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Analysis of the Feasibility and Inspiration of Ant Colony Algorithm in University Physical Education Teaching

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ABSTRACT

This paper introduces the application of the ant colony algorithm in university physical education teaching (such as physical exercises). It also provides new ideas and methods for optimizing the teaching mode through analysing its feasibility and inspiration. The ant colony algorithm is an algorithm based on the behavior characteristics of ants when searching for food, and it can be used to solve problems in university physical education teaching, such as selecting sports projects and evaluating students' physical fitness. Its application can promote the informatization development of university physical education teaching and provide new ideas and methods for optimizing the teaching mode. Applying the ant colony algorithm brings new inspiration to university physical education teaching, helping students choose suitable sports projects and promoting the informatization development of university physical education teaching.

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1. Introduction

With the rapid development of information technology, the traditional mode of university physical education teaching has been unable to meet the needs of modern education [1]. How to use information technology to optimize the physical education teaching mode and improve the teaching quality is an important issue facing current university physical education teaching. The ant colony algorithm, as an advanced artificial intelligence algorithm, has certain feasibility and inspiration when applied to university physical education teaching, and it can provide new ideas and methods for solving problems under the traditional teaching mode [2]. The ant colony algorithm is an effective optimization path search technology, and its basis is the pheromones produced by ants when searching for food. These pheromones decrease with distance, so their pheromone concentration reaches its highest when they approach food, enabling them to locate the destination accurately. The ant colony algorithm has many

applications in solving practical problems. For example, in optimization problems, the ant colony algorithm can be used to find the shortest path, minimum spanning tree, and other problems; in the field of machine learning, the ant colony algorithm can be used for cluster analysis, feature selection, and other problems; in the financial sector, the ant colony algorithm can be used for stock prediction, risk assessment, and other issues [3]. In conclusion, the ant colony algorithm has broad application prospects, and its emergence provides a new approach and method for solving optimization problems. By applying the ant colony algorithm to university physical education teaching, multiple important optimizations and innovations can be achieved [4]. This can better meet the student's needs and improve the teaching quality. Secondly, by using the ant colony algorithm to evaluate students' physical fitness, personalized physical education courses can be provided for each student. This can better cater to individual differences and meet their needs more effectively. In addition, applying the ant colony algorithm can promote the informatization development of university physical education teaching and provide new ideas and methods for optimizing the teaching mode, thus better adapting to the needs of modern education [5]. In summary, applying the ant colony algorithm in university physical education teaching is of great research significance. It can provide new ideas and methods for solving problems under the traditional teaching mode, improve the teaching quality, and better meet the student's needs. At the same time, applying the ant colony algorithm can promote the informatization development of university physical education teaching and provide new ideas and methods for optimizing the teaching mode, thus better adapting to the needs of modern education. Therefore, further research and promotion of the application of the ant colony algorithm in university physical education teaching should be carried out to make positive contributions to education development.

2. Related Work

In recent years, the rapid increase in the rate of recruiting new students by higher education institutions has led to a severe shortage of educational resources. Additionally, with the growth of data volume, numerous complex constraints, and changes in educational practices, effectively arranging and organizing classroom content has become a current challenge [6]. With the advancement of technology, traditional manual course scheduling models are increasingly inadequate to cope with the growing number of teaching tasks. Therefore, utilizing computational technology to achieve classroom teaching has become increasingly important. Developing specialized, reliable, and scalable software that meets the specific needs of each college is necessary. As technology continuously evolves, the ant colony algorithm has been widely applied to teaching equipment due to its outstanding robustness, ability to collaborate with various technologies, and sophisticated distributed processing capabilities [7]. Scholars have extensively explored optimizing the application of the ant colony algorithm in university physical education teaching [8]. Students can select the most suitable sports activities by establishing risk and return assessment models for sports projects. Additionally, the ant colony algorithm assesses students' physical fitness, providing a basis for personalized physical education courses.

The article presents experimental results demonstrating that the ant colony algorithm can effectively improve teaching quality and meet individual student needs. Some researchers have delved into the application methods of the ant colony algorithm in university physical education teaching [9]. They first introduce the basic principles and characteristics of the ant colony algorithm and then elaborate on its application steps in university physical education teaching. Students are assisted in selecting appropriate sports activities by establishing risk and return assessment models for sports projects. Also, the ant colony algorithm is employed to assess students' physical fitness and provide a basis for personalized physical education courses. Other researchers have analyzed the optimization application of information technology in university physical education teaching [10]. Initially, they discuss the current application status and information technology issues in university physical education teaching and then propose an optimization plan based on information technology. Students are assisted in choosing suitable sports activities by establishing risk assessments for sports projects. Moreover, information technology assesses students' physical fitness and provides a basis for personalized physical education courses. The article also demonstrates experimental results showing that information technology can effectively improve teaching quality and meet individual student needs. In summary, applying the ant colony algorithm in university physical education

teaching is of significant research importance. Students are assisted in selecting the most suitable sports activities by establishing risk and return assessment models for sports projects. Additionally, using the ant colony algorithm to assess students' physical fitness provides a basis for personalized physical education courses. Experimental verification results show that the ant colony algorithm can improve teaching quality and meet individual student needs. Therefore, further research and promotion of the application of the ant colony algorithm in university physical education teaching should be pursued to contribute positively to education development.

3. University Physical Exercise Model based on the Ant Colony Algorithm

3.1. Behavior Feature Extraction

When college students engage in physical exercises, they can enhance their body's strength through jumping, achieving optimal results in both horizontal and vertical directions. With an increase in college students' physical exercise, their body's center of gravity undergoes significant changes, evidenced by alterations in the position of their body's center of gravity during walking and running. Although there is no apparent change in the vertical direction of students' body center of mass, their horizontal movement speed has increased significantly, which is impressive. Studies show that athletes have significantly faster movement speeds compared to other sports. This can be observed from the athletes' motion state, where they move more. Research indicates a close relationship between athletes' movement volume and that of other athletes. College students' physical activities are analyzed using background noise suppression techniques to obtain their dual parameters. These dual parameters are used to identify their focus, considered as their core, and their horizontal and vertical movements are then used to calculate their movement speed. Formula (1) describes the image matrix through the utilization of image moments.

$$\tau_{ij}(t+n) = (1-\rho)\tau_{ij}(t) + \Delta\tau_{ij}(t) \tag{1}$$

3.2. Ant Colony Algorithm Model

When ants encounter empty cells, or college students' physical exercise behaviour carries them, feature vectors exhibit high consistency with the feature vectors in neighbouring grids; they can estimate the probability of abandoning them based on the density of surrounding feature vectors. According to this estimation, they will abandon these feature vectors. When the density is high, college student physical exercise behavior feature vectors should be discarded, and other feature vectors should be retained to capture better and analyze these features. In this way, we can continuously cluster different types of college student physical exercise behavior feature vectors. The Euclidean distance $d(Wi, Wj)$ represents the feature vectors of college student physical exercise behavior. When their consistency is high, $d(Wi, Wj) = 0$; when their consistency is low, $d(Wi, Wj) = 1$. We can obtain a two-dimensional consistency matrix by calculating Euclidean distance. If multiple ants continuously pick up and put down college student physical exercise behavior feature vectors in this two-dimensional grid, when they find these feature vectors Wi on cell r, their local density can be represented using formula 2.

$$f(W_i) = \frac{\sum W_i \left(s + \frac{d(W_i, W_j)}{2} \right)}{2} \tag{2}$$

3.3. Sports Teaching System Model Flowchart

The self-organized sports teaching system is an organic entity with specific functions composed of several interconnected and interacting elements. People are the subject of sports education, the main factor of the teaching system, and the driving force behind the self-organized development of the system. There are individual differences and collective identities among the elements. Individual differences manifest as competition, while collective identity manifests as cooperation. They are interdependent, interact, and complement each other, producing a collective effect through the teaching process, as shown in Figure 1. The model depicted in Figure 1 illustrates that the integrity of the self-organized system is the basic condition for the system to maintain its unique prescribed movement. As a system, university sports constitute a multi-level whole, not a simple sum of all its

components but an organic combination of all its components. It reveals the significant characteristics of the interactive evolution of the teaching system dominated by the interactions between teachers and students. The main element of the sports education system is humans, characterized by "initiative" and "vitality." It is the key element of the system, playing a leading role in the operation and development of the system.

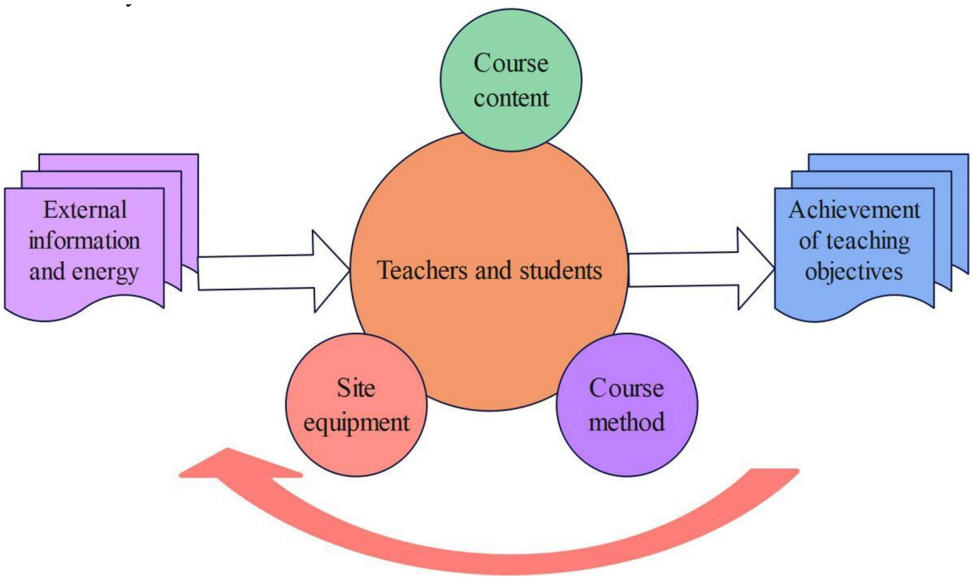

Figure 1. Sports Teaching System Flow Framework

3.4. Overall Optimization of Teaching System

With the development of technology, the number of available image acquisition devices is increasing, and the number of people participating in sports activities is also growing. Daily, mobile phones and cameras capture many sports videos, posing a challenge for sports video management. To address this issue, an ant colony optimization algorithm (ACOA) and support vector machine (SVM) can be used to optimize the classification of sports videos. Then, the principal component analysis (PCA) algorithm is used to process the features of the classified sports videos. A sports video classification model is established with SVM as input and sports video categories as output. ACOA is applied to optimize SVM to generate the optimal sports video classifier. Equation (3) is used to process the data in high-dimensional space.

$$\min_{\omega,b,\xi} J\left(w,x_i\right)=\frac{1}{2}w^T\cdot w+C\sum_{i=1}^{l}x_i^2 \tag{3}$$

4. Experimental Design and Analysis

4.1. Experimental Design

Obtaining higher-level knowledge during the learning process depends not only on the guidance of teachers but also on the students' ability to self-study. While others organize the former, learners organize themselves for the latter. Self-organization relies not only on students but also requires the guidance and intervention of teachers. In the field of social sciences, self-organization demonstrates its scientific nature and emphasizes the importance of guiding students to establish an orderly knowledge system, enhance students' interest in learning, and promote their development as the fundamental idea of instructional design. After the teaching experiment, a comparison is made between the pre-and post-experiment of the experimental group (EG). The teaching content is continuously enriched to maintain these achievements, allowing more choices in content selection and goal setting for physical education. Students gain the deserved freedom and autonomy from

passive learning to active learning. The openness of physical education development, based on developing sports technology and maintaining physical and mental health, utilizes a more open teaching environment and a coordinated teaching atmosphere to develop students' subjectivity, enabling an unordered knowledge system to build an orderly knowledge structure in an open environment. Five categories of sports video data are selected as experimental objects to test the effectiveness of ACOA optimizing SVM for sports video classification. Learning training samples and corresponding sports video classifiers are established, and then ACOA-optimized SVM, parameter-free optimized SVM, and BPNN (Backpropagation Neural Network) methods for sports video classification are used to classify verification samples and calculate the accuracy of sports video classification. To broaden the scope of teaching, students are allowed to play freely. When teachers take effective action or respond to the teaching content, they improve students' thinking to increase their involvement, strengthen self-learning, increase interest in sports, and guide students to perfect the existing knowledge structure through mutual coordination and reasonable competition in physical education classes. This can accelerate students' physical development and improve the quality of classroom teaching. Observe how students' conditions change over time, determine the breakthrough points, encourage students to approach these breakthrough points continuously, and finally create conditions for technological progress. Teachers are allowed to lead students through sudden shifts in their interests. To improve the accuracy of sports performance prediction, this paper proposes a sports performance prediction model based on the firefly optimization ant colony algorithm to solve the problem of determining the connection weights and thresholds of BPNN. Grey model, BPNN, and RBF neural network are selected for comparative experiments, and the 1000m running results are chosen as experimental objects.

4.2. Experimental Results Analysis

After the teaching experiment, a comparison was made. The results indicate that adopting an open and collaborative teaching method from a holistic perspective can effectively enhance students' interest in learning, classroom participation, and self-study after class. After years of campus study and life, students have already developed a strong aversion to the organized teaching environment, so they view physical education classes as an opportunity for self-liberation. When students discover that sports also require a lot of repetitive learning, they naturally develop resistance. After statistical analysis, the control group (CG) compared their pre-test and post-test experiments. The results show that CG's scores have slightly improved in all four dimensions, indicating that students' interest in sports learning can be significantly increased regardless of the teaching method used in physical education. However, self-organised teaching can greatly improve teaching effectiveness in a short period.

By adjusting the number of ants, the extremum information on the path, and the frequency of iterations, we found that our method yields better clustering results when all these factors are considered. For example, when the number of ants reaches 50, we obtain 400; when the frequency of iterations reaches 200, we obtain 200. After 100 measurements in two databases, we found that using our proposed method to optimize the exercise habits of college students, the *F*_measure values all exceed 0.8, and the algorithm's performance for the vast majority of exercise habits exceeds 0.9.

Through the practical application of HPSO algorithm, we found that it has a significant advantage in convergence speed and differs greatly from algorithms in the literature. We conducted comparative experiments on 20 virtual computing resources and 500 tasks. The experimental results are shown in Figure 2. After 20 iterations, the task completion speed of HPSO has decreased. However, HPSO constructs the population through chaotic opposition, which helps increase the complexity of the population and thereby increases the likelihood of finding better results.

In the experiment, the number of tasks remained constant at 600, and the number of virtual machines was set to 10, 20, 30, 40, and 50, respectively. The completion time required by the literature and HPSO were compared. All experiments were repeated 5 times, and the average completion time of the five repetitions was taken as the experimental result, as shown in Figure 3. HPSO greatly improves the iteration efficiency of PSO by introducing genetic algorithm mutation operations, and the introduction of the centroid of the particle swarm greatly enhances the diversity of the population. Additionally, HPSO adopts chaotic and oppositional learning

significantly increasing the initial diversity of the population and making the algorithm more likely to methods, thereby obtain optimal solutions. The graph shows that the athlete performance fitting and predictive performance of this model are superior to the comparative models.

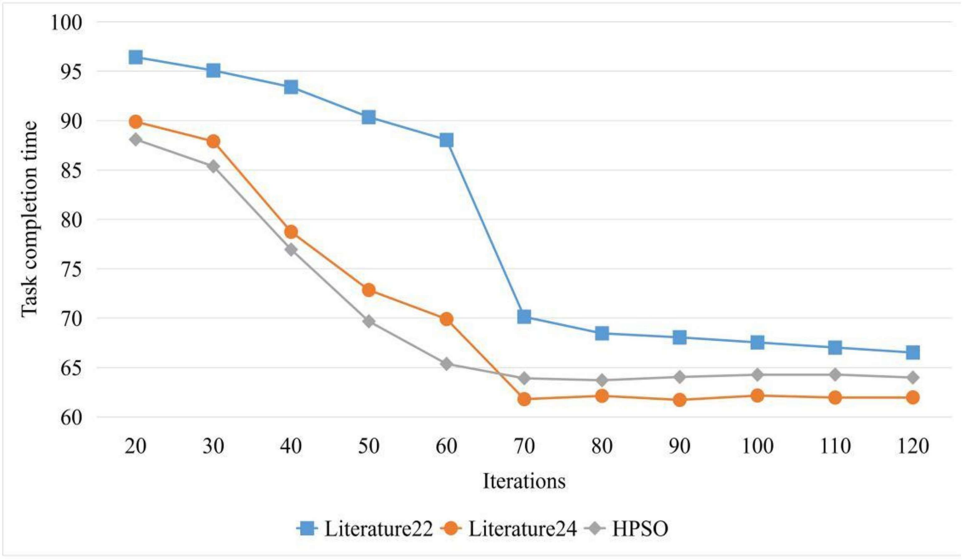

Figure 2. Comparison of Convergence Speed of Different Algorithms

In physical education classes, adjusting students' heart rates is essential because students need to adapt to the demands of the teaching content continuously. Only under appropriate heart rate conditions can students achieve the desired exercise effects. Furthermore, as physical exercise is a progressive process in physical education, the exercise load system not only needs to grasp the rhythm of a class but also consider the size of the exercise load based on the arrangement of physical activities (morning exercises, exercises during breaks, physical education classes, extracurricular physical activities, amateur training, and competition activities) and teaching activities within a week to promote students' healthy development.

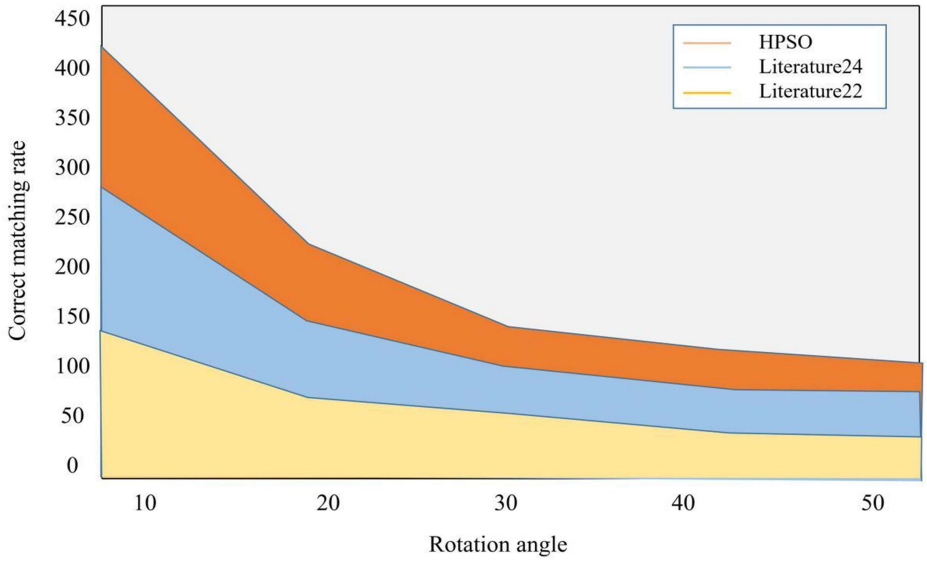

Figure 3 .Comparison of Different Task Completion

5. Conclusions

The self-organization control theory has been widely applied in the fields of nonlinear science and natural science for a long time. Still, its application in university sports has been rarely studied. In physical education classes, starting with teaching objectives, refining the objective structure, and creating a multi-level objective system is essential. Based on the holistic theory, a new concept of physical education has been formed, attempting to establish a paradigm that focuses on students' subjective development and multiple transformations. The results show that the algorithm is superior to other algorithms in task completion time and convergence speed. By classifying sports videos, we found that their accuracy far exceeds that of other current methods. We can also control the error rate within an appropriate range, thus overcoming the limitations of other sports performance prediction models and making the prediction results more reliable. This is crucial for scientific decision-making in sports training. In future research, further exploration can be conducted on integrating the ant colony algorithm with other information technologies to optimise physical education further. Through continuous in-depth research and promotion, applying the ant colony algorithm in university sports education will positively contribute to education development.

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