interest and self-confidence. Then, there are problems related to emotion and healthy exercise. Then, there are the problems of learning methods and efficiency and mental health. Parents are most concerned about the problem of dawdling and adolescent rebellion. Secondly, there are problems of concentration, interest, and habit; more concerned with learning methods and efficiency, effective communication, mental health, health, and exercise. Teachers focus on concentration, learning efficiency, and other issues.

4.1.2. Evaluation of Home-School Cooperation Mechanism. We count parents' evaluation from different regions and different genders. According to chi-square test, $P < 0.01$, there are significant differences between urban and rural evaluation. This shows that urban parents pay more attention to school education and require more construction, as shown in Figures 12 and 13.

4.2. Simulation Analysis of Fusion Algorithm. Using MATLAB software, add BPNDA and SOFMDA algorithm comparative analysis. In order to compare the efficiency of various data fusion algorithms, the unoptimized LEACH protocol is used in the experiment. Refer to the first type of wireless communication energy consumption model. The energy consumption of sending, receiving, and fusing data of nodes is counted, respectively, where n represents the number of network layers of BPNDA, d is the dimension of the input data, and c represents the number of data categories. In the simulation experiment, the relevant parameters are shown in Table 2.

Table 2: Simulation parameters.

Parameter	Numerical value
Network scope	100 m × 100 m
Number of nodes	100
Sink node coordinates	(50,50)
Node initial energy	0.5 J
Convolution kernel size	3 × 3
Convolution step	1
Maximum number of simulation rounds	2000
Header length	100 bit
Clustering message length	100 bit
Packet length	2000 bit

4.2.1. Error Rate Comparison. For feature extraction classification, the error rates of the three algorithms are compared. Data with low dimensions and few categories can be found, and the error rates of the three algorithms are basically the same. With the increase of dimension, CNNMDA performed well, and the error rate remained at a low level all the time. However, the performance of the other two algorithms shows a continuous downward trend, and the error rate increases obviously, as shown in Figure 14.

4.2.2. Comparison of Average Time Spent. CNNMDA is more efficient than the other two. It shows that data fusion is faster, the time consumed by feature extraction is obviously

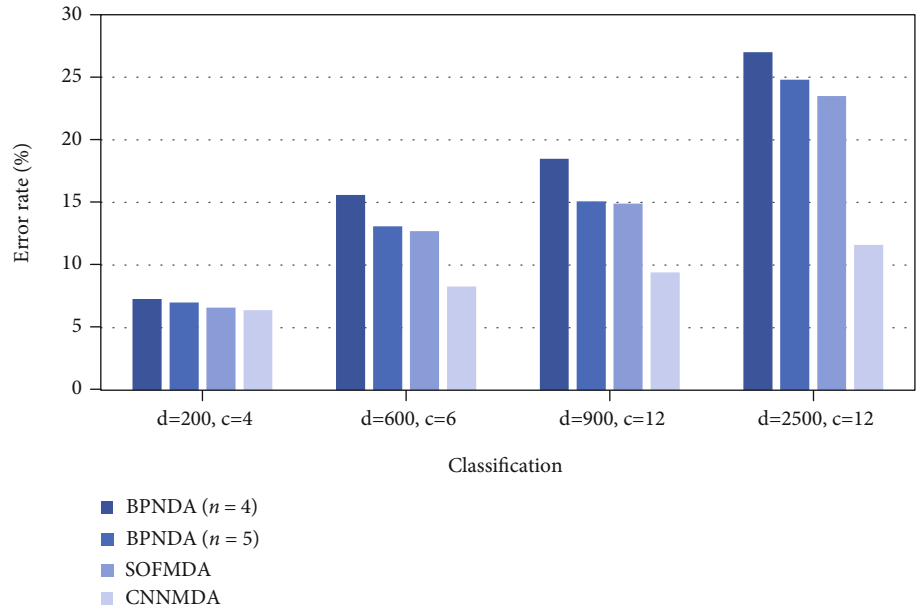

Figure 14: Error rate of feature extraction classification.

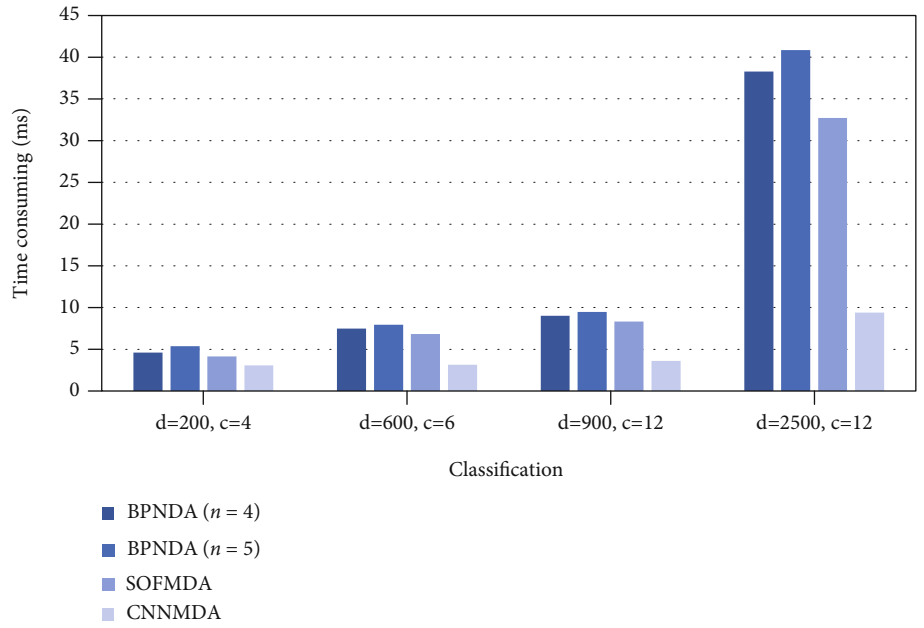

Figure 15: Average time spent on feature extraction and classification.

less due to the powerful dimensionality reduction ability of CNN, and the performance is better, as shown in Figure 15.

4.2.3. Comparison of Energy Consumption of Network Nodes. $d = 2500, c = 12$ compares the energy consumption of network nodes of the algorithm. The more the number of simulation rounds, the more the total energy of the network. The energy consumption of the CNNMDA algorithm is obviously lower than that of other algorithms. The energy consumption of these three algorithms is lower than that of LEACH which has not been processed. CNNMDA is more efficient in data fusion. The energy consumption of network nodes is reduced by 7.5% on average, as shown in Figure 16.

4.3. User Portrait Data Analysis. Part of the environment is when testing the user portrait, as shown in Table 3.

4.3.1. Functional Testing. When we tested the function of student user portrait, we invited 5 groups (10 people in each

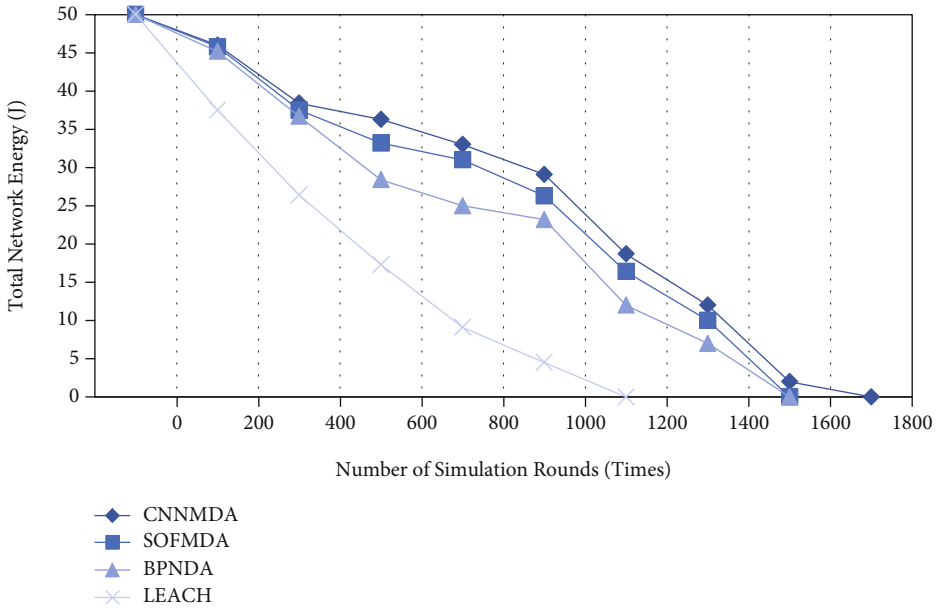

Figure 16: Network node energy consumption.

Table 3: Test environment configuration table.

Test environment	Configure	Specific parameters
Hardware environment of database server	CPU	AMD Opteron 6140 Quad Core
	Memory	4G
	Hard disk	150G
Database server software environment	Operating system	CentOS 7.4 (Linux)
	Database	MySQL cluster 7.5

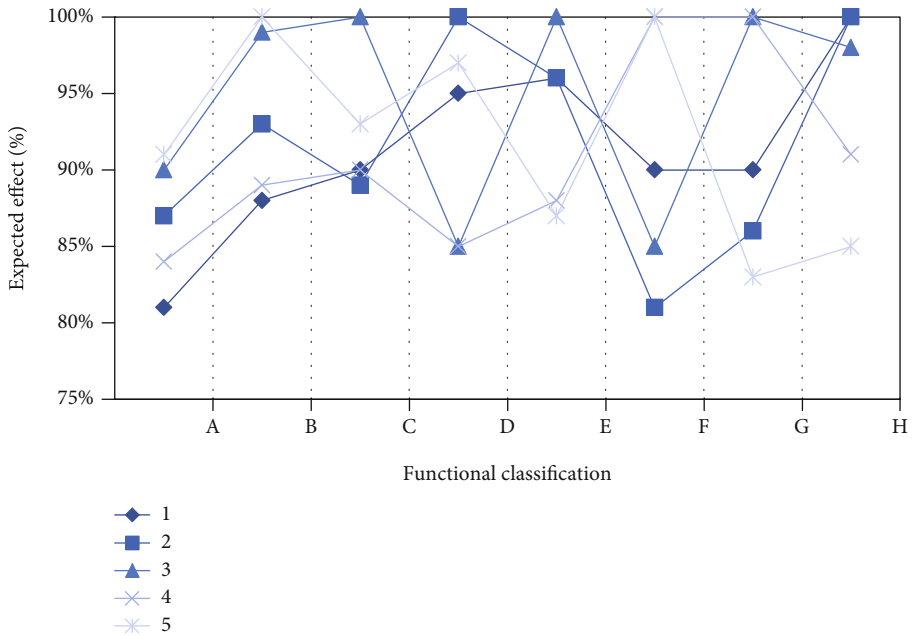

Figure 17: Functional test situation.

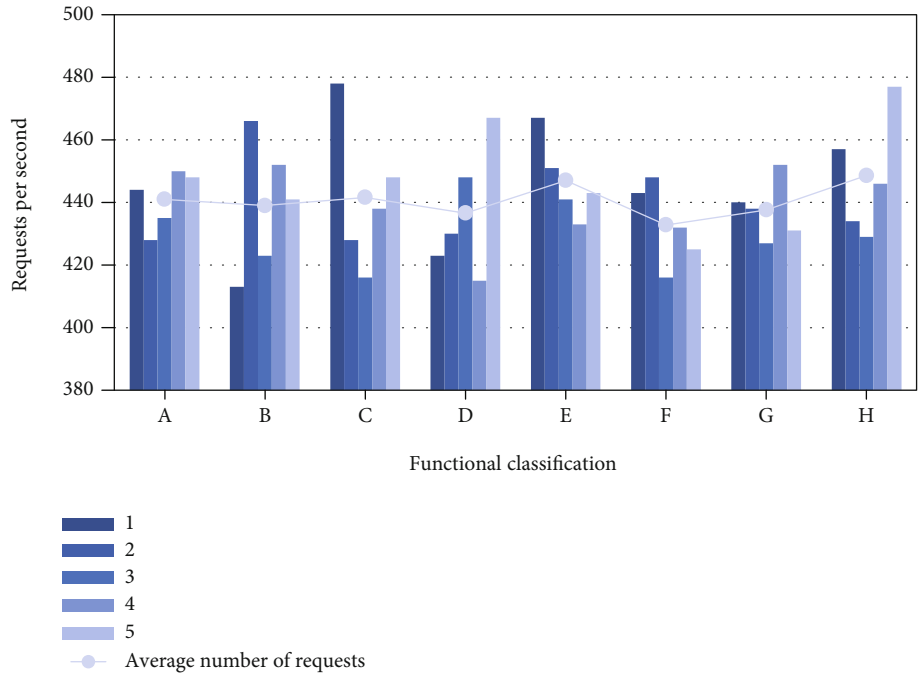

Figure 18: Stress test situation.

group) of volunteers with different identities and roles to conduct a small-scale test. Functions were divided into *A*, *B*, *C*, *D*, *E*, *F*, *G*, and *H*. The expected effect is over 80%, and the function is normal, as shown in Figure 17.

From the figure, we can find that the functional test results of user portraits are all over 80%, which achieves the expected functional effect and can be further tested.

4.3.2. Pressure Testing. The average number of requests per second for each function in the figure is basically the same. A server is concurrent about 441 times per second, as shown in Figure 18.

5. Conclusion

The research results of this paper can show the following points:

(1) Different identity roles have different needs for home-school collaboration. Parents are most concerned about dawdling and adolescent rebellion. Teachers focus on concentration and efficiency of learning methods. Students are most concerned about their own interest habits and self-confidence

(2) For the evaluation of the construction of home-school coordination mechanism, $P < 0.01$, there is a significant difference between urban and rural parents' evaluation. $P > 0.05$, parents' evaluation has little relationship with gender, and the overall difference is not significant

(3) Compared with BPNDA and SOFMDA. The error level of this algorithm increases slowly with the increase of dimension. It has super high data fusion execution efficiency. The energy consumption of network nodes is reduced by 7.5% on average. The excellent performance of this method is illustrated

(4) The eight functions of *A*, *B*, *C*, *D*, *E*, *F*, *G*, and *H* of the user portrait are tested, the expected results are all over 80%, and there is no abnormality in the functions. The number of concurrent times per second is about 441, and the performance of each function is relatively stable

(5) Although the application prospect of deep learning model in the field of data fusion is very broad, the final data analysis results obtained in this paper perform well, and the algorithm performance has been greatly improved and promoted, but there are still some problems, for example, how to simplify the related model parameters better, how to reduce unnecessary redundant data steps, and further improve the efficiency of data execution. After comprehensive analysis, this topic can also enhance research funding, improve data construction facilities, strengthen talent construction, optimize the utilization efficiency of big data, improve the management of big data system, and strengthen the protection of private information. These problems still need to be further studied by later generations

Data Availability

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

Conflicts of Interest

The author declares that he/she has no conflicts of interest regarding this work.

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