ORIGINAL

REFORMING PHYSICAL EDUCATION TEACHING MODELS USING NEURAL NETWORK ALGORITHMS DRIVEN BY BIG DATA ANALYTICS

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ABSTRACT

BD (big data)-driven sports precision teaching can turn the exploration of causality to the discovery of correlation, pay attention to finding correlation in different data, and pay attention to exploring the law of correlation in the process. As a practical course, most of physical activities are the main courses, and different events have different technical action essentials. Therefore, this paper studies the reform of PET (physical education teaching) mode based on BPNN (Neural network) algorithm driven by BD. The theory of BPNN is applied to the TQE (Teaching quality evaluation) system of college PET, and the changing adaptive learning rate is adopted, which makes the network training automatically set different learning rates at different stages. In order to ensure the reliability of the application of neural network in college physical education TQE, GA (genetic algorithm) is introduced into the neural network to improve and optimize the network weight. It is found that the error values obtained by BPNN improved by GA are the best. Compared with other algorithms, the average error is reduced by 1.687%. The experiment proves that the application of GA-improved BPNN model in teaching evaluation is scientific, objective and reasonable.

KEYWORDS: Big Data Drive; Neural Network; Physical Education Teaching Mode; Teaching Quality Evaluation

1. INTRODUCTION

In the information age, under the background of the comprehensive promotion of digital reform in the social and economic fields, the education and

teaching reform of the education system is also emphasizing the digital trend, and PET (physical education teaching) is no exception (Hiroshige et al., 2020; Kidokoro et al., 2020). The main driving force for the deep adjustment and optimization of social functions and social actions. As the product of the close combination of PET theory and PET practice, PET mode is not only the application of PET theory in PET practice, but also the systematic and rational generalization of PET experience, which has the closest relationship with teaching and learning. Problems such as the construction of humanism are becoming more and more prominent and important. Education, which has great influence on society and people, is bound to be in a period of great transformation. With the development of society, people's subjective value gradually occupies the core position in the social development system, and the research on "people-oriented" sports sustainable development also appears in the sports field, which reflects the intrinsic value core of humanistic sports concept. On the basis of various new PET ideas and theories, combined with the problems existing in PET practice and curriculum reform in ordinary schools, the majority of PET workers put forward several representative teaching modes through thinking, conception, experiment and theoretical summary. Nowadays, how to evaluate students' academic development in vocational education colleges more accurately and reasonably, and promote students to recognize themselves in time, strengthen their beliefs, and help them grow actively is an important theoretical and practical issue in the process of deepening education reform and comprehensively promoting quality education, and it is also one of the directions of the new round of national education reform (Lai et al., 2018). In other words, in teaching, there is no way to distinguish which one of the selected teaching contents and teaching methods can achieve the teaching goal more effectively. The research of the new PET mode still has a long way to go.In recent years, although China's school PET has made great progress, the goal of improving students' health has not yet been achieved, and what is more serious is that the reform of school PET is in trouble. Generally speaking, the existing research mostly uses theoretical speculation from concept to concept or focuses on the research of a single PET link, but seldom explores, analyses and discovers the research that can guide the specific PET action from the overall perspective. Therefore, we can make full use of the convenience brought by BD (big data) era and actively explore a more scientific and rational information-based PET mode through the related advantages of Internet technology, which is also the only way for future PET reform. Under the background of BD application, it is of positive significance both in theory and in practice to explore the construction of college physical education TQE system.

1.1 Research Innovation

(1) From the perspective of BD application background, this paper explores the construction of university sports TQE system, and comprehensively uses the relevant knowledge of BD and sports TQE to explore

how to build a university sports TQE system that meets the requirements of BD era.

(2) In this paper, the TQE model of college PET is established by using neural network theory.

The chapters and contents of the paper are arranged as follows: The first chapter introduces the background work of the research. The second chapter mainly introduces the present situation of this research. In chapter 3, a sports TQE model based on BPNN (Neural network) algorithm is proposed. The fourth chapter verifies the performance of the model studied in this paper. The fifth chapter is the conclusion.

2. Related Work

2.1 Present situation of Sports-Related Research

" The study of "people-oriented" in sports has made "people's problems" stand out in the sports development theory, and formed that the development of sports turned to the concern of people themselves, and started to think about the all-round development of sports on people's body, spirit, psychology and society. Demir et al. put forward the guiding ideology of "health first", which accelerated the reform of college PET (Demir & Güreş, 2023; Ding et al., 2021). Luo et al. put forward the guiding concept of "health first, lifelong PET, personality education, and all-round development", actively advocated open and inquiry teaching, expanded the time and space of PET courses, and advocated that schools should independently formulate teaching syllabus and independently select teaching material content in light of their own reality (Luo et al., 2020). Teaching mode is the intermediary link of applying teaching theory to teaching practice, and it is a paradigm and plan that constitutes courses and coursework, selects teaching materials and prompts teachers' activities. The social responsibility model proposed by Cao et al. aims to cultivate students' sense of responsibility for themselves and society (Cao et al., 2022). This model is to attract children to participate in sports activities, so as to change their behaviour patterns and become useful people to society. Popovich et al. classified the PET modes into several categories according to the functions and objectives of PET: the "developmental" PET mode formally includes the discovery learning teaching mode, the problem-solving learning teaching mode and the goal learning teaching mode with the main functional objectives of cultivating ability and developing physical and mental quality (Ding et al., 2020; Popovich et al., 2021).

2.2 Present Situation of TQE Related Research

Carrasco et al. took the comprehensive evaluation of students' academic test scores as the evaluation object and established a comprehensive

evaluation model with BPNN (Páez & Martínez-Díaz). Their research has achieved certain results and opened up a new path for teaching evaluation. Nelson et al., based on in-depth analysis of the principles of data processing methods such as neural network, fuzzy evaluation and analytic hierarchy process, and guided by the systematic thought (Nelson et al., 2019). Fujitaka et al. uses the known part of information to find rules and extract those values that are useful for generating information. Finally, he can find the rules of the whole sample and describe and control them (Fujitaka et al., 2020). The drawback is that in the process of practical application, some samples are looking for rules, and there is no significant difference. The quality of teaching is an important sign to evaluate the success of a school. Billings studied the parameter selection and convergence of basic PSO(Particle swarm optimization) by random method, and achieved valuable results (Billings, 2019); Phipps put forward PSO with reproduction and subgroup hybridization, which can effectively avoid the potential problems when offspring optimize functions with multiple local extremum points due to the selection of fitness values (Phipps, 2021); Xie et al. applied PSO to BPNN weight optimization, and designed the analysis method of "natural language group words" with trained neural network (Xie et al., 2019); Sato & Ishida constructed a neural network model, generated various types of training samples to train the network, and the trained network can be used to evaluate teachers' working conditions (Sato & Ishida, 2019).

3. Methodology

3.1 Selection and Construction of PET Model

Which requires providing high-quality and personalized educational content according to students' needs. In the traditional PET process, the PET teacher is the main body and the leader of the classroom, explaining the essentials of movements for students and demonstrating them. In the process of actively participating in learning, their cognitive abilities, such as muscle memory and body awareness, will be improved, making learning easier to master, having a stronger sense of accomplishment, and making them more willing to learn, thus forming a virtuous circle, further improve the information technology literacy and ability of PET teachers, and make the information technology and PET deeply integrated. Although "PET and Health" has a unified curriculum standard, it is influenced by regional conditions, school environment, teachers' strength, students' learning situation and other conditions. PET curriculum needs PET teachers to design, develop and implement scientifically according to school conditions and learning situation. The existing research and practice of PET stratified teaching generally take students' sports achievements and sports skills as stratified basis, and lack of consideration for students' physical health. Healthy BD provides a strong support for PET hierarchical teaching. In order to effectively improve students'

physical health, school PET needs to carry out stratified teaching according to students' physical condition, that is, to provide students with appropriate PET contents and teaching methods. In order to effectively improve students' physical health, school PET needs to carry out stratified teaching according to students' physical condition. The college PET mode has a systematic structure, and it must follow the teaching rules in its characteristics of the school, and a specific teaching mode should achieve a specific teaching effect. Therefore, each teaching mode should have its own clear standard of effect evaluation. In actual teaching, textbooks take specific technical teaching projects as the content, and students use various manipulative modern materials, such as competition videos, classroom videos, textbooks, e-books and various search engines as the information sources of the projects, and make use of communication between students and teachers to form an implementation, namely, the students' cognitive rules, the formation rules of sports skills, the rules of sports load and emotional experience. The college PET mode has a systematic structure, and it must follow the teaching rules in its implementation, namely, the students' cognitive rules, the formation rules of sports skills, the rules of sports load and emotional experience. Therefore, the scope of application of college PET mode should be determined according to the guiding ideology of teaching, the region where it is located and the actual interactive learning atmosphere. The PET curriculum teaching under BD thinking has moved towards a new paradigm of public service, which analyzes the construction of PET curriculum case resource base from the theoretical level. This paper establishes a BD-driven intelligent dynamic prediction system model of students' ability, as shown in Figure 1.
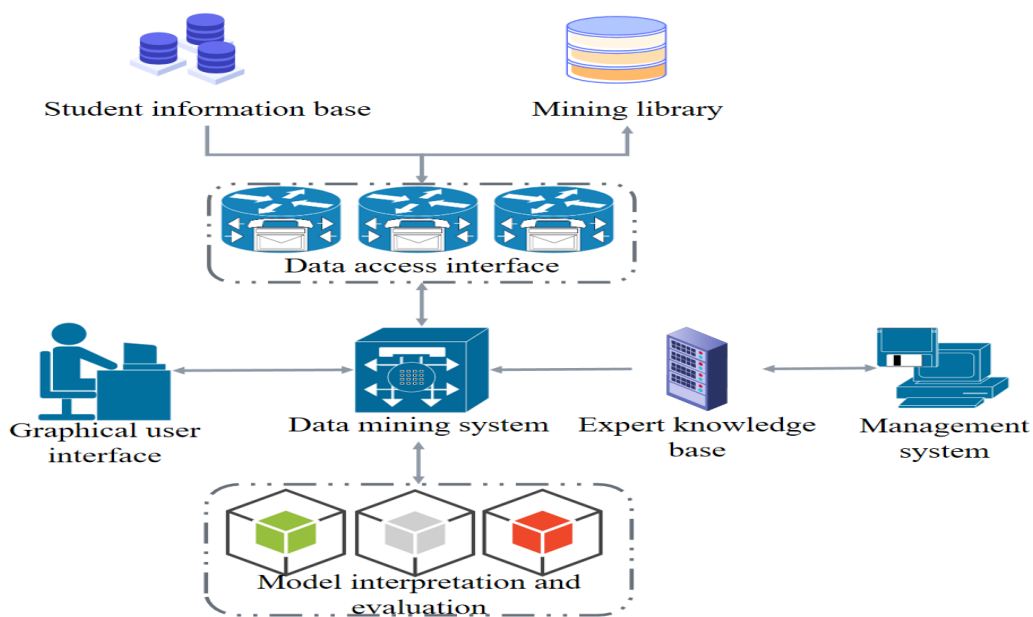

Figure 1: BD-driven intelligent dynamic prediction system model of students' ability

Through the data collection of large samples, we can monitor students'

different learning stages and states. Through real-time data feedback, students' learning deficiencies and problems can be found; BD-driven sports precision teaching can turn the exploration of causality to the discovery of correlation, pay attention to finding correlation in different data, and pay attention to exploring the law of process correlation, and discover the factors and interactions that affect students' sports learning process. The unclear teaching goal is a typical problem in the current college PET reform. In the reform of college PET, actively promoting and implementing sunshine sports can mobilize students' initiative after the improvement of PET content, make it a PET theme, and make students have the consciousness of actively participating in physical exercise, so as to improve students' sense of participation in the practice of physical education courses, guarantee the quality of college PET, and innovate the PET practice mode.

3.2 Sports TQE Model Based on BPNN Algorithm

The design, production and construction of teaching resources is an important starting point to promote the construction and application of information-based teaching platform, and an important condition to promote the innovation of information-based teaching mode of college PET. Self-evaluation of P.E. teachers refers to a kind of knowledge of self-teaching quality of P.E. teachers, which is the basic way of TQE (Liu et al., 2019). Cognitive psychology holds that motor skill learning is mostly a conscious and complex cognitive process, rather than a straight unconscious process. Reasonable information stimulation collocation can produce positive transfer of specific cognition, which is in line with human cognitive law, which is necessary to cultivate innovative talents. Specifically, the choice of media content should match the teaching content and objectives; The time of media presentation should be appropriate to achieve the best effect and prevent negative effects. College sports associations can effectively supplement the shortcomings of traditional sports work in schools. It advocates the combination of students' independent ability and flexibility, which is more conducive to the cultivation of students' overall quality, and also enables students to establish the idea of lifelong sports in the activities of sports associations. The most important point in sports TQE movement is to index the evaluation system. Individualization helps to concretize some general and vague contents in the evaluation activities, refine them to every clear point, and enhance the operability of the evaluation activities (Chen & Zhu, 2019). Emotion and skills, emphasizing the organic unity and balanced development of knowledge, emotion, intention and action. Therefore, the current school PET reform, from the target level, must pay attention to the affective function in teaching, so that students can experience the fun of sports and form the consciousness of lifelong sports. We should integrate the teaching materials and the information outside the teaching materials, real life and students' experience, organize various practical activities with the teaching materials, and adjust and reorganize the teaching materials

appropriately according to the needs of students' development. Because a large number of factors in decision-making cannot be expressed quantitatively and can't avoid the decision-makers' choices and judgments in the decision-making process (Liu et al., 2021). Calculate the weight w_i of each index by the square root method, and calculate the geometric average of all elements in each row of the judgment matrix:

$$\bar{w}_i = \sqrt[n]{\prod_{j=1}^{n} b_{ij}} \tag{1}$$

Through normalization, the component of the feature vector W is obtained:

$$w_i = \frac{\bar{w}_i}{\sum \bar{w}_i} \tag{2}$$

Calculate the maximum characteristic root of the judgment matrix:

$$\lambda \frac{1}{n} \sum \frac{(AW)_i}{w_i}_{max} \tag{3}$$

A is the judgment matrix, and W is the eigenvector. A process in which teachers constantly satisfy students' thirst for knowledge, and improve students' abilities, knowledge and cognition. No matter what kind of evaluation method, the process of growing into people needed by the society is unilateral and has limitations. However, teachers' teaching activities are all-round activities with complexity and creativity. Teaching evaluation should be carried out in various forms and channels, and it should be rich and flexible in content, methods or means. However, as the subject of monitoring and evaluating the teaching quality, whether the students' evaluation results are objective and credible is a controversial issue for a long time. Resistance and opposition are mainly from teachers, and there are many excellent teachers. BPNN is a multilayer feedforward network trained by error back propagation algorithm (Baylor et al., 2019). Figure 2 shows a three-layer BP network model.
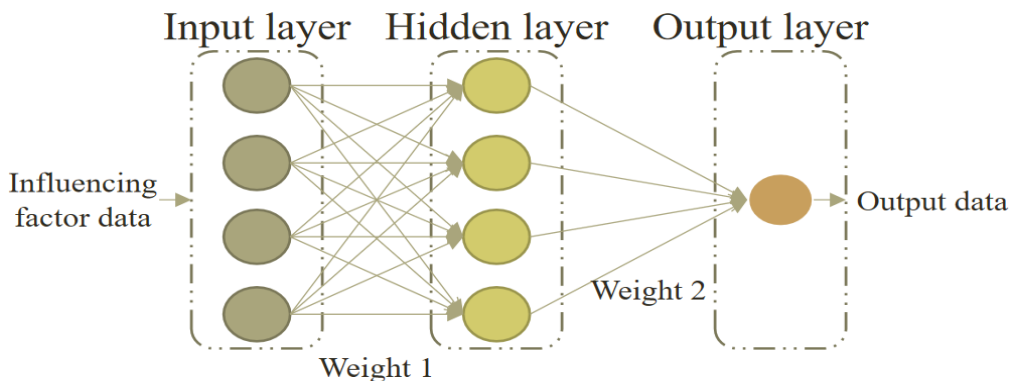

Figure 2: Three-layer BP network model

Output of the i neuron in HL (hidden layer):

$$a_{1i} = f_1\left(\sum_{j=1}^{r} w_{l_{ij}} p_j + b_{1i}\right), i = 1,2,\cdots,s_1 \tag{4}$$

Output of the k neuron of OL (Output layer):

$$a_{2i} = f_2\left(\sum_{i=1}^{s_1} w_{2_{ki}} a_{l_i} + b_{2k}\right), k = 1,2,\cdots,s_2 \tag{5}$$

In the above two formulas, the transfer function $f(x)$ is a unipolar Sigmoidal function (or hyperbolic tangent function):

$$f(x) = \frac{1}{1+e^{-x}} \tag{6}$$

The error can be defined as:

$$E_s = \frac{1}{2}\sum_{S=1}^{N_3}(T_s^k - O_s^k) \tag{7}$$

BPNN can solve the problem of nonlinear relationship. For nonlinear problems, neural networks can establish nonlinear continuous functions with approximate accuracy. Variable number. The number of input/outputs depends on the actual situation, and there is no fixed setting. In traditional physical education classroom teaching, most teachers adopt demonstration teaching methods to ensure the completion of teaching tasks. In this process, students imitate teachers' actions mechanically, which greatly limits students' ability to play independently.

Moreover, the design of teaching objectives has also changed, and group teaching objectives and individual teaching objectives can be set to implement the educational policy of individualized development of students. Teachers will also arrange pre-class exercises and strengthen training after class. However, although most college students already own smart phones, the school network environment still needs to be optimized and supplemented with basic facilities.

Students' autonomous learning ability in physical education is relatively poor, which makes college PET reform have no practical teaching significance, and also leads to the deviation of teaching effect from the ultimate PET goal. In the process of designing a neural network, the network has to undergo several different learning rate trainings. By observing the decline rate of the sum of the squares of errors after each training. According to the above analysis, the structure diagram of TQE model based on BPNN is shown in Figure 3:
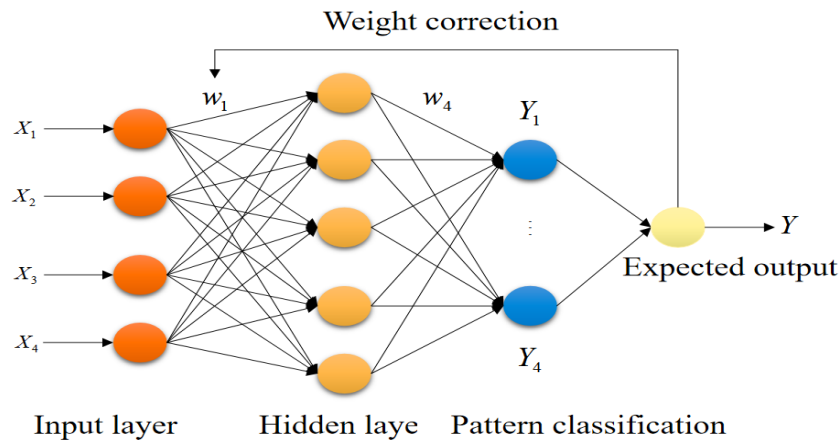
Figure 3: TQE model based on BPNN

Evaluation of individual fitness is calculated as follows:

$$F = a \times f + b \tag{8}$$

$$F = \alpha \times \frac{1}{E} + \beta \times \frac{T}{t} \tag{9}$$

In the formula, T represents the maximum number of HL neurons, t represents the total number of activated neurons in the network, a, b, α, β represents a real number between 0 and 1, and E represents the mean square error of BP network.

The input sample normalization formula is:

$$X = \frac{T - T_{min}}{Tmin_{max}} \tag{10}$$

X is the normalized neural network input value, T is the unprocessed input value, T_{max} is the maximum neural network input value, and T_{min} is the minimum neural network input value.

4. Experiment and Results

The accuracy of 14 sample data collection is directly related to the accuracy of the network model of students' academic performance evaluation, so we should pay special attention to the collection of training samples. When collecting sample data, the principle of fairness and objectivity should be followed to ensure that the sample data is true and representative. It introduces the advantages of network into the TQE system of college PET, and makes the quality evaluation quantitative, objective and systematic. The choice of network structure is very important in the whole network building process. A good network model structure can reduce the number of trainings, reduce workload and improve efficiency. The relationship between the number of hidden nodes

and the error is shown in Table 1 and Figure 4:

Table 1: Relationship between the number of hidden nodes and error

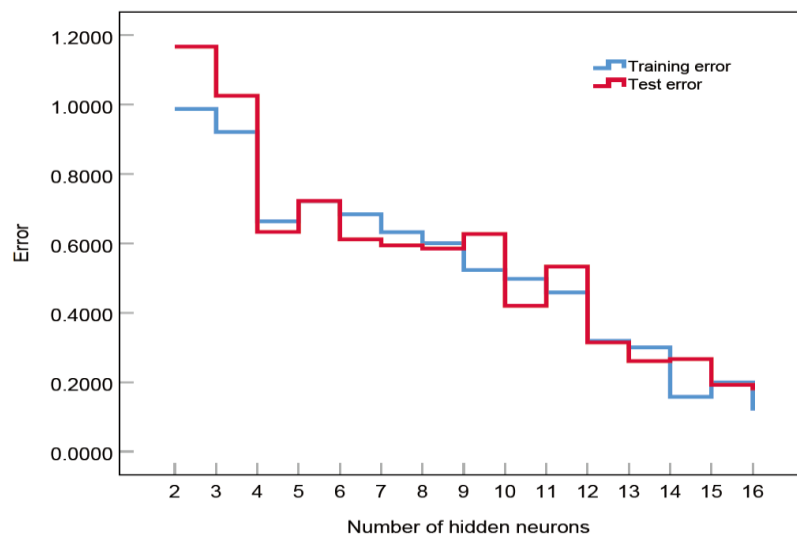| NUMBER OF HIDDEN NEURONS	TRAINING ERROR	TEST ERROR
2	0.9877	1.1671
3	0.9211	1.0258
4	0.6638	0.6331
5	0.7212	0.7224
6	0.6838	0.6117
7	0.6323	0.5942
8	0.6006	0.585
9	0.5233	0.6272
10	0.4978	0.4201
11	0.4587	0.5332
12	0.3188	0.3143
13	0.3001	0.2605
14	0.1576	0.2663
15	0.1992	0.1924
16	0.1183	0.1766

Figure 4: Relationship between the number of hidden nodes and error

Contemporary college students have already got rid of naivety and blind obedience, their psychology has developed to a relatively mature level, and they have been able to look at life and study more rationally. Although the characteristics of students' individuality are also taken into account, it is far from the ideal goal of educating people. Only guiding students to master common motor skills or strengthening the training of a new round of difficult movements has long neglected the promotion and application of the most basic motor skills. In the teaching process, the viewpoint of lifelong learning should be organically integrated with the daily teaching objectives. On the premise of fully meeting

students' learning needs, students should be guided by correct ideas and trained to actively participate in learning. Different training functions will affect the performance of the network, such as convergence speed and network promotion ability. The error curve is shown in Figure 5.
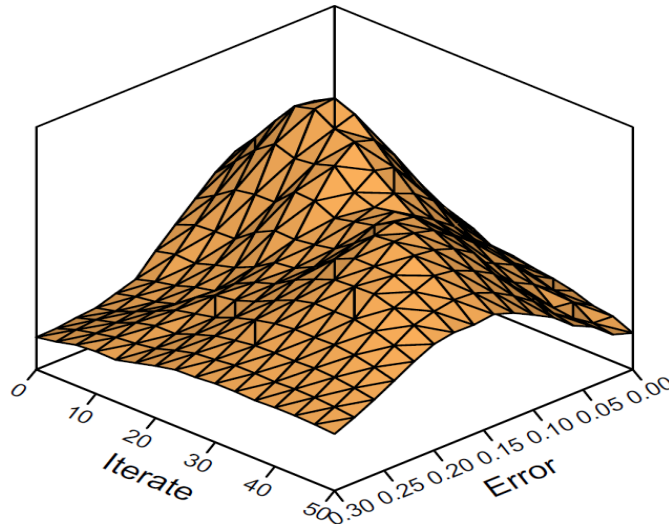

Figure 5: Error trend change potential

Table 2 is compared with Figure 6 for expert scoring and test results. It can be seen that the scores of experts are close to the test results, and the network convergence is good, but it is not stable enough, and the error is slightly larger. Based on this problem, in order to ensure the reliability of the application of neural network in college physical education TQE, GA (genetic algorithm) is introduced into the neural network to improve and optimize the network weight, so as to ensure more accurate network results.

Table 2: Comparison of Expert Scoring and Test Results

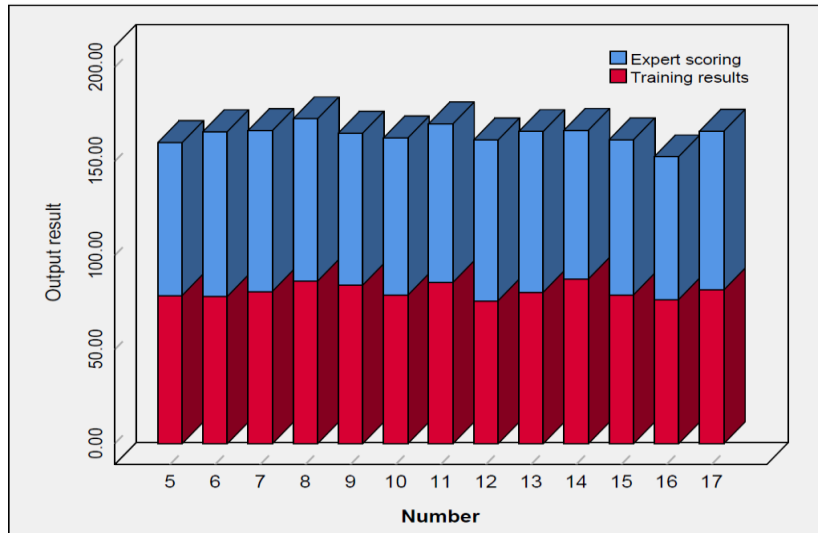| NUMBER	EXPERT SCORING	TRAINING RESULTS
5	81.26	78.65
6	87.59	78.15
7	85.46	80.85
8	86.31	86.28
9	80.84	84.14
10	83.58	78.81
11	84.3	85.61
12	85.44	75.89
13	85.46	80.4
14	79.08	87.42
15	82.47	78.99
16	75.91	76.53
17	84.37	81.58

Figure 6: Comparison of expert scoring and test results

In this paper, the standard BPNN algorithm, PSO and GA-improved BPNN algorithm are used for training. The network structure used by some algorithms is 786-40-15, and the initial values of the parameters conform to the normal distribution. The MSE (mean-squared error) comparison is shown in Figure 7.
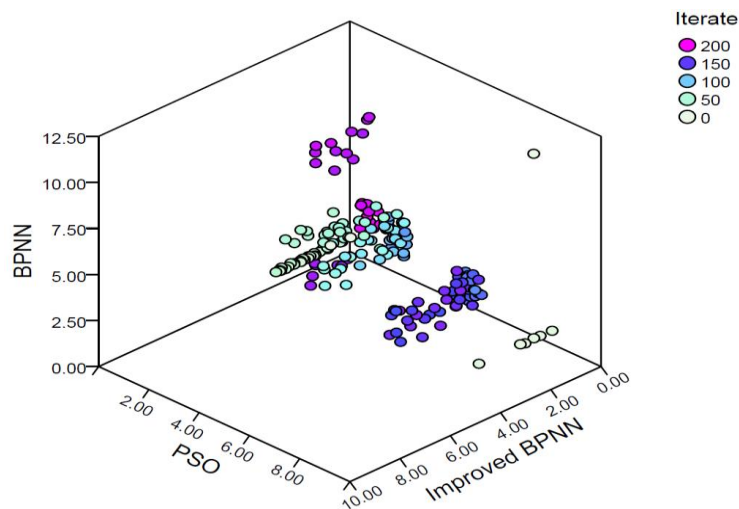

Figure 7: MSE comparison results

It can be seen that the algorithm has 10 valleys in 150 iterations, which means that 10 local minimum points have been found, most of which converge more thoroughly than the standard neural network algorithm. However, it can also be seen that the GA search method doesn't jump to the nearby valley, so it has a better overall situation and a greater possibility to achieve lower convergence. Generally speaking, the number of iterations required for convergence caused by quasi-Newton method is much less than that of gradient descent method. In order to investigate the experimental results of GA-

improved BPNN, the performances of the three methods were compared. Figure 8 shows the relative error comparison results of BPNN prediction, PSO prediction and GA search improved BPNN prediction.
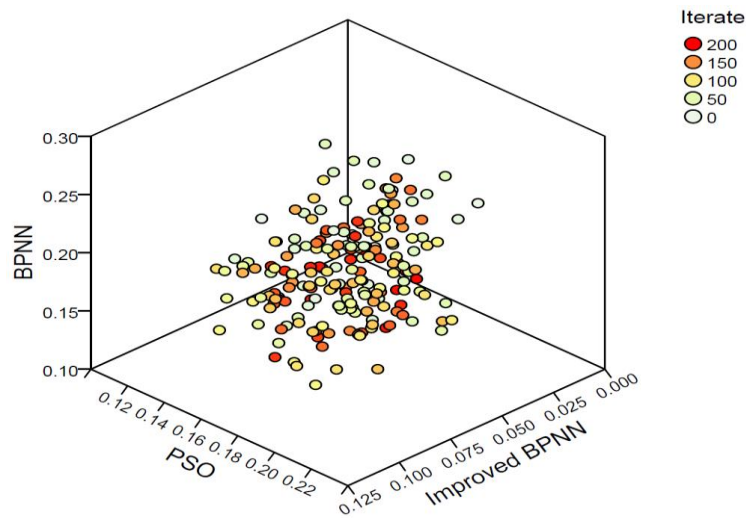

Figure 8: Comparison of relative errors

It can be found that the average error of improved BPNN by GA search is 0.0673. It can be found that the error values obtained by BPNN improved by GA are the best. Compared with other algorithms, the average error is reduced by 1.687%, which improves the optimization efficiency to some extent. Therefore, the values obtained by GA searching improved BPNN are better than those obtained by BP network. As a skill, sports should also attach importance to the teaching of physical fitness theory, and the concept of lifelong sports should be integrated into the physical fitness theory. College PET courses can be combined with compulsory and optional courses, theory and practice, etc., so as to build a rich and reasonable subject curriculum structure with school characteristics, not just limited to the diversification of sports events. We should establish the modern college PET mode and concept, give strong support to the growth and development of college sports associations, strengthen the management and guidance of sports associations, and increase the investment in sports associations, so as to give full play to their functions and functions. The core quality of physical education involves all aspects of physical education curriculum, which is the refinement of comprehensive requirements of PET, extracurricular sports, amateur training, etc. However, PET only focuses on classroom teaching and does not involve extracurricular sports activities. It has been widely publicized and spread in all kinds of teacher training at all levels. PET is subordinate to the discipline teaching theory, and it is logical to use the three-dimensional teaching goal of pedagogy to guide PET goal. However, the problem lies in the particularity of physical education, and there is still room for exploration whether pedagogy can become a supporting discipline of school physical education.

5. Conclusions

The fundamental and foundation of PET is to cultivate students' sports ability, so that students can master scientific and reasonable fitness methods, and lay the foundation for their lifelong physical exercise. Therefore, the cultivation of students' sports ability and technical learning has become the key to college PET, and has made a clear direction for the construction of theoretical system of college PET reform. The sports TQE driven by BD can feed back the results of sports TQE more timely. Under the background of BD application, it is of positive significance both in theory and in practice to explore the construction of college physical education TQE system. BPNN can solve the problem of nonlinear relationship. To ensure the reliability of the application of neural network in TQE of college PET, GA is introduced into the neural network to improve and optimize the network weight, so as to ensure more accurate network results. It is found that the error values obtained by BPNN improved by GA are the best. Compared with other algorithms, the average error is reduced by 1.687%.

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