International Journal for Housing Science and Its Applications
Publish August 4, 2025. Volume 46, Issue 3 Pages 9060-9069

https://doi.org/10.70517/ijhsa463178

Using dynamic programming algorithms to study the enhancement of physical education curriculum on college students' mental health in the framework of physical education reform in colleges and universities

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Abstract This study takes the dynamic planning algorithm as the core tool to construct a dynamic optimization model of college physical education curriculum, aiming to explore the synergistic enhancement of curriculum on college students' mental health and physical fitness. The scientific allocation of teaching resources is realized through a multi-stage decision-making model, and its efficacy is verified by combining empirical data from a university. The experimental results show that the optimization method based on dynamic planning achieves 98.34% in the utilization rate of teaching resources, which is significantly higher than the 85.25% of the traditional method and the 76.90% of the random forest algorithm. Student satisfaction of 9.42/10, teaching quality of 95.4/100 and curriculum rationality of 91.1/100 are better than the control group. In the subgroup experiments, male students in the experimental group improved their standing long jump by 2.95 cm (p=0.000) and female students shortened their 50-meter run by 0.37 seconds (p=0.000). The total mental toughness score increased from 82.06 to 94.33 (difference 12.27, p<0.001), of which the positive cognitive dimension increased by 4.01 points. The dynamic planning algorithm effectively promotes students' mental health level, physical fitness and social adaptability by optimizing the curriculum structure and resource allocation, which provides a quantifiable practical path for sports reform in colleges and universities.

Index Terms dynamic programming, physical education curriculum, mental health, mental toughness

I. Introduction

Physical education program plays an important role in the growth process of college students, which not only develops students' physical and motor skills, but also positively affects their physical and mental health [1], [2]. The primary goal of the physical education program is to develop students' sports skills and gain physical health [3]. By engaging in physical activities, college students can exercise their bodies and increase their physical strength and endurance [4], [5]. By way of example, exercise improves college students' cardiorespiratory fitness, enhances their bone and muscle development, and prevents obesity and other chronic diseases [6], [7]. Physical education programs provide opportunities for college students to exercise and form good habits of lifelong participation in sports [8], [9].

With the development of modern society and education, the teaching of physical education is no longer simply pursuing physical training and athletic performance, but is more concerned about the overall development and mental health of college students [10], [11]. In the daily life of college students, they need to bear a lot of pressure of study and examination, and the long-term tension of study and work makes college students often in the state of physical and mental fatigue [12]-[14]. In physical education courses, college students can stay away from academic pressure, relax their bodies and minds, and enjoy the fun of sports [15], [16]. Through team sports can also cultivate college students' cooperative spirit and team consciousness, and increase their social interaction opportunities [17], [18]. In addition, sports activities can also cultivate college students' good living habits, strengthen the teamwork spirit, improve academic performance and develop a correct sense of competition [19]-[21]. Therefore, schools and educational institutions should pay attention to the setting and development of physical education programs, provide more opportunities for college students to engage in physical activities, and comprehensively promote the physical and mental health development of college students [22]-[24].

This paper takes the dynamic programming algorithm as the core tool and combines the design of intelligent teaching mode to explore the optimization path of physical education curriculum and its promotion effect on mental health. By analyzing the flexibility, individualization and adaptive characteristics of the intelligent teaching mode, it provides a methodological basis for curriculum optimization. It also systematically elaborates the theoretical framework of the dynamic programming method, clarifies its applicability in multi-stage decision-making problems, and constructs a dynamic optimization model for the allocation of physical education curriculum resources through the design of state variables, decision-making strategies and indicator functions. The introduction of the dynamic planning method not only realizes the efficient allocation of teaching resources, but also ensures the scientificity and sustainability of the curriculum through the optimization of the stage decision-making, and provides quantifiable theoretical support for mental health improvement. On this basis, combined with empirical data, the positive impact of the optimized physical education curriculum on mental health is quantitatively analyzed in terms of three dimensions: self-confidence, teamwork and emotion management.

II. Intelligent teaching model construction and dynamic planning-driven physical education curriculum optimization mechanism

II. A. Case Study of Intelligent Teaching Models for Courses

The teaching mode of intelligent physical education courses should be flexible, changeable and diverse. According to the different needs of students, the teaching mode of intelligent physical education courses can be divided into traditional teaching mode, personalized teaching mode and adaptive teaching mode. Personalized teaching mode is to provide each student with specific course content and personalized learning suggestions based on the student's linguistic strengths, learning interests and learning effects. Adaptive teaching mode, on the other hand, is based on students' behavioral data, combined with machine learning and artificial intelligence technology to achieve personalized adjustment of teaching methods, teaching content and teaching pathways.

(1) The teaching mode of intelligent physical education courses also needs to pay attention to the structural design of teaching content and the creation of a language environment. For example, on the basis of mastering language knowledge, students are provided with contextualized language learning by using interesting scenarios such as gamified learning or virtual reality. Through deliberate practice and practical manipulation of this language knowledge, students can better understand and master sports. In addition, the teaching model of an intelligent physical education program needs to focus on interactive communication and real-time feedback from students. Therefore, classroom teaching and online interaction can be used to promote discussion and communication among students and improve physical fitness in practice. At the same time, in order to let students know their learning status and progress in a timely manner, a real-time feedback mechanism can be provided to make timely teaching adjustments based on students' learning performance and feedback information.

(2) Intelligent physical education courses can also combine multimedia technology, the Internet and other resources to construct a diversified exercise environment. In the teaching of intelligent physical education courses, it is also important to focus on cultivating students' independent learning ability and encouraging them to obtain more profound learning experiences and results through self-inquiry and reflection.

(3) The teaching mode of intelligent physical education courses should be compatible with the role of teachers. Teachers should give full play to their role in guiding and directing students to learn, and cultivate students' critical thinking ability and willingness to learn while mastering knowledge. At the same time, teachers should constantly update their curriculum design and educational methods, keep abreast of the times, improve their professional ability and educational level, and provide students with better quality physical education.

II. B. Theoretical analysis of dynamic programming method

The design of intelligent teaching models needs to rely on scientific theories to support their dynamic adjustment capabilities. For this reason, this section further introduces the dynamic planning algorithm to provide a mathematical basis for the optimal allocation of teaching resources through a multi-stage decision-making model. The basic concepts of dynamic planning are described below.

(1) Stages

The process of a given problem is appropriately divided into a number of interrelated stages so that it can be solved in a certain order. The variables describing the stages are called stage variables and are often denoted by k. The division of stages is generally based on the natural characteristics of time and space, but to facilitate the process of the problem can be transformed into a multi-stage decision-making process.

(2) State

The state indicates the natural or objective conditions under which each stage begins, which describes the condition of the research problem, also known as the uncontrollable factors. Variables that describe the state of the process are called state variables. It is common to use S_k to denote the kth stage state variable. Assuming that there are m states in the kth stage, the state variable can take m values, i.e., C_1, C_2, ..., C_m. The set

$\{C_1, C_2, \cdots, C_m\}$ is then referred to as the set of reachable states in the k th stage. It is denoted as $S_k = \{C_1, C_2, \cdots, C_m\}$.

The state referred to here should have the following property: if the state of a certain stage is given, the development of the process after this stage is not affected by the states of the previous stages of this stage. In other words, the past history of the process can only influence its future development through the current state, which is a summary of the past history. This property is called non-sequitur (i.e. Markovian).

If the state only describes the specific characteristics of the process, not any actual process can satisfy the requirement of non-sequitur. Therefore, when constructing a dynamic planning model of a decision-making process, it is important not to fix the state variables in such a way that they only characterize the process, but to pay due attention to whether or not they satisfy the requirement of non-sequitur. If a certain way of specifying the state may lead to not meeting the requirement of no later validity, the method of specifying the state should be changed appropriately so that it can meet the requirement of no later validity.

(3) Decision-making

Decision making indicates that when the process is at a certain stage, different decisions (or choices) can be made to determine the state of the next stage, and such decisions are called decisions. It is also called control in optimal control. A variable that describes a decision is called a decision variable. It can be described by a number, a set of numbers or a vector. It is common to use $u_k(s_k)$ to denote the decision variable at stage k when the state is at s_k . It is a function of the state variable. In practical problems, the values of the decision variables are often restricted to a certain range, which is called the set of allowed decisions. It is common to use $D_k(s_k)$ to denote the set of permissible decisions in the kth stage from the state s_k , which obviously has $u_k(s_k) \in D_k(s_k)$.

(4) Strategy

A strategy is a collection of decisions consisting of sequential decisions. The process starting from the kth stage of the process and ending at the termination state is called the posterior subprocess (or k-subprocess) of the problem. The sequence of decision functions $\{u_k(s_k), \cdots, u_n(s_n)\}$ consisting of the decisions of each segment in order is known as a k-subprocess strategy, or strategy for short, and is denoted $p_{k,n}(s_k)$. That is.

$$p_{k,n}(s_k) = \{u_k(s_k), u_{k+1}(s_{k+1}), \cdots, u_n(s_n)\} \tag{1}$$

When $k=1$, this sequence of decision functions is called a policy, or strategy for short, of the full process, denoted $p_{1,n}(s_1)$. That is.

$$p_{1,n}(s_1) = \{u_1(s_1), u_2(s_2), \cdots, u_n(s_n)\} \tag{2}$$

In practical problems, there is a range of available strategies, which is called the set of permissible strategies, denoted by P . The strategy that achieves the optimal result from the set of permissible strategies is called the optimal strategy.

(5) State Transfer Equation

The state transfer equation is to determine the evolution of a process from one state to another. If the value of the state variable s_k in the kth stage is given, the value of the state variable s_{k+1} in the $k+1$th stage is also completely determined if the decision variable u_k in that segment is determined once. That is, the value of s_{k+1} varies with the values of s_k and u_k . This definite correspondence, denoted as

$$s_{k+1} = T_k(s_k, u_k) \tag{3}$$

The above equation describes the state transfer law from the k stage to the $k+1$ stage and is called the state transfer equation. T_k is called the state transfer function.

(6) Indicator function and optimal value function

A quantitative indicator used to measure the merit of the realized process is called indicator function. It is a quantitative function defined on the whole process and all the latter processes. It is often expressed as $V_{k,n}$. i.e.

$$V_{k,n} = V_{k,n}\left(S_k, u_k, S_{k+1}, \cdots, S_{n+1}\right), k = 1, 2, \cdots, n \tag{4}$$

For the indicator functions that are to form the dynamic programming model, they should be separable and satisfy the recurrence relation. That is, $V_{k,n}$ can be expressed as a function of s_k , u_k , $V_{k+1,n}$. Denoted as

$$V_{k,n}\left(S_k, u_k, S_{k+1}, \cdots, S_{n+1}\right) = \varphi_k\left[S_k, u_k, V_{k+1,n}\left(S_{k+1}, \cdots, S_{n+1}\right)\right] \tag{5}$$

Many indicator functions in real problems satisfy this property.

The optimal value of the indicator function, called the optimal value function, is denoted as $f_k(s_k)$. It represents the value of the indicator function obtained by adopting the optimal strategy for the process starting from the state s_k in the kth stage to the termination state in the nth stage. That is.

$$f_k(s_k) = opt\ V_{k,n}(s_k, u_k, s_{k+1}, \cdots, s_{n+1}) \tag{6}$$

where “opt” is an abbreviation for optimization and can be taken as min or max depending on the question.

II. C. Positive impact of physical education program on students' mental health

The theoretical framework of the dynamic planning method provides a methodological guarantee for the optimization of the curriculum, while its practical value needs to be verified through the specific improvement of mental health indicators. In the following, we analyze the practical effects of the optimized curriculum from the dimensions of mental toughness and social competence.

II. C. 1) Enhancing students' self-confidence and self-efficacy

The physical education program plays an important role in the improvement of students' self-confidence and self-efficacy. Through continuous practice and mastery of various gymnastic skills, students are able to experience their own progress and achievements, thus enhancing their recognition and affirmation of their abilities. When students successfully complete a difficult movement or participate in an exciting sports program, their sense of pride and achievement will be greatly enhanced, which helps to cultivate students' positive self-perception and self-evaluation. The physical education program provides a stage for students to show themselves, they show their talents and style in front of teachers and peers, and gain appreciation and recognition from others, which is important for improving students' self-confidence and self-efficacy.

II. C. 2) Developing students' teamwork and social skills

Physical education programs are mostly conducted in a group setting and require close cooperation and collaboration among students. In activities such as formation and group dance, students need to keep in line with others and cooperate with each other in order to complete the overall movement. This process not only develops students' sense of teamwork, but also improves their social skills and interpersonal skills. Through cooperation and communication with others, students can learn how to express their own ideas, respect and appreciate the views of others, and build good interpersonal relationships. Physical education courses provide students with opportunities to make new friends and expand their social circle, which helps to promote the development of students' social adaptability and interpersonal skills.

II. C. 3) Promote emotional management and stress relief among students

The role of physical education courses in promoting students' emotional management and stress relief should not be overlooked. Exercise can stimulate the human body to release the “happy hormone” endorphins, which can help people relieve stress and maintain a positive and optimistic emotional state. Through regular and rhythmic movements, physical education programs help students release physical and mental stress and relieve anxiety and tension. Physical education programs can divert students' attention, make them temporarily forget their worries in life and study, and devote themselves to sports, so as to achieve the purpose of relaxing the body and mind. Physical education programs help students develop a healthy lifestyle and positive emotional coping strategies, and improve their ability to cope with stress and manage their emotions.

III. Empirical evidence of the optimization effect of physical education courses based on dynamic planning

Chapter 2 constructs a dynamic planning-driven physical education curriculum optimization model and theoretically analyzes its role in promoting mental health. To further validate the practical efficacy of the model, this chapter combines empirical data from a university to systematically assess the comprehensive effect of optimizing the curriculum in terms of the dimensions of resource utilization, student satisfaction, physical fitness and mental toughness.

III. A. Validation of the efficacy of dynamic programming versus traditional methods

The previous optimization methods and the optimization methods designed in this paper are compared, in which the optimization method of college sports course management settings based on dynamic programming algorithm designed in this paper is Method 1, the traditional optimization method is Method 2, and the optimization method based on Random Forest Algorithm is Method 3. In order to compare the optimization performances of the three methods mentioned above in the practical application, the comparison experiments designed are specified as follows.

III. A. 1) Experimental preparation

In order to verify the effect of the optimization method based on the dynamic programming algorithm designed in this paper for the management of physical education course settings in colleges and universities in practical applications, experimental tests are carried out. In the experiment, a university is taken as the experimental object, and the data related to the physical education courses in this university in the past five years are collected, and the collected data are summarized. The data were collected from the teaching management system, student management system and teaching quality assessment system of this university, etc., and a total of 10TB of data were collected for this experiment. In this experiment, the above acquired dataset is used as the basis to process it using the optimization method designed in this paper to improve the quality of the data of physical education courses in the above university. At the same time, the above acquired dataset is stored into the existing database, and the databases used in this experiment are relational and NoSQL databases, which are able to store the data in a better way, with good confidentiality, to avoid data loss.

III. A. 2) Comparative analysis of experimental results

In order to verify the effect of the above three optimization methods in practical application, the teaching resource utilization rate of the three optimization methods is used as the evaluation index to compare the performance of the three methods. In the experiment, using the three optimization methods in the experimental environment constructed above, the management settings of sports courses in a university are optimized several times, and the teaching resource utilization rate of the multiple optimization results is counted. Its specific statistical results are shown in Table 1.

Table 1: Optimization results of three methods

	Method 1	Method 2	Method 3
1	99.66%	87.62%	75.03%
2	97.85%	84.86%	77.34%
3	98.70%	82.80%	76.30%
4	97.46%	85.64%	72.80%
5	98.60%	84.04%	75.57%
6	96.67%	85.45%	75.00%
7	99.49%	86.45%	75.98%
8	97.74%	86.51%	79.92%
9	99.54%	84.05%	80.03%
10	97.65%	85.06%	81.04%
Average	98.34%	85.25%	76.90%

As shown in Table 1, in the above experimental results, after many experiments, the utilization rate of teaching resources of method 1 is higher, and it is kept at a high level in many experiments, and the utilization rate of teaching resources based on dynamic planning is 98.34% on average, while the average utilization rate of teaching resources of traditional optimization method and random forest algorithm based on random forest algorithm is only 85.25% and 76.90%, which shows that the optimization method of this paper under the dynamic planning is able to utilize teaching resources in a more planned way and ensure teaching effectiveness.

In order to compare the performance of the methods more comprehensively, more three indicators of student satisfaction (satisfaction score of 10), teaching quality, and rationality of curriculum (employer satisfaction score) are introduced, and the results are shown in Table 2.

Analyzing Table 2, it can be seen that by comparing the performance of the three different optimization methods for physical education course management settings on the three key indicators (student satisfaction, teaching quality, and curriculum rationality), it can be clearly found that Method 1 shows superiority in all indicators, with an average of 9.42 points in student satisfaction, an average of 95.4 points in teaching quality, and an average of 91.1 points in curriculum rationality, which is significantly superior to the traditional method and the optimization method based on the random forest algorithm, successfully improving the overall effect of course management. This is of great significance for improving the learning effect of students, meeting the needs of employers and promoting the sustainable development of universities.

Table 2: Comparison of various indicator results

	Student satisfaction			Teaching quality			The rationality of the curriculum setting		
	Method 1	Method 2	Method 3	Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
1	9.5	7.8	7.8	96	79	90	87	78	84
2	9.4	7.8	7.5	89	78	82	92	75	82
3	10	7.4	8.5	100	74	87	96	80	87
4	9.1	6.9	7.8	96	83	83	86	74	77
5	9.5	7.2	7.3	96	78	82	88	77	77
6	9.4	7.5	7.8	99	77	85	97	70	88
7	9.8	7.2	8.7	90	79	88	100	73	79
8	9.8	7.8	8.3	99	82	81	86	75	83
9	9.8	7	7.2	98	85	80	94	79	88
10	9.8	7.5	8.2	89	81	84	85	69	88
Average	9.42	7.41	7.91	95.4	79.6	84.2	91.1	75	83.3

III. B. Physical fitness level impact

The optimization efficacy of the dynamic programming algorithm is confirmed by comparing its teaching resource utilization and satisfaction indexes with those of the traditional method. On this basis, its specific impact on college students' physical fitness is further explored, and group experiments are designed to verify the effect of course optimization on the enhancement of athletic ability.

In this study, the influence of the intelligent teaching mode of physical education course based on dynamic programming algorithm on the physical fitness and physical fitness of college students was taken as the research object, and the students of class 1 and class 2 of human resources major of a university in 2024 were selected as the experimental objects, with 64 students in class 1 (34 boys and 30 girls), 65 students in class 2 (33 boys and 32 girls) in class 2, and class 1 as the experimental group. Conduct a one-semester experiment.

III. B. 1) Analysis of the results of the comparison of physical fitness between the experimental group and the control group before the experiment

First, a comparative analysis of physical fitness was carried out. For boys, the tests were standing long jump, sitting forward bending and 50-meter run; for girls, the tests were one-minute rope skipping, sitting forward bending and 50-meter run.

An independent samples t-test was conducted on the test results of the experimental and control groups to compare the differences in physical fitness among the three groups of students. By comparing the results, we can clearly understand the performance of the experimental group and the control group in terms of physical fitness as shown in Table 3.

Table 3: The comparison results of physical fitness before the experiment

Sex	Test content	Experimental group	Control Group	t	p
Male	Standing long jump (cm)	215.34±21.38	216.38±22.30	-0.088	0.933
	Sit forward Bend (cm)	16.29±6.02	16.60±5.28	-0.010	0.994
	50-meter dash (s)	8.40±0.56	8.38±0.61	-0.218	0.792
Female	1 minute of rope skipping	125.38±6.32	127.01±7.83	-0.182	0.843
	Sit forward Bend (cm)	18.42±3.88	18.48±4.39	-0.128	0.882
	50-meter dash (s)	10.66±0.80	10.69±1.05	0.017	0.956

Before the teaching experiment, the two groups of students were comprehensively tested in physical quality and other aspects, including standing long jump, seated forward bending and 50-meter run, and the sample test was carried out. The results showed that the two groups showed no significant difference in these test indexes, and the p-value was greater than 0.05. This indicated that the two groups showed comparable levels of physical fitness before the beginning of the teaching experiment, and the experimental grouping had a good balance, which ensured the accuracy and reliability of the results of the subsequent experimental tests.

III. B. 2) Analysis of the results of the comparison of boys' physical fitness before and after the experiment

The results of the comparison of boys' physical fitness before and after the experiment were analyzed as shown in Table 4.

Table 4: The comparison of male physical fitness before and after the experiment

	Test content	Before the experiment	After the experiment	t	p
Experimental group	Standing long jump (cm)	215.34±21.38	218.29±23.49	7.938	0.000
	Sit forward Bend (cm)	16.29±6.02	17.29±5.22	7.392	0.000
	50-meter dash (s)	8.40±0.56	8.02±0.41	6.394	0.003
Control Group	Standing long jump (cm)	216.38±22.30	216.55±20.38	1.374	0.093
	Sit forward Bend (cm)	16.60±5.28	16.62±4.29	1.203	0.288
	50-meter dash (s)	8.38±0.61	8.35±0.78	1.573	0.121

As can be seen from Table 4, in the standing long jump test the average scores of the boys in the experimental group before and after the experiment were 215.34 cm and 218.29 cm respectively, with an improvement of 2.95 cm, and the p-value of the two groups of data was 0.000, which was less than the significance level of 0.05, so that it was considered that there was a significant difference between the before and after experiments. In the Seated Forward Bend test, the average performance of the experimental group of men before and after the experiment was 16.29 cm and 17.29 cm, with an improvement of 1.00 cm. The p-value of the two groups of data was 0.000, which is smaller than the significance level of 0.05, and therefore a significant difference was considered to exist between the performance before and after the experiment. For the 50-meter run, the average time taken before and after the experiment was 8.40 seconds and 8.02 seconds respectively, an increase of 0.38 seconds. The p-value for the two groups was 0.003, which is less than the significance level of 0.05, and therefore significant differences between the results before and after the experiment were found. The three achievements of the control group were also improved, but only to a small extent, the p-value of standing long jump, forward body flexion and 50m running were 0.093, 0.288 and 0.121 respectively, which were smaller than the significance level of 0.05, so there was no significant difference between before and after the experiment in the control group.

III. B. 3) Comparative results analysis of girls' physical fitness before and after the experiment

The results of the comparison of girls' physical fitness before and after the experiment were analyzed as shown in Table 5.

Table 5: The comparison of female physical fitness before and after the experiment

	Test content	Before the experiment	After the experiment	t	p
Experimental group	1 minute of rope skipping	125.38±6.32	129.04±4.29	8.301	0.000
	Sit forward Bend (cm)	18.42±3.88	19.76±3.17	7.329	0.000
	50-meter dash (s)	10.66±0.80	10.29±0.71	10.383	0.000
Control Group	1 minute of rope skipping	127.01±7.83	127.63±8.29	1.283	0.169
	Sit forward Bend (cm)	18.48±4.39	18.82±3.29	1.933	0.083
	50-meter dash (s)	10.69±1.05	10.66±0.84	1.630	0.121

In the one-minute rope skipping test, the average performance of the girls in the experimental group increased from 125.38 times before the experiment to 129.04 times, an improvement of 3.66 times, P=0.000, indicating that the dynamic programming algorithm significantly improves their athletic endurance; the seated forward bend performance increased from 18.42 to 19.76, an improvement of 1.34cm, P=0.000, reflecting a significant improvement in flexibility; the 50-meter run The time taken was shortened from 10.66 seconds to 10.29 seconds, an improvement of 0.37 seconds, P=0.000, a significant improvement in speed quality. On the contrary, in the control group, the improvement of the three indexes is not statistically significant (P>0.05), for example, the one-minute rope skipping only increased from 127.01 to 127.63, P=0.169. The comparison between the experimental group and the control group shows that the curriculum based on dynamic planning can systematically promote the overall improvement of girls' physical quality, while the traditional model has limited effect.

III. C. Mental Toughness Level Impact

The improvement of physical quality lays the foundation for mental health. In order to fully reveal the comprehensive benefits of the dynamic planning algorithm, this section focuses on the mental toughness indicators, and quantifies and analyzes the promotion effect of the optimization program on students' stress resistance and social adaptability through scale measurement and statistical tests.

The instrument used to measure college students' mental toughness is the Youth Mental Toughness Scale, which consists of 25 entries and is divided into two main dimensions: personal strength and supportive strength. The personal strength dimension was further subdivided into three subcategories: goal focus, emotion regulation, and positive thinking, while support strength consisted of two subcategories: family support and human-computer assistance. Each subcategory is scored as 20 and the total score is 100; the higher the total score, the better the mental toughness. This scale demonstrated very high internal consistency in this study, with an alpha coefficient of 0.921, showing its excellent reliability and validity.

III. C. 1) Results of the pre-test homogeneity test

Before the experiment, the experimental and control groups were tested for homogeneity with the group as the independent variable, the mental toughness indicators and each factor as the dependent variable, and the homogeneity test of the mental toughness indicators and each factor in the experimental and control groups is shown in Figure 1.

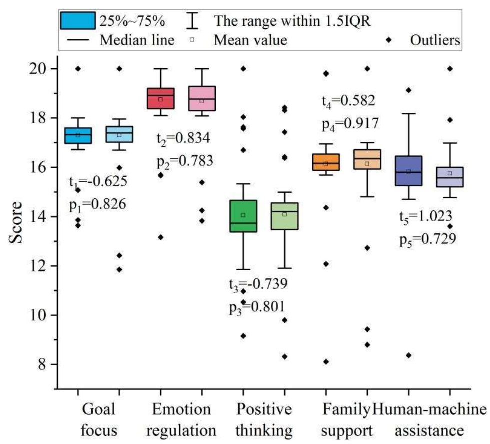

Figure 1: Psychological resilience indicators and homogeneity tests of each factor

T-test results show that before the experiment, the total level of mental toughness (t=0.611, p=0.830), goal focus (t=-0.625, p=0.826), emotional control (t=0.834, p=o.783), positive cognition (t=-0.739, p=0.801), family support (t=0.582, p= 0.917), and interpersonal assistance (t=1.023, p=0.729) tests are not significantly different, indicating that the two classes of students selected for this experiment have similar levels of mental toughness and do not interfere with the experimental results.

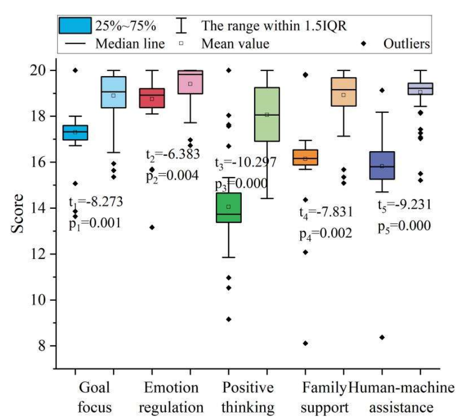

Figure 2: Results of psychological resilience before and after the experiment

III. C. 2) Analysis of the results of the comparison of students' mental toughness before and after the experiment

The paired-sample t-test was conducted on the pre- and post-test data of the mental toughness and each factor index of the students in the experimental group, and the comparison of the mental toughness indexes and the results of each factor in the experimental group before and after the experiment is shown in Figure 2.

The level of mental toughness of the students in the experimental group significantly increased after receiving the optimization of the physical education curriculum based on dynamic planning. Specifically, the goal focus score increased from 17.30 to 18.90 before the experiment, with a mean difference of 1.6, t=-8.273, p=0.001, indicating that the students' goal management ability was significantly enhanced; the emotion control score increased from 18.75 to 19.40, with a difference of 0.65, t=-6.383, p=0.004, reflecting the emotion regulation ability's Improvement. Positive cognition showed the most significant improvement, jumping from 14.05 to 18.06 points, with a difference of 4.01, t=-10.297, p<0.001, suggesting that students were more inclined to respond to challenges with a positive attitude. In addition, significant increases in family support 16.14 → 18.92, difference 2.78, p=0.002 and interpersonal assistance 15.82 → 19.05, difference 3.23, p<0.001 indicate a strengthened social support system. The overall mental toughness total score increased significantly from 82.06 to 94.33 with a difference of 12.27, t=-13.740, p<0.001 and p-values of all dimensions were less than 0.05, verifying that the optimization of the course by the dynamic planning algorithm was statistically significant in the overall enhancement of the students' mental toughness.

IV. Conclusion

This study constructs the optimization model of college physical education courses based on dynamic programming algorithm, and verifies its significant enhancement effect on college students' mental health and physical fitness through empirical analysis. The experimental results show that:

(1) The dynamic planning-driven curriculum optimization method outperforms the traditional method and the random forest algorithm in terms of 98.34% of resource utilization and 9.42 of student satisfaction, which confirms its scientific nature and sustainability.

(2) In the experimental group, boys' standing long jump performance improved by 2.95cm, and girls' 50-meter run time was shortened by 0.37 seconds, while there was no significant difference in the control group, which highlights the systematic promotion of students' athletic ability by the dynamic planning curriculum.

(3) The total score of mental toughness increased by 12.27 points, of which the positive cognition (+4.01 points) and interpersonal assistance (+3.23 points) dimensions improved particularly significantly, indicating that the optimization course effectively enhanced students' stress resistance and emotion regulation through the enhancement of goal management and social support.

Funding

This work was supported by Jiangsu Provincial University Philosophy and Social Science Research Foundation Project (Project No.: 2023SJYB0593).

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