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Retraction

Retracted: Sports Training Management Model Based on Big Data Digital Technology under Complex Human Environment

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets 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 own 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.

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[1] J. Xu, L. Xu, and X. Wu, "Sports Training Management Model Based on Big Data Digital Technology under Complex Human Environment," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 6302591, 9 pages, 2022.

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Research Article

Sports Training Management Model Based on Big Data Digital Technology under Complex Human Environment

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Data physical education process is also the practical process of information technology and college physical education curriculum integration. In order to improve the accuracy of college sports training management evaluation, we propose a golden sine algorithm (GoldenSA) based on back propagation neural network (BPNN) model whose performance is affected by its parameter selection to optimize BPNN (GoldSA-BPNN). The quality evaluation model of physical education in higher education institutions is based on GoldenSA. Firstly, a multi-indicator evaluation system of university sports training management based on hierarchical analysis was constructed from four dimensions, including teaching contents, teaching methods, teaching attitudes, and teaching effects; secondly, the scores of 12 secondary indicators of university sports training management evaluation were taken as the input vector of BPNN.

1. Introduction

In physical education, a large number of courses are different from those of other majors and have their own unique characteristics, so the effect of using pure textual descriptions and simple book images in the classroom is not good [1].

Therefore, teachers of physical education should make more use of computer multimedia technology and interactive network to present teaching contents, so that the content is richer, the knowledge is easier to understand, and students can learn more quickly and accurately to achieve twice the result with half the effort [2, 3]. The construction of an interactive digital physical education teaching resource platform adds rich digital information resources to the platform and adds interactive functions and network functions to change the traditional single teaching mode and create a good teaching atmosphere and environment, which also greatly improves teachers' teaching efficiency and effectiveness [4].

The process of education informatization is accelerating, and digital teaching resources have penetrated in all fields of study [5]. The combination of physical education courses and digital technology in colleges and universities is not simply using some digital equipment and sports information resources from various shared platforms as a demonstration tool, but not only to achieve the mutual integration and penetration between digital information technology and physical education, but also to integrate the digital virtual space with the real application. At the recent stage, major universities in China have carried out digital physical education to enrich classroom teaching forms, explore new ways of physical education in colleges and universities, and effectively promote the smooth implementation of physical education curriculum integration in colleges and universities, which is of great significance to physical education curriculum reform and innovation [6–8].

Digital physical education is a process and way to integrate digital technology and resources into the original college physical education curriculum, change the traditional college physical education concept, deliver the latest information of physical education resources in time, and fully explore and develop the potential functions of physical education to realize the integration and optimization of physical education curriculum and better accomplish the goals of college physical education [9]. It is also the practical process of integrating information technology and college physical education curriculum. The digital physical education teaching transmits images, sounds, videos, animations, and text materials in a "networked," "intelligent," and "digital" way through modern educational means such as electronic database, hypermedia, network, and word processing [10]. The teaching contents such as sound, video, animation, and text materials are transmitted in a "networked," "intelligent," and "digital" way. The teaching activities of digital physical education courses are two-way, which not only promote the communication between teachers and students but also create a good environment for students to learn physical skills and exercise healthy physical and mental qualities [11].

For a long time, the traditional physical education teaching mode has been single. In order to better promote the intellectual development of college students, promote the comprehensive cultivation and development of college students' moral, intellectual, and physical abilities, and inject new vitality into physical education teaching, we should explore the digital physical education teaching mode [12]. The reform of digital physical education mode is aimed at helping students develop good habits of lifelong exercise, further develop, explore, and cultivate students' innovation and practical ability, and form a good model for teachers and students to learn and progress together [13]. For example, in the process of teaching martial arts, multimedia materials such as the spirit of Chinese martial arts can be played at the same time during the preparation activities, so that students can enjoy the ancient Chinese culture and develop a sense of pride in the strength of the motherland and a passion for exercising to defend the motherland [14]. For example, before teaching Taijiquan, digital technology can be used to explain the origins, development, and schools of Taijiquan culture in a systematic way to better arouse the interest of learners, and while watching the live performance of the famous masters, students can rub their fists and love the ancient culture of the Chinese nation in the atmosphere of traditional martial arts music [15–17]. The spirit of martial arts is reflected in every move, and the health and wellness effects of ancient Chinese sports are felt in every breath. The students are motivated to learn and relax while studying martial arts and Taiji. The exploration and development of the digital physical education model is conducive to increasing the initiative and motivation of the learners, increasing the level of active participation, putting the learners in an active position in the learning process, and helping them to develop a sense of collaboration and learn to learn collaboratively [18–20].

2. Data Collection and Preprocessing of University Students' Physical Education Learning

2.1. Information Collection Related to College Students' Physical Education and Learning. The use of excel tables to summarize students' grades achieves long-term storage of data, but the intelligence of summarizing data and extracting key information is low, and the value and utilization rate for teaching decision-making is not high. C/S is the abbreviation of client/server. A server usually uses a high-performance PC, workstation or minicomputer, and a large database system. B/S is the abbreviation of browser/server. The teaching information management platform integrates the advantages of data processing and analysis of information technology and big data technology and has powerful resource integration function; it adopts a hybrid structure of C/S and B/S as the overall architecture of the platform, which can handle complex data business procedures, properly solve the demand for diversified decision-making participation, and meet the use demand of independent parallel business [4]. In the teaching information management platform shown in Figure 1, the application server and the data server can communicate with each other interactively. After receiving the data information, the application server divides the information into two ways: one way is sent to teachers, students, and other types of customers through the firewall; the other way is received directly by the platform administrator to facilitate the management of sports teaching information, maintain the safety of teaching data, and control the access qualification of users.

The platform database is the main source of students' sports performance information, training information, and personal information, so the database design should meet the increasing demand of teaching data and ensure the stable operation of the platform while storing data safely. The database structure of the platform is designed using SQL technology, and the relationship between information categories is described based on E-R diagram.

2.2. Autonomous Physical Fitness Training Monitoring System. The hardware equipment mainly includes acceleration sensor, image sensor, Bluetooth communication module, training information collection module, and information processing module [17], and the layout of the Android platform-based autonomous physical training monitoring system is shown in Figure 2.

The system shown in Figure 2 uses acceleration sensors and image sensors to collect behavioral data, such as body amplitude and movement strength, during the students' voluntary physical training; this information is transmitted to the information processing module through the microcontroller in Bluetooth communication mode for original backup on the one hand and to the information processing module through the centralized integration of the information collection module on the other hand; finally, the Android platform receives the processed physical training information and the original physical data [18].

2.3. Information Data Preprocessing. For example, students' performance in 100-meter run is expressed in different forms, and the method of normalization is shown in the following equation:

$$\hat{x}_i = \frac{(x_i - x_{\min})}{(x_{\max} - x_{\min})}. \quad (1)$$

In (1), the initial 100-meter run performance and the normalized 100-meter run performance are expressed as x_i and $\hat{x}_i$respectively; the upper and lower limits of

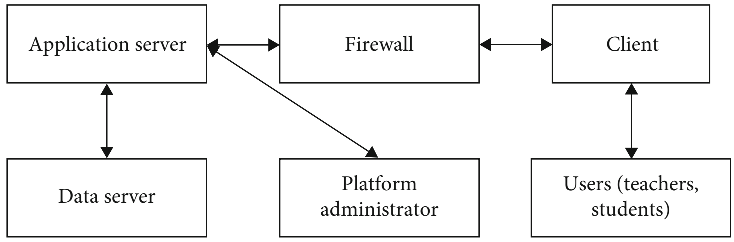


Figure 1: Structure layout of teaching information management platform.

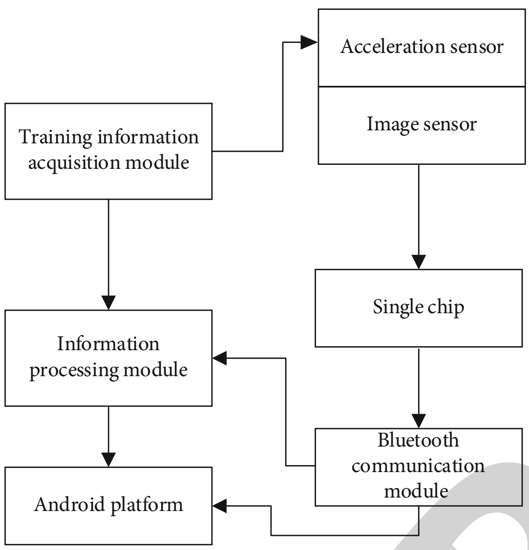


Figure 2: Layout of the autonomous physical training monitoring system.

performance are described as $x_{\min}$ and $x_{\max}$, respectively. Finally, the data between [0.1] are used to describe the students' sports performance, which simplifies the calculation process of data mining later.

3. The Foundation of Building a Digital Physical Education Teaching Resource Platform

The development environment of the digital physical education resource platform is the CAI computer system, including various hardware and software components for courseware development. The software structure is divided into two hierarchical structures, and the lowest hierarchical structure is the computer itself, that is, the hardware system that constitutes the computer, which is the most basic support, and the computer hardware equipment used in. They are shown in Figure 3.

3.1. Multi-Indicator Evaluation System for Sports Training Management. The establishment of scientific and systematic sports training management evaluation indicators is the basis for objective evaluation of sports training management, as shown in Figure 4.

3.2. Backward Propagation Neural Network. BPNN generally consists its network structure is shown in Figure 5.

In Figure 5, the input and output variables of the BPNN are $X = (X_1, X_2, \cdots, X_n)$ and $Y = (Y_1, Y_2, \cdots, Y_m)$, respectively, and the training procedure of the BPNN network can be described as follows:

Step 1. Initialize the BPNN network. The weights between the input layer and the implicit layer and between the implicit layer and the output layer are represented by w_{ij} and w_{jk}, respectively.

Step 2. Calculate the output of the hidden layer.

$$H_j = f\left(\sum_{i=1}^{n} w_{ij} x_i - a_j\right), j = 1, 2, \cdots, l. \quad (2)$$

In equation (2), X represents the value of the input layer variables, w_{ij} represents the connection weights from the input layer to the hidden layer locks, and a represents the threshold value of the hidden layer. $f(x)$ is expressed as $f(x) = 1/(1 + e^{-x})$.

Step 3. Calculate the output layer output. Based on the BPNN implicit layer output H and the connection weights w_{jk} from the implicit layer to the output layer neurons and the corresponding threshold b in the output layer, the prediction value O of the BPNN is calculated.

$$O_k = f\left(\sum_{j=1}^{l} H_j w_{jk} - b_j\right), k = 1, 2, \cdots, m, \quad (3)$$

$$e = Y_k - O_k, k = 1, 2, \cdots, m. \quad (4)$$

Step 4. Update the weights.

$$w_{ij} = w_{ij} + \eta H_j (1 - H_j) x(i) \sum_{k=1}^{m} w_{jk} e_k, i = 1, 2, \cdots, n \, ; j = 1, 2, \cdots, l, \quad (5)$$

$$w_{jk} = w_{jk} + \eta H_j e_k, j = 1, 2, \cdots, l \, ; k = 1, 2, \cdots, m. \quad (6)$$

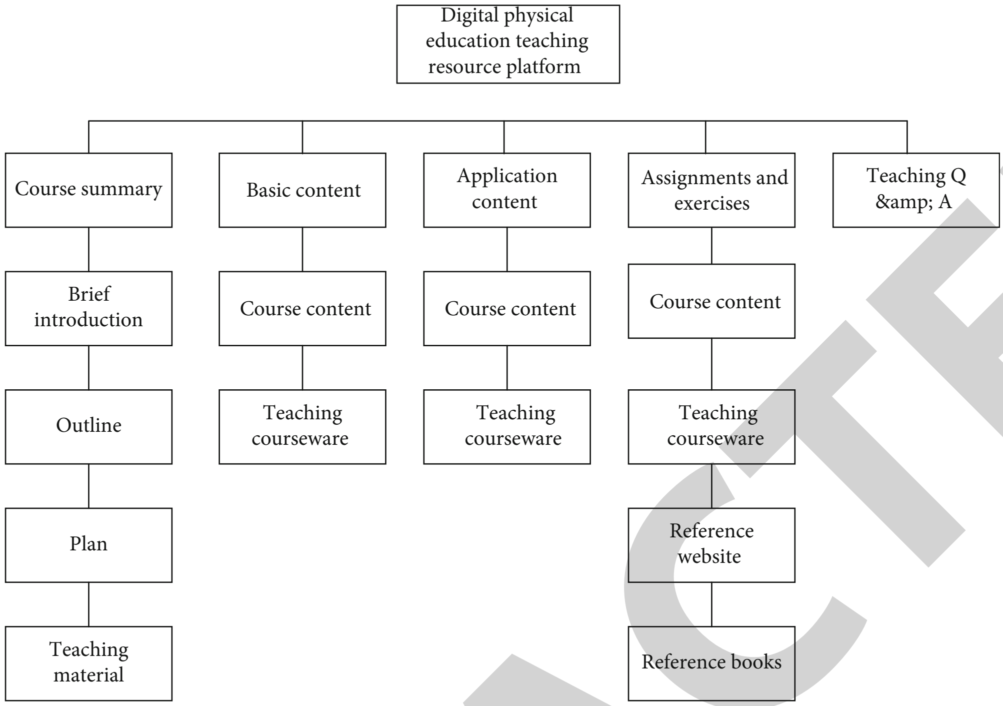


Figure 3: Education platform construction.

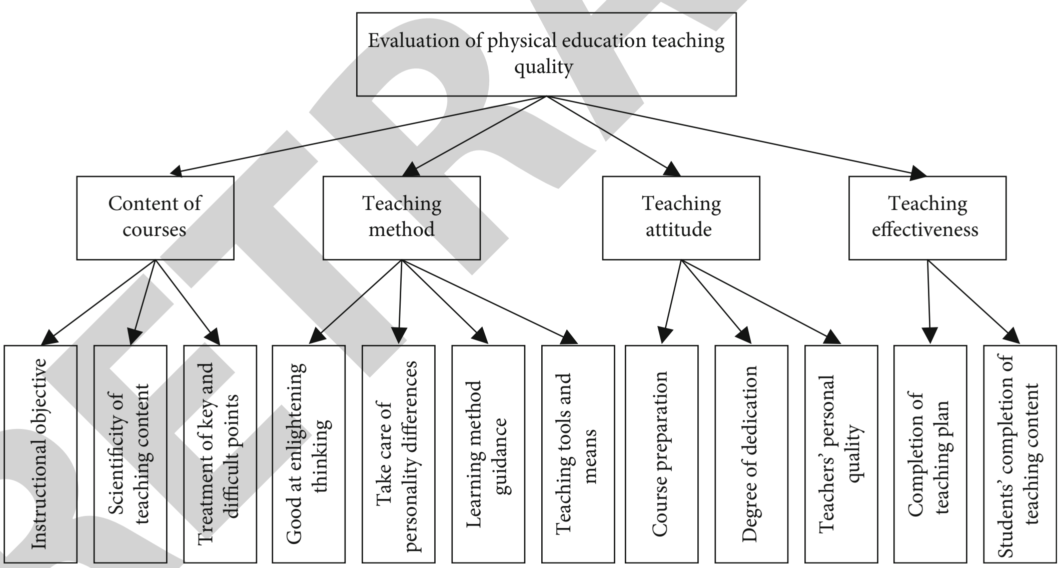


Figure 4: Sports training management evaluation index system.

Step 5. Update the threshold value.

$$a_j = a_j + \eta H_j\left(1 - H_j\right) \sum_{k=1}^{m} w_{jk} e_k j = 1, 2, \cdots, l,$$
$$b_k = b_k + e_k, k = 1, 2, \cdots, m. \quad (7)$$

Step 6. The termination condition of the algorithm. If the termination condition is satisfied, the algorithm stops; otherwise, return to Step 2.

4. GoldenSA-BPNN-Based Evaluation Model for University Sports Training Management

The overall process of the GoldenSA-BPNN model-based teaching quality evaluation model of physical education in higher education institutions is shown in Figure 6.

Firstly, the data sets obtained by the system were divided into training set and test set in the ratio of 4 : 1. Then, the GoldenSA optimized BPNN model with weights and thresholds was used to build the GoldenSA-BPNN model based on

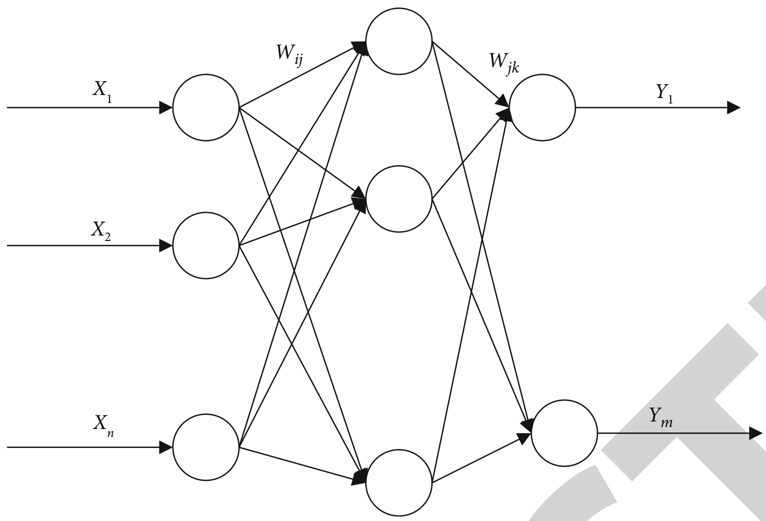


FIGURE 5: BPNN network structure diagram.

the training technique data. The overall implementation process is described as follows:

Step 1. Read the evaluation data of university sports training management.

$$x_{\text{new}} = La + \frac{x - x_{\min}}{x_{\max} - x_{\min}} \times (Lb - La). \quad (8)$$

In equation (8), x represents the original data, x_{new} represents the normalized data, $x_{\min}$ and $x_{\max}$ are used to refer to the minimum and maximum values in the original data set, and La represents the minimum value according to equation (9); use the BPNN model to obtain the weights and thresholds. Mark the initial position of each individual of each population.

$$V_i = lb_i + \text{rand}\,(0, 1) \times (ub_i - lb_i), \quad (9)$$

$$\begin{aligned} x_1 &= a \times (1 - \tau) + b \times \tau, \\ x_2 &= a \times \tau + b \times (1 - \tau). \end{aligned} \quad (10)$$

In equation (10), τ is the golden mean coefficient, $\tau = (\sqrt{5} - 1)/2$, $a = -\pi$, and $b = \pi$ in the text.

Step 2. Use equation (11) to calculate the best fitness value ACC for each individual in the population, and keep the best individual V_{best_c}.

$$\max \text{ACC}(C, g) = \frac{\sum_{k=1}^{K} \text{acc}_k}{K} \text{ s.t} \begin{cases} C \in [C_{\max}, C_{\min}], \\ g \in [g_{\max}, g_{\min}], \end{cases} \quad (11)$$

$$V_i^{t+1} = V_i^t \times |\sin\,(r_1)| - r_2 \times \sin\,(r_1) \times \left|x_1 \times D_i^t - x_2 \times V_i^t\right|. \quad (12)$$

In equation (13), V_i^{t+1} and V_i^t are the $t + 1$th and tth iteration positions of individual i, respectively; D_i^t is the tth iteration optimal position of individual i; r_1 and r_2 are the random numbers between $[0,2\pi]$ and $[0,\pi]$.

Step 3. For the population individuals whose positions have been updated, the calculator adaptation value ACC_{new} is used to compare with the best adaptation value ACC_{best} of the previous generation, and if ACC_{new}⊠ACC_{best}, the best adaptation value is updated to obtain the latest adaptation value for this iteration, and at the same time, the latest position of the individual is recorded; otherwise, ACC_{best} is kept without updating.

Step 4. According to the output of Step 4, the evaluation of college sports training management is carried out for the test data set.

5. Experimental Results and Analysis

5.1. Data Sources and Evaluation Indicators. To validate the effectiveness of GoldenSA-BPNN for sports training management evaluation, the Matlab2020(a) software was used in the experimental environment, and a PC with 32G of memory, 2.6 GHz CPU, Intel(R) Core(TM) i5-7200 4-core CPU, and Windows 10 Professional was selected as the operating system. Windows 10 Professional Edition was selected. The data were collected from "Research on University Physical Education Teaching Model," a teaching reform project of our university, and 3000 sets of data were collected. In order to evaluate the effectiveness of university sports training management evaluation, the accuracy of ACC classification accuracy, specificity, and sensitivity algorithms was used.

In order to verify the effectiveness of GoldenSA-BPNN for university sports training management evaluation, the recognition effects of GoldenSA-BPNN, PSO-BPNN, and

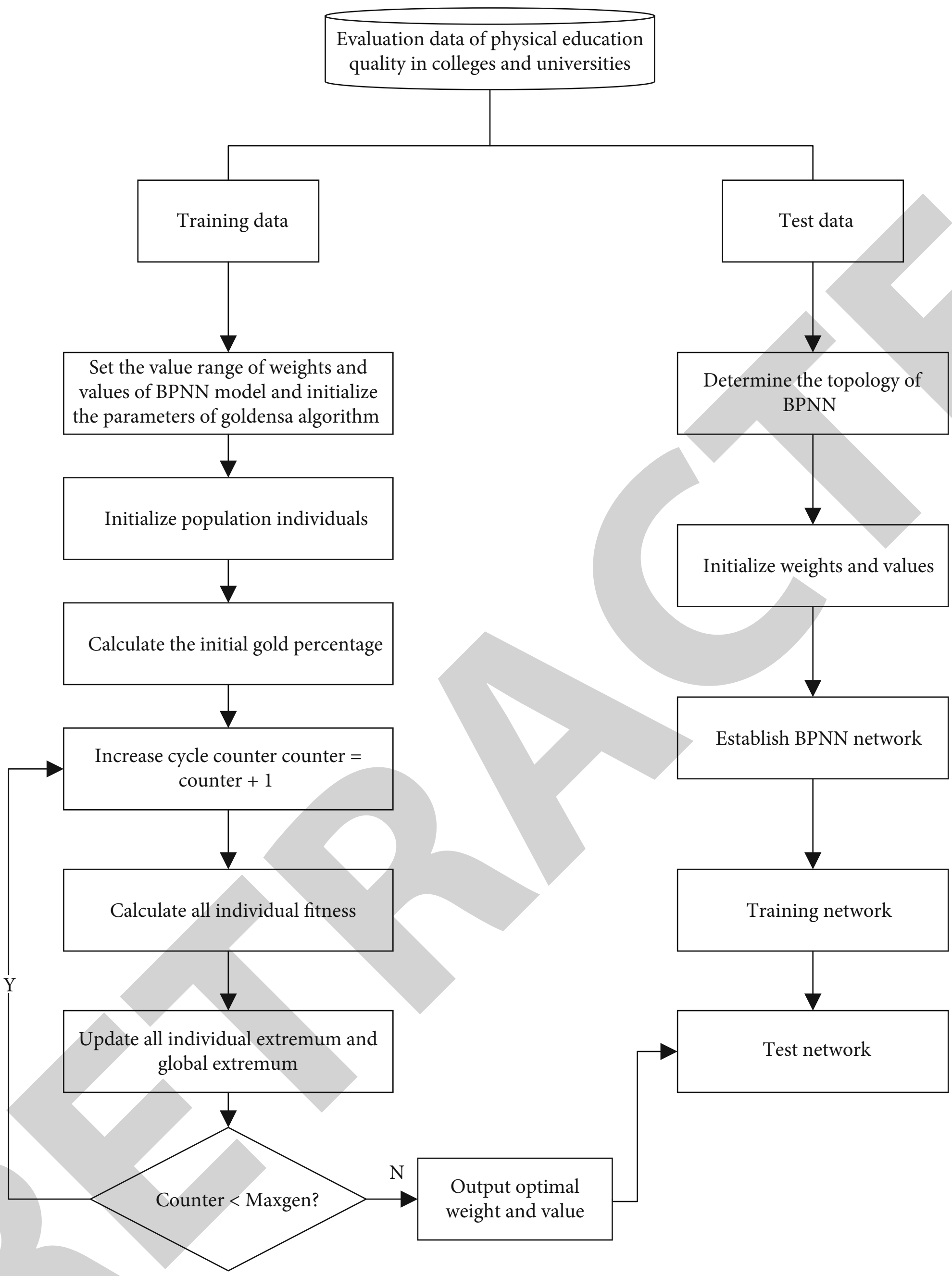


Figure 6: Evaluation flow chart.

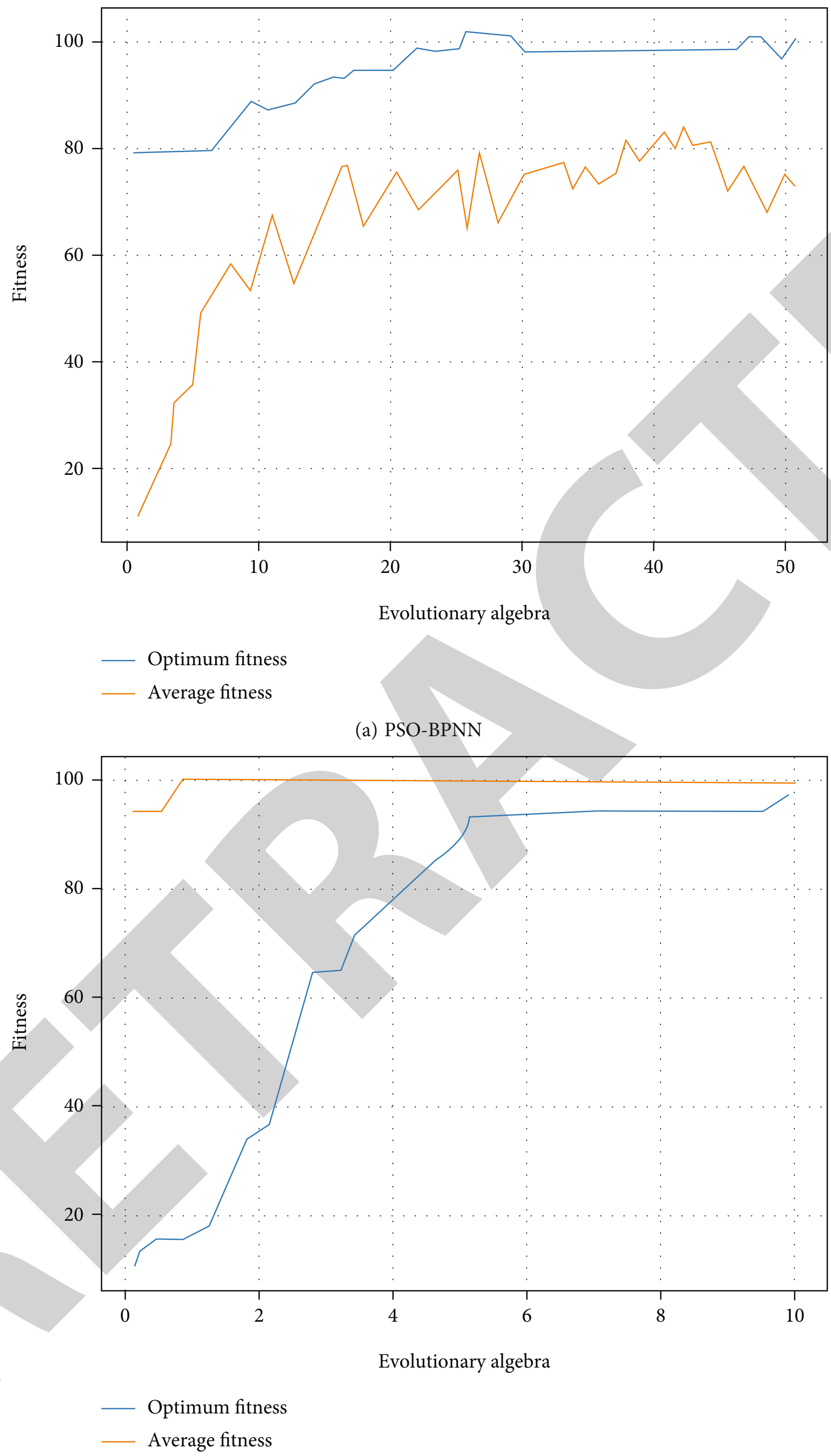
BPNN were compared, and the parameters of the algorithm were firstly set as shown in Table 1.

5.2. Analysis of Results. The input matrix vector of BPNN was selected from the evaluation scores of the secondary indicators of all grades of physical education training management evaluation of 15 universities, and the output vector of BPNN was the level of physical education training management (excellent, good, fair, and poor) of universities, and the BPNN model of physical education training management evaluation of universities was established. GoldenSA-BPNN is used to establish a GoldenSA-BPNN model for evaluating the teaching quality of physical education in higher education institutions.

Table 1: Parameter settings.

Algorithm	Parameter setting
GoldenSA	$M = 10$, $t = 50$
PSO	$M = 10$, $t = 50$, $C = 2$
BPNN	$N_1 = 12$, $N_2 = 24$, N_3

Figure 7 shows the comparison of the convergence speed of different algorithms, where GoldenSA-BPNN has a faster



(a) PSO-BPNN

(b) GoldenSA-BPNN

Figure 7: Convergence speed comparison chart.

convergence speed and starts to converge at iteration number 5. The evaluation results of GoldenSA-BPNN, PSO-BPNN, and BPNN are shown in Table 2.

As shown in Table 2, the classification accuracy (ACC) of GoldenSA-BPNN was 95.62%, which was better than that of PSO-BPNN (92.85%) and BPNN (90.77%). The specificity of GoldenSA-BPNN was 95.39%, which was better than that of PSO-BPNN (93.09%) and BPNN (92.34%). The greater the ACC, specificity, and sensitivity, the better the algorithm is. In terms of classification accuracy, the

Table 2: Evaluation results.

Method	ACC/%	Specificity/%	Sensitivity/%
GoldenSA-BPNN	94.63	94.39	96.45
PSO-BPNN	93.84	95.09	95.35
BPNN	92.77	91.34	90.16

algorithm improved by 2.77% and 4.86% compared with PSO-BPNN and BPNN, respectively. In terms of specificity, the improvement was 2.28% and 3.05% compared with PSO-BPNN and BPNN, respectively. In terms of sensitivity, the increase was 3.12% and 6.31% compared with PSO-BPNN and BPNN, respectively. The results of ACC, specificity, and sensitivity showed that GoldenSA-BPNN has higher classification accuracy, specificity, and sensitivity in the evaluation of university sports training management.

6. Conclusions

In this study, a GoldenSA-BPNN model is proposed to evaluate the teaching quality of physical education in higher education institutions. Compared with GoldenSA-BPNN, PSO-BPNN, and BPNN, the Golden-SVM model has the best performance in terms of classification accuracy, specificity, and sensitivity of the three performance evaluation indexes. However, due to the various factors affecting the quality of physical education teaching in colleges and universities, this study only studied the influence of 4 primary indicators and 12 secondary indicators on the evaluation of physical education training management in colleges and universities. Compared with previous studies, this model has a higher degree of intelligence, higher value, and utilization rate for teaching decision-making, integrates the advantages of data processing and analysis of information technology and big data technology, and has a powerful function of resource integration.

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 declared that they have no conflicts of interest regarding this work.

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