

## *Retraction*

# **Retracted: Design of Personalized Recommendation System for Swimming Teaching Based on Deep Learning**

### **Security and Communication Networks**

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### **References**

- [1] Z. Shi and W. Wang, "Design of Personalized Recommendation System for Swimming Teaching Based on Deep Learning," *Security and Communication Networks*, vol. 2021, Article ID 1211059, 7 pages, 2021.

## Research Article

# Design of Personalized Recommendation System for Swimming Teaching Based on Deep Learning

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Swimming is not only an entertaining hobby but also a sporting event. It is a sport for strengthening the body. Although there are many swimming coaches, there are different swimming teaching courses. However, choosing the right swimming instructor or course is the motivation for learning swimming activities. To this end, this paper conducts related research on the personalized recommendation system for swimming teaching based on deep learning with the purpose of improving the accuracy of the recommendation system to meet the needs of the users and promote the development of swimming events. This article mainly uses the experimental test method, the system construction method, and the questionnaire survey method to analyze and study the personalized swimming teaching system and the students' attitude to it and draw a conclusion finally. The data results show that the accuracy of the system designed in this paper can meet the basic requirements. Hence, it can bring an excellent experience to the users. According to the questionnaire data, 85%–95% of people have great confidence in the personalized recommendation system.

## 1. Introduction

The amount of information in swimming teaching is huge, and the learning time is long. How to choose a suitable swimming teaching course from the massive data is the basis for improving swimming skills. This is a top priority for swimming enthusiasts. At the same time, a new generation of information technology, such as network technology and database and cloud computing, has been continuously introduced into the education field, and it has a huge impact on traditional teaching models. The use of deep learning methods to improve the personalized recommendation system for swimming teaching is conducive to the choice of swimming enthusiasts and saves their time and cost.

There are many kinds of research on personalized recommendation systems based on deep learning. For example, Long Hu said that deep learning is the development of neural networks. The personalized learning resource recommendation system can meet the needs of

personalized and precise learning [1]. Lu Gang said that with the exponential increase in the amount of information on the internet, it has become a complicated and time-consuming task for users to select target information from the massive amount of information [2]. Feng Beibei believes that the way for users to solve the problem of being unable to quickly obtain the target information because of information explosion is to build a recommendation system [3]. Therefore, from the perspective of deep learning, the research on the recommendation system of swimming teaching is an innovative exploration based on the existing theoretical results.

This article, firstly, studies the related technologies of deep learning. Then, the related algorithms of the recommendation system are studied. What I studied later was the detailed design of the recommendation system.

Finally, the system is framed, experiments and questionnaire surveys are carried out, and the experimental results and survey data are obtained.

## 2. Design of Personalized Recommendation System for Swimming Teaching Based on Deep Learning

*2.1. Deep Learning Technology.* Deep learning is a research subfield of machine learning. In short, it is a technology that can improve computer systems based on experience and data. The neural network is the foundation of deep learning, also known as the artificial neural network. It is inspired by the research of bionics and simulates the function of neurons in the brain [4, 5]. Deep learning involves learning the inherent laws and representation levels of the sample data, and the information obtained in the learning process is of great help in interpreting data, such as text, images, and sounds. Its ultimate goal is to allow the machines to analyze and learn like humans and recognize data, such as text, images, and sound. Deep learning is a complex machine learning algorithm that has achieved far more results than the previous related technologies in speech and image recognition.

The perceptron is a linear artificial neuron with two classification functions: generally, the feature vector of the instance is the input, and the output is the corresponding category. Similar to perceptrons, the S-type neurons are composed of multiple inputs, however, these inputs can take any value between 0 and 1. The basic unit of a neural network is a neuron, which can form a structure. Very complex neural networks are because of various connections. A neural network is an important machine learning algorithm that uses a gradient descent algorithm for training. Like other machine learning algorithms, the neural networks include supervised and unsupervised learning methods. In supervised learning, the input is passed through the neural network, and the output is received. The output will deviate from the expected output. The neural network uses this distortion to invert the weight of the entire network so that the actual calculated value is as close as possible to the expected value. In unsupervised learning training, the network combines its own learning rules to adjust the weights by continuously receiving dynamic information. The goal of learning neural networks is to find the model parameters that minimize the algebraic function. The gradient descent algorithm can solve this minimization problem well. An important method for calculating these gradients in neural networks is backpropagation [6, 7].

Artificial neural networks are very popular today and have a wide range of applications. The functions that form the basis of deep learning are as follows:

- (1) *Strong learning ability.* The biggest feature of a neural network is its strong feature extraction ability. Similar to the brain, it can process conversions from various inputs. If the input changes, it can adjust the extracted features over time, which is very adaptable [8, 9].
- (2) *Parallelism.* The human brain can process multiple things at the same time, reflecting the parallelism of the human brain. The neural networks can process

information independently by simulating the human brain and reflecting the same parallelism.

- (3) *Nonlinearity.* A neural network is a very important research tool for nonlinear systems. It can effectively identify the pattern of a nonlinear relationship between the input and output. From the outside, the neural network is like a black box tool, hiding other parts of the neural network structure, except for entry and exit.
- (4) *Robustness.* Since the neural network contains many neurons, and each neuron shares a contribution value, each neuron has a relatively small influence on the overall result. If some data is contaminated, it will affect the overall performance of the network. In particular, language has little effect on distributed computing. This robustness can be more strongly reflected [10, 11].

Therefore, the design of a swimming recommendation system can fully consider the role of a neural network. Applying deep learning to the recommendation system is conducive to course learning and publicity.

*2.2. Recommendation System Related Algorithms.* Because of the development of modern technology, the popularization of the recommender systems in various aspects enables them to play a great role in personalization. Therefore, it is necessary to study the related algorithms of the recommendation system to improve the accuracy of the recommendation system. In general, the recommendation system can be divided into three parts: user, recommendation object, and recommendation algorithm. Firstly, get the user's interest preferences. One of these two methods is the display method, and the other is the default method. The display mode means that the user actively provides interest preferences to the system. The implicit method means that the system analyzes the user's past behavior data, and then the recommendation system models the user based on the obtained interest preferences. Obtain information from the recommended objects, extract the information the objects can represent, and model these recommended objects. Then, use a suitable recommendation algorithm to process the created model, combine the items to be recommended, calculate the recommendation object that meets the user's interest, and recommend it to the user [12, 13].

The pros and cons of the recommendation algorithm have an important impact on the efficiency of the recommendation system. The basic principle of the content-based recommendation algorithm is to calculate the item relevance based on user preference metadata and recommend highly relevant tutorials to the users based on the user preference history. Simply put, it is to use the user's previous records to extract the user's preference information, and at the same time, to extract the attributes of the item and compare the two to recommend a tutorial that is closer to the preference information for the user [14, 15].

These vectors represent the degree of correlation between the course and swimming. To get the weight, the first

thing to do is to calculate the frequency of class, which is as follows:

$$KP(a_m, b_n) = K(a_m, b_n) \cdot \log \frac{X}{(x_m + 1)}, \quad (1)$$

where  $X$  represents the number of swimming courses in the course,  $x_m$  represents the number of swimming courses  $a_m$ , and the purpose of adding 1 is to avoid the denominator being 0. Course frequency is generally defined as follows:

$$KP(a_m, b_n) = \frac{G_{m,n}}{\max_c g_{c,m}}. \quad (2)$$

$G_{m,n}$  is the frequency of swimming  $a_m$  in the course  $b_n$ , and  $\max_c g_{c,m}$  is the frequency of the most frequent words  $a_c$  in the course  $b_n$ . In this way, the weight  $w_{m,n}$  of the words  $a_m$  in the course  $b_n$  is expressed as follows:

$$w_{m,n} = \frac{KP(a_m, b_n)}{\sqrt{\sum_{v=1}^{|s|} KP(a_v, b_n)^2}}. \quad (3)$$

By the above calculation, the path can be represented by a vector. Then, recommend to the users by calculating the similarity. As an effective recommendation method, the content-based recommendation is simple and easy to understand. The results of the recommendation are also in line with the people's cognition. There is no interaction between the users.

**2.3. Swimming Teaching System.** Swimming is a kind of functional activity that relies on its own body movement and water power to move or advance in the water. It has higher requirements for the adaptability and control of the body, as well as for experience and feeling.

Dialogue teaching is based on teacher-student dialogue, giving full play to the teacher-led and student-led "dual center" teaching activities. In teaching, students are guided to learn in an active, independent, cooperative, and exploratory manner. On the basis of the accurate prediction of development, a learning attitude and a sense of autonomous participation are created for active communication and participation with teachers and peers. Students' knowledge level and the composition of their personality ultimately require each student to actively participate in the teaching process to achieve the purpose of acquiring technical skills and developing skills. Determine the purpose of the conversation. Design the corresponding dialogue according to the characteristics of the dialogue class and the characteristics of the students. Questioning is the starting point of dialogue theory, which specifically includes the following two stages: the systematic analysis of the specific content of the professional knowledge system, the specific question design of the dialogue content, and the determination of evaluation criteria.

In addition to teaching methods, swimming recommendation systems also need to have the following characteristics. Personalized recommendation for swimming teaching is a complete, relatively independent, and abstract with strong technical content. At the same time, it relies on

the database and has a huge amount of data. Therefore, it needs to be analyzed in detail when extracting information as different users have different requirements for this information. Therefore, we have to accurately predict the preferences of all possible users and the characteristics of the topics and content they care about to build the corresponding models to improve the system's performance. The individual characteristics of the system are based on the database technology to establish a swimming teaching-related information database and carry out data statistics and analysis on it. The needs of students are predicted by collecting the swimmers' kinematics, heart rate changes, and other human physiological index parameters, as well as the time variables that users spend in inquiries. Then, build a new model based on these data. According to this model, different user groups can be divided into multiple subtype object sets to determine the personalized recommendation content and recommendation range for each specific target group.

The main process of the personalized recommendation system for swimming teaching includes the following: user registration and login, administrator releasing the class schedule, student login and selection of topics, selection of training methods, and result inquiries. Preliminary scoring system: this module is a statistical analysis and processing of raw data. The main purpose is to evaluate the performance of students in swimming lessons. Teacher teaching the recommendation process: according to the user's login password and personal identification information, it is judged whether to choose the door number of the teaching school as the teaching object or class. At the same time, you can search for the learning situation, employment issues, and other related materials of the major using the keyword. When the new students enter, they can enter the swimming schedule in the database to query and return the results.

**2.4. Design of Personalized Recommendation System.** With the development of the network, various information resources on the network have exploded. When presented to users in a stacked manner, users are faced with the problems of information overload and deterioration of user experience. It is precisely because of the expansion of data resources in the network that it is difficult for the users to choose suitable courses for themselves. Therefore, the generation of a personalized recommendation system is necessary. In addition, the number of network users is increasing, and there are individual differences between the different users. Therefore, the system must take into account the needs of different users while improving the system and providing personalized services to meet the needs of different users. The personalized recommendation system for swimming lessons based on deep learning is a typical vertically-integrated project. Its purpose is to provide the users with more and better life-saving methods, including the analysis and treatment of swimming techniques, life-saving equipment, and other related information. This module is mainly aimed at the different needs of users in terms of age and leisure. The use of systems and resources requires

technology that can map information resources to the users to establish a connection between the users and resources and improve users' adaptability to the system. More specifically, the customization requirements of e-learning platforms are mainly reflected in the following aspects:

The personalized needs of users for learning resources are different. Different users have different learning resource needs. When the system presents the same content to all users regardless of the differences between them, the result is the user experience. If the system's data processing is not good, it is not conducive to the full use of resources.

Improve the adaptability of users to the system. With the continuous growth of the system resource base, the number of learning resources is also increasing. Because of the large number of learning resources, learners are prone to information overload. At the same time, because of the lack of connection between the learners and resources, there is a phenomenon of resource separation and isolation, which is not conducive to the use and management of resources considered in the process of learning. To improve the adaptability of users to the system, make the system more attractive, and reduce the loss of users. The mapping relationship between the users and resources is established by a personalized recommendation technology that can not only improve the use of resources but also improve the convenience of resource management. To a certain extent, it can eliminate the gap between the resources and users.

The biggest advantage of personalized recommendation is that it collects the user characteristic information and provides the users with personalized recommendation services based on this information. The role of personalized recommendation is mainly manifested in these aspects. The first is to reduce the time required for the users to retrieve resources. The personalized recommendation is to actively provide the users with recommendation services. This process is executed automatically by the system and does not require user intervention. At the same time, the personalized recommendation system can help users quickly find learning content they are interested in, thereby reducing the time for users to obtain information and improving the efficiency of user learning. The second is to search for potential points of interest of the users. Compared with information search, a personalized recommendation can search for the users' potential points of interest, thereby improving the utilization of information resources.

The personalized teaching recommendation system based on deep learning is a multilevel complex and huge fusion. Many factors must be considered when designing the model, including user characteristics, swimmers' own characteristics, and related environment. Firstly, analyze the following aspects: user data, i.e., the study of the storage structure and processing capabilities of the original database, time difference processing, and the simplification of complex data. Combine the learning model to model and solve the problem, and send the result to the decision engine. To improve the attractiveness of the system, the personalized recommendation system recommends based on the learning resources that users are already interested in. At the same time, the system can analyze the changes in the user's leisure

and information resources and automatically update the recommendation list. The personalized recommendation system can not only provide personalized services but also establish a stable relationship with the users, thereby attracting them, improving their compliance with the system, and reducing their churn to a certain extent.

The personalized recommendation system for swimming lessons based on deep learning is mainly used to analyze the user's swimming preferences and create a training model after extracting massive amounts of data. The algorithm, firstly, calculates the functional relationship between the number of people and courses. Then, input the predicted result into the neural network. After many iterations, the optimal parameter set (i.e., weight value) and the probability matrix triggered by the most number of right-clicks are obtained, and the final weight vector and the output vector of the mapping rule are obtained as the number of training samples. Fully collect and analyze the user demand information. The deep model is created by digging into the user's points of interest, sports hobbies, and other related functions. The system supports multiple technical methods, such as multidimensional in-depth modeling and analysis, hierarchical evaluation, and decision trees to describe complex problems, and to a certain extent, solve the problem of a large amount of information in traditional article recommendation algorithms. At the same time, it also provides the users with a new way of "learning-personalization." The personalized recommendation system based on deep learning is a complex and huge multidimensional nonlinear model. When evaluating the students' swimming performance, traditional teaching methods often ignore feature extraction. From the user's point of view, this article proposes a new idea, which is to use the training data sets to predict and identify the sporting goods that may have the same attributes. At the same time, it is also considered that a personalized recommendation system based on deep learning can construct different types of training examples and use the raw data for modeling.

### 3. Implementation of Personalized Swimming Recommendation System and Questionnaire Survey

*3.1. The Overall Framework of the System.* The system is mainly composed of two parts: model construction and custom swimming recommendation engine. According to the processing sequence, the system is mainly divided into the data processing layer, model building layer, and user recovery layer. The system adopts the B/S architecture, the user interest capture model is written in Python code, and the back-end logic of the system is written in Java language. The original data set does not fully meet the experimental requirements of this article and must be processed twice. Firstly, perform some conventional preprocessing operations on the text data, such as removing the stop words, removing the garbled codes, and so on. Then, get the user's interest expression using the deep learning model. The modeling layer is divided into two levels: the research layer

and the recommendation layer. The research layer should use a deep learning model to generate feature vectors based on the text that users are interested in. The main purpose of the user query level is to establish a benchmark platform for user research, provide users with personalized search results, and recommend swimming lessons for research based on the results of the swimming pool. The specific process is shown in Figure 1.

**3.2. Operating Environment.** This system adopts the JavaWeb program of the B/S architecture. Because of the multiplatform characteristics of the Java language, the system can run on different systems. The system adopts the MVC design model and SSM framework for system development. The front-end interaction uses the JSP pages and CSS is applied to beautify the front-end. The data interaction between the background and the foreground is completed by asynchronous Json interaction. The back-end data and database interact with the Mybatis framework. The open source Lucene search engine is used for index construction and query analysis. The specific tools used by the system are as follows:

- Operating System: Windows13
- Development language: Java
- JVM version: JDK1.8
- Python version: Python3.1.5
- TensorFlow version: TensorFlow1.5.0
- Development tools: Myeclipse13
- Server: Tomcat9
- Search engine: Lucene5.5.0
- Segmentation device: IKAnalyzer2018FF\_u1
- Database: MySQL5

**3.3. Experimental Process.** This article provides 50 testers to test the system, mainly to test the recommendation effect of the recommendation algorithm. The specific test plan and evaluation criteria are as follows:

Resource tags are defined by users and system administrators. Users can define resource tags according to their own understanding. At the same time, the system administrator will set the default label of the resource when the resource is released. When users search for resources, the system will reorganize and weigh the user-defined tags to form the matrix resource tag data. According to the recommendation algorithm based on social tags, the system searches the database for resources with high similarity to the resources searched by the user and recommended to the user. The accuracy of the user's judgment of the recommendation result is mainly to judge whether the resource recommended by the algorithm is similar to the learning resource sought, and then the accuracy is used as the criterion for evaluating the recommendation algorithm. The recommendation algorithm is that the recommendation effect is better, and vice versa, the recommendation effect is relatively weak.

This experiment is divided into a control group and an experimental group. The control group does not use algorithms to fill data, and the experimental group uses algorithms to fill data. A total of five sets of tests were conducted. In each experiment cycle, 10 users are selected as test subjects, and all 10 users are required to mark the same learning resources. Testers can mark the learning materials according to their own understanding. After all the testers have configured the tags, the next step is to test the recommendation accuracy of the recommendation algorithm based on social tags is judged based on accuracy.

**3.4. Questionnaire Survey.** After the experiment, a questionnaire survey was conducted for the students who love swimming. The subject of its investigation is the feasibility of a personalized recommendation system. To understand the design points of the swimming personalized recommendation system, 20 people were interviewed using the questionnaire, which was conducted in the form of on-site interviews and answering questions, which lasted one hour.

## 4. Analysis of Experimental Test and Survey Results

**4.1. Comparison of MAE between the Two Sets of Tests.** The user-based collaborative filtering recommendation algorithm is tested. Because of the small number of testers, the data obtained is relatively sparse. The MAE value is tested every time 10 testers are added, and the test results are shown in Table 1.

As shown in Figure 2, we observe that as the number of testers increases, the average absolute error of the experimental group and control is decreasing. From an error of 2.5 and 2.8 for 10 testers to an error of 1.6 and 2 for 50 testers, the average error dropped by 0.9 and 0.8, respectively. This is because as the number of testers increases, other objects similar to the target object also increase. The higher the accuracy of experimental prediction, the average absolute error of the experimental group is significantly lower than that of the control group.

**4.2. The Precision Analysis of Recommendation Algorithm.** If the label set by the user reflects the characteristic information of the learning resource, then the higher the accuracy of the recommendation algorithm recommendation based on the social label, the higher the accuracy rate. Among those with a supportive attitude, 17 people identified with the learning environment, 18 identified with the cognitive level, and 19 identified with the learning outcomes. The details are shown in Table 2.

As shown in Figure 3, the results of the experimental test are relatively volatile, however, the accuracy of the experimental test is above 40%. The reason for the relatively large volatility is that the tags set by the user

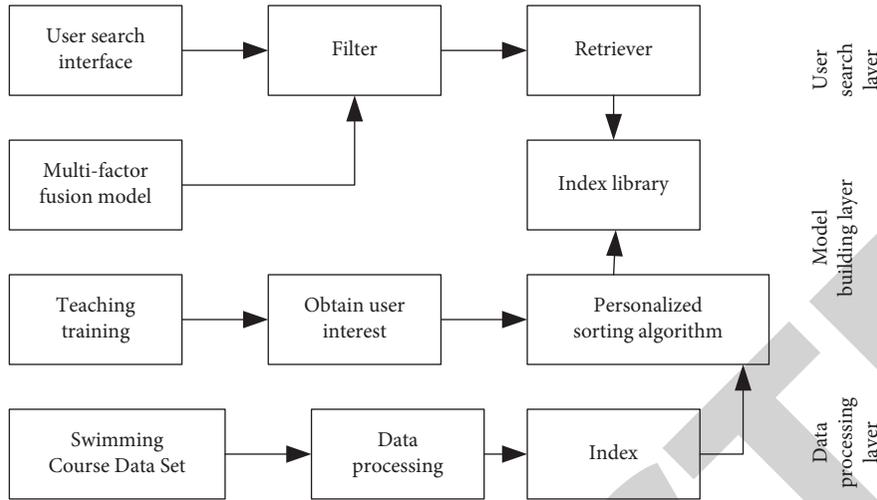


FIGURE 1: Overall structure layout of personalized recommendation system.

TABLE 1: The MAE comparison of the two groups of tests.

	Experimental group (error)	Control group (error)
10	2.5	2.8
20	2.3	2.6
30	1.9	2.3
40	1.8	2.2
50	1.6	2

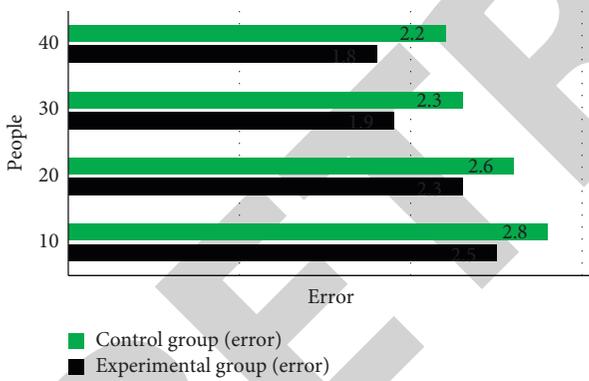


FIGURE 2: The MAE comparison of the two groups of tests.

TABLE 2: Analysis of five rounds of calibration results.

	Frequency of item	Precision
First round	33	0.65
Second round	42	0.85
Third round	25	0.49
Fourth round	31	0.62
Fifth round	45	0.9

sometimes do not reflect the characteristics of the learning resources well.

4.3. Analysis of Student’s Attitude toward Swimming Personalized Recommendation System. According to the form

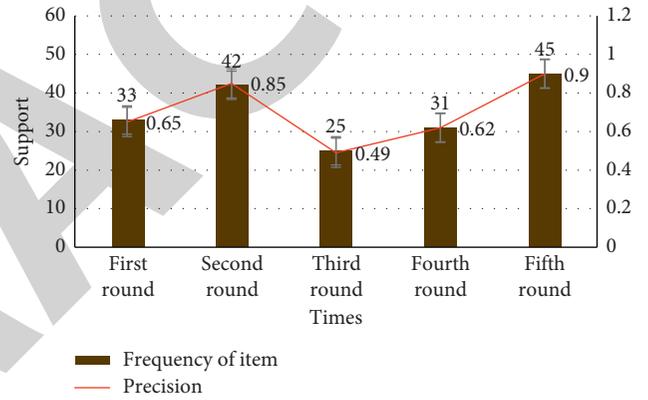


FIGURE 3: Analysis of five rounds of calibration results.

TABLE 3: Students’ attitude analysis toward the personalized swimming recommendation system.

	Affirm	Negate	Uncertain
Learning environment	17	1	2
Cognitive level	18	1	1
Learning result	19	0	1

of the questionnaire survey, dozens of students’ suggestions and attitudes toward the personalized recommendation system for swimming have been collected. The main information obtained includes the learning environment, cognitive level, and learning effect. From these aspects, the student’s attitude can be derived. The specific situation is shown in Table 3.

As shown in Figure 4, we can find the attitude toward the personalized recommendation system for swimming. More than 85% of people agree with this. Only a small number of people are uncertain about this, and 2 people are negative. Therefore, the personalized recommendation system for swimming teaching plays a very important role in teaching effects and can be studied in depth.

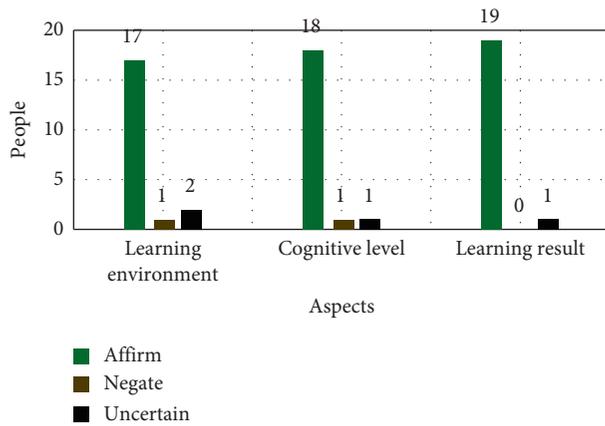


FIGURE 4: Students' attitude analysis toward the personalized swimming recommendation system.

## 5. Conclusion

With the popularity of swimming, people's demand for water enjoyment services is also increasing. Swimming courses have also been favored by more people. It is very necessary and meaningful to develop a set of personalized service analysis systems for user needs. The system can push information according to the user's age, hobbies, and other characteristics, helping swim enthusiasts to better understand the content and knowledge they have gained. Therefore, a set of personalized recommendation systems suitable for swimming-loving users can be developed to promote the development of swimming, enhance the strength of the people, and help provide those who want to swim the suitable courses. This article, firstly, studies deep learning and elaborates the advantages of deep learning based on artificial neural networks. Secondly, the related algorithms of the recommender system are researched. By the description of its algorithm, the data processing capability of the system is improved. Then, it analyzes the personalized recommendation system and unfolds it one by one from its content, characteristics, and reasons. Finally, the experiments and questionnaires were conducted. According to the results of experiments and investigations, the system designed in this paper has good accuracy and practicability, and the system is supported by most users.

## 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 authors declare that they have no conflicts of interest to report regarding the present study.

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