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Design of students' emotional intervention strategies and mental health enhancement paths in physical education based on artificial intelligence analysis

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Abstract Mental health problems of students in today's society are becoming more and more obvious, and physical education is an important way for students' emotional intervention. This study constructed an intelligent physical education teaching model and explored its effect on college students' emotional intervention and mental health enhancement. The study used the literature method, questionnaire survey method, field survey method and mathematical statistics method to obtain 810 valid samples through random whole cluster sampling with students from four colleges and universities in S city as the research object. The study used multidimensional scales to measure physical activity habits, emotion regulation self-efficacy and negative academic emotions, and conducted intelligent physical education intervention experiments. The results showed that: in the formation of physical activity habits, emotion regulation efficacy could influence exercise adherence through emotion regulation strategies and exercise commitment, in which cognitive reappraisal strategy was significantly better than expression inhibition strategy; SAS scores in the smart physical education intervention group decreased significantly from 61.42±8.06 to 36.34±5.69 before the intervention, whereas those in the control group decreased to 50.24±7.96; and HAMA scores in the intervention group decreased to 50.24±7.96; and HAMA scores in the control group decreased to 50.24±7.96. Meanwhile, the HAMA score of the intervention group decreased from 18.41±4.32 to 6.25±1.58, which was significantly lower than that of the control group (11.49±2.89), and it was found that college students' anxiety was affected by personality traits, employment pressure and family education style, of which employment pressure and family education style had a positive effect on anxiety, with regression coefficients of 0.642 and 0.401, respectively. Based on the results of the study, the intelligent sports teaching mode has a significant effect on college students' emotional intervention and mental health enhancement, and the cultivation of emotional regulation ability and the application of intelligent technology should be strengthened to provide new ideas for the reform of sports teaching.

Index Terms artificial intelligence, intelligent physical education teaching, emotional intervention, mental health, emotional regulation efficacy, physical exercise habit

I. Introduction

In today's society, students' mental health problems are getting more and more attention, and mental health is an important part of students' comprehensive quality, which is of great significance for students' overall development [1], [2]. Physical education, as an important course of student education, plays an important role in student emotional intervention and enhancement of student mental health problems, and with the development and application of artificial intelligence (AI), a solid foundation has been laid for the realization of this goal [3]-[6].

First, AI can help recognize and manage students' emotions through the application of smart devices and software [7], [8]. Using devices such as smartphones in physical education, AI technology can be utilized to monitor students' emotional states [9]. Through the analysis of data such as voice, image and text, AI can accurately determine the current emotional state of students and provide relevant suggestions and interventions [10]-[12]. This intelligent assistance can help students better manage their emotions, relieve stress, and improve their mental health [13], [14]. Second, AI can provide personalized mental health services for students [15]. Based on individual emotional characteristics, needs, and past feedback data, AI can customize an exclusive emotional management program for each student [16], [17]. Through technologies such as big data and machine learning, AI can analyze the emotional data of an entire group, identify effective solutions for similar situations, and provide personalized psychological support to individuals [18]-[20]. This personalized service can better meet each individual's mental health needs, help them better manage their emotions, and improve their mental health [21], [22].

Mental health is an important part of students' comprehensive quality and is of great significance to their overall development. In recent years, students' mental health problems have gradually increased, causing widespread concern in the field of education. As an important part of school education, physical education has unique advantages in emotional intervention and mental health enhancement. The rapid development of artificial intelligence technology provides new possibilities for physical education teaching mode innovation and mental health intervention. Existing studies have shown that physical activity has a positive effect on improving students' emotional state, relieving stress, and enhancing mental health.Cho(2020) found through meta-analysis that physical education has a significant effect on the change of students' emotional competence.A systematic review by Ricco-Gonzalez(2023) pointed out that the development of emotional intelligence through physical education is an effective way.Lu and Buchanan (2014) emphasized the value of physical education courses in developing students' emotional well-being.Leisterer and Jekauc (2019) investigated students' emotional experiences during physical activities, providing a theoretical basis for emotional interventions.

Artificial Intelligence (AI) technologies show great potential for emotion recognition and management.Salloum et al. (2025) explored the possibility of using AI to detect students' emotions and adjust teaching methods.Bravo-Pacheco et al. (2024) investigated the role of AI-based emotion recognition systems in enhancing students' motivation to learn.Lu and Zhou (2025) analyzed the role of the Internet of Things (IoT) and artificial intelligence in student stress. Networking and artificial intelligence in the process of student stress and emotion recognition.Du et al. (2023) pointed out the importance of emotion recognition in assessing online learning performance. Several studies have confirmed that AI technology can enable accurate determination of emotional states and provide appropriate intervention recommendations.

AI has also demonstrated unique advantages in personalized services for mental health.D'alfonso et al. (2017) explored the impact of AI-assisted online social therapy on adolescent mental health.Lueken and Hahn (2020) examined the application of AI technology in the prediction of treatment response for anxiety disorders.Mehta (2025) noted that AI has a promising future in the mental health is promising.Yeasmin et al. (2025) analyzed the application of AI in mental health diagnosis, treatment, and emotional well-being.Jelassi et al. (2024) investigated ways to enhance personalized mental health support through AI. These studies suggest that AI technology can provide tailored mental health services based on individual characteristics and needs, effectively enhancing intervention outcomes.

Although existing studies have explored the relationship between physical activity and mental health, and the application of AI technology in emotion recognition and mental health services, there are fewer studies that have combined AI technology with physical education, constructed an intelligent physical education teaching model, and systematically investigated its effect on students' emotional intervention and mental health enhancement.

Based on constructivism theory and educational change theory, this study constructs an intelligent physical education teaching model, analyzes its elemental composition and implementation path, and explores the effect of intelligent physical education teaching on college students' emotional intervention and mental health enhancement. The study firstly clarifies the theoretical basis and components of intelligent physical education through literature analysis and expert interviews; secondly, analyzes the current characteristics and interrelationships of college students' physical exercise habits, emotion regulation self-efficacy, and negative academic emotions through questionnaires and field surveys; thirdly, explores the main factors affecting college students' anxiety; finally, verifies the effects of intelligent physical education on college students' anxiety and mental health through comparative experiments. Finally, through a comparative experiment, the effect of intelligent physical education teaching intervention on college students' anxiety and mental health was verified. The results of the study will provide theoretical basis and practical reference for the innovation of physical education teaching mode in colleges and universities and students' mental health intervention, so as to promote students' comprehensive development and healthy growth.

II. Intelligent Physical Education Teaching Model Construction

II. A. Theoretical foundations

II. A. 1) Theories of educational change

Educational change has always existed, influenced and impacted by different times, producing different results. Times are constantly changing and changes in education make sense. Havelock and Goode categorize educational change into two types. One category is planned educational change, that is, the existence of a clear purpose, program or strategy of change, this type of change is generally implemented by the education sector. One is natural educational change, which refers to changes that are not organized in advance, but are caused by teachers' adjustments to their own teaching styles and methods, or by the general environment. Researchers also have different views on the target of educational innovation, with some considering the entire education system, while

others consider the scope to be narrower, oriented towards curricula, teaching modes, and so on. Therefore, the pedagogical change explored in this study is a new teaching model differentiated from traditional teaching, i.e., the focus of this study is the construction of an intelligent physical education teaching model [23].

II. A. 2) Constructivist Theory

According to constructivism, for learners to accomplish understanding of knowledge, it also needs to be constructed by the individual based on his or her own knowledge experience, and also depends on the learning journey in a particular context, i.e., to achieve a deep understanding of the nature of the thing reflected in that knowledge, its laws, and the connections between that thing and other things. Learning is the process of constructing knowledge by students themselves. Students are not simply passive recipients of information, but actively construct the meaning of knowledge, and the best way to do this is to let the learner go to the real environment of the real world to feel and experience (i.e., to learn by acquiring direct experience). Teaching can not ignore the learners' existing knowledge and experience, can not simply force the implementation of knowledge from the outside of the learners of “filling”, but should guide the learners from the original knowledge and experience, and actively construct new knowledge and experience. Therefore, the theory of constructivism provides support for the construction of an intelligent physical education teaching model in this study.

II. B. Components of Smart Sports

The six components of smart sports in colleges and universities are shown in Figure 1, and this part is mainly to theoretically analyze each component. According to the results of expert interviews, combined with the literature and students' demand for smart sports, the three aspects of the meaning, main points and connotations, and main contents of each constituent element are elaborated respectively, and the Delphi method is used to confirm the 38 subject words after three rounds of testing to form the mapping relationship between the six constituent elements and the subject words. They not only represent the hot areas or areas of concern corresponding to each constituent element, but are also the main content for recognizing each constituent element. Therefore, the following section focuses on analyzing the six constituents and their respective subject terms [24].

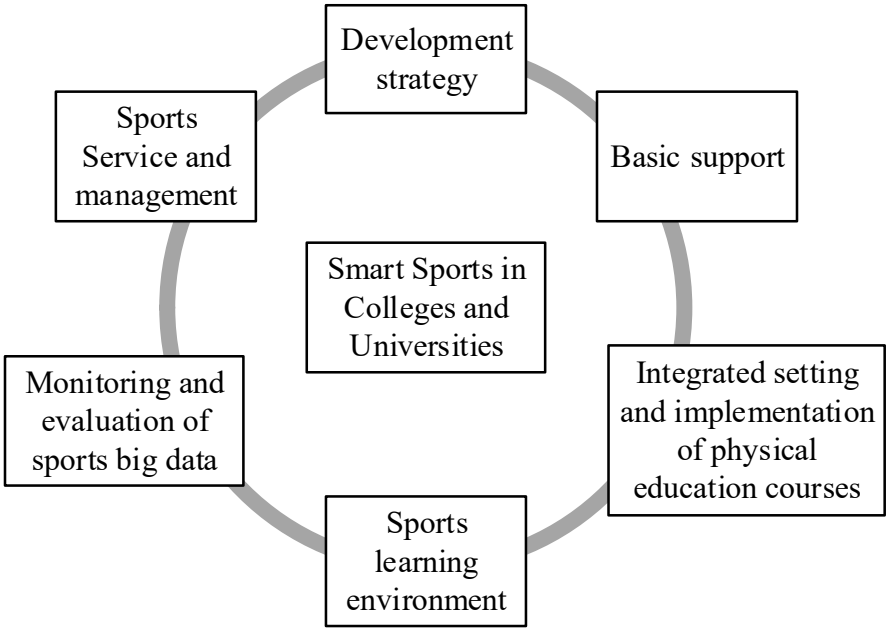

Figure 1: Six constituent Elements of Smart Sports in Colleges and Universities

II. B. 1) Development strategies

The analysis of the development strategy of intelligent sports can present the idea of “wisdom” in campus intelligent sports in a more systematic way, and can also make the different forms and interactions of the constituent elements to be expressed completely, so as to further sort out and compare, clarify the law and essence of its operation, and provide reference and help for the following analysis of the horizontal and vertical relationships. Help. In order to clarify the meaning of development strategy, the characteristics of the development strategy of intelligent sports should be analyzed first. The first main feature of the development strategy is systematic. The development strategy

takes the global law of the construction and development of smart sports as the research object, as mentioned in the literature review, under the perspective of educational systematic research, smart sports present an organic systematicity. The second main characteristic of the development strategy is complexity. The development strategy of smart sports is a very complex system, which is manifested in the following three aspects: There are many participating factors and synergistic functions [25]. The development strategy is the core of the smart sports can realize the "wisdom" of the development of the "wisdom of the strategy" to play a systematic leading and coordinating role, to promote sports work continuously to the direction of smart sports. From the viewpoint of the implementation process of development strategy, development strategy includes three aspects, namely, development strategy goal, development strategy means and development strategy result; from the viewpoint of the presentation structure of the system, development strategy includes the main element, the object element, and the control means and methods of the interconnection of the main and the object. The main points and structure of the development strategy of intelligent sports are shown in Figure 2, which can be used to analyze the components of the development strategy of intelligent sports from the main points and structure, and the corresponding objectives, means, visions and subject-object elements explain the components of the development strategy of intelligent sports.

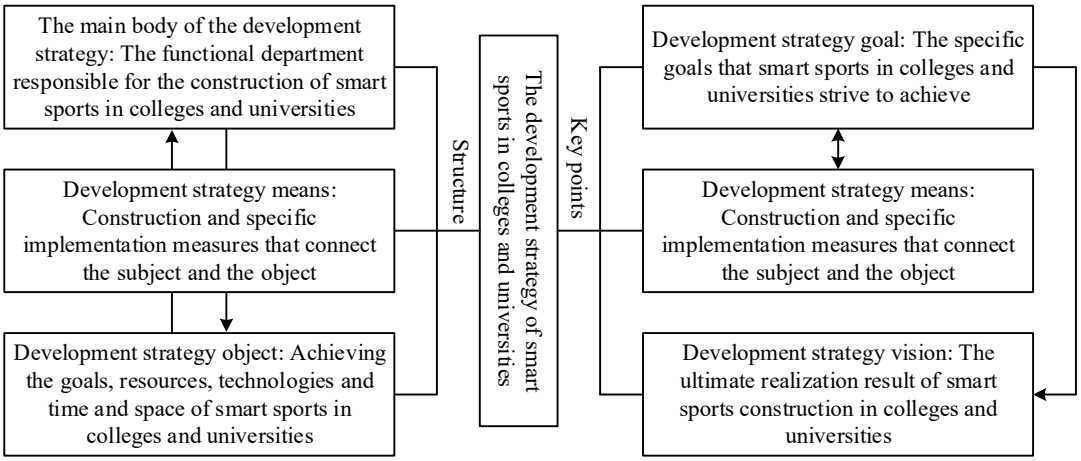

Figure 2: The development strategy and structure of intelligent sports

II. B. 2) Infrastructural support

Some scholars in the previous study defined the wisdom education model as a new form of modern education that is supported by information technology such as Internet of Things, big data, wireless communication and so on, aiming at combining Internet technology with modern education and embodying the characteristics of intelligence, diversification, personalization and ecology. It can be said that without the development of information technology such as the Internet of Things, big data, wireless communications and other information technology and the construction of related infrastructure, the work of smart education can not be carried out. Based on the expert Delphi method, the theme words about the basic support include: information technology, Internet, information infrastructure, cloud (informatization) platform, cloud technology and artificial intelligence. In conjunction with the analysis of the meanings above, the key points are analyzed below. The main role of the information technology system is to provide technical support for the normal operation of smart sports. The basic support of smart sports is mainly based on the following technologies as the key to implementation: 1) Internet of Things, 2) cloud computing, 3) ubiquitous network, 4) virtual simulation technology, etc.

II. B. 3) Integrated Physical Education Curriculum and Implementation

Sports curriculum construction is an important part of smart sports. Intelligent sports rely on the integrated setting and implementation of systematic, intelligent and modernized physical education curriculum to give play to its sports value and function. In order to better carry the function of school sports education and development, smart sports must develop and establish a perfect curriculum system and implementation content. The theme words of the integrated curriculum and implementation of physical education obtained after the Delphi test are: physical education curriculum objectives, intelligent physical education classroom, physical education teaching mode, physical education courseware, intelligent physical education learning, physical education course evaluation, ubiquitous learning, independent learning and physical education instructional design, which cover the core areas of the curriculum, classroom, instructional mode, learning process, learning mode, textbook, and instructional design

of intelligent physical education, and so on. It reflects the systematic and complete characteristics of the integrated setting and implementation of the smart PE curriculum.

II. B. 4) Physical education learning environment

The sports learning environment is the place where smart sports happen and the main place, and smart sports in colleges and universities play their educative function under the support of the learning environment system. In order to better utilize the educational function of wisdom sports in colleges and universities, it is necessary to establish a perfect wisdom sports learning environment. Therefore, intelligent sports learning environment is a necessary condition for the occurrence of college smart sports, which also plays a fundamental role in guaranteeing college smart sports and catalyzes the quality and effect of smart sports. The traditional sports learning environment is mainly a static place, mainly a static place for classes, fitness and exercise competitions in the general sense; while the intelligent sports learning environment has the typical characteristics of an intelligent learning environment, which integrates the automatic identification, information technology, intelligent generation and dynamic generation of sports, and demonstrates the typical features of an intelligently-driven, static and dynamic, and ecologically-developed intelligent sports learning environment. The sports learning environment referred to in this paper includes the learning environment of “teaching and learning” of teachers and students [26].

III. Subject and methodology of the study

III. A. Subjects of study

This study focuses on the current characteristics of physical activity habits, emotion regulation self-efficacy, negative academic emotions and the relationship between the three in the college population. The students of S city were used as the survey object.

III. B. Research methodology

III. B. 1) Literature method

The screening and reviewing of domestic and international related research literature is carried out through the literature method, combining the purpose and content of this study. The domestic literature is mainly obtained through China Knowledge Network, Wanfang Database and ReadShow Academic Search Engine. Foreign literature is mainly obtained through Web of science and ProQuest full-text database of doctoral and master's theses. In this study, the literature was collected and organized mainly from the following aspects: high-quality domestic studies on physical exercise habits, self-efficacy for emotion regulation, and academic emotions. Studies related to the relationship between physical activity and mental health and mood. Basic foreign research on academic emotions, emotion regulation self-efficacy, and other areas. On the basis of reviewing and combing the existing research literature, we have read the policy documents related to basic education reform, school sports reform and youth sports issued by the state and education departments in the past five years. By reading and organizing the above literature, we laid the foundation for the design, implementation and writing of this study.

III. B. 2) Questionnaire method

(1) Subjects of the survey

Students from four colleges and universities in S city were selected for the questionnaire survey using random whole cluster sampling.

(2) Survey tools

Basic information questionnaire. The basic information of the respondents mainly includes three indicators: gender, grade level and total midterm examination grade in the fall semester of the 2023-2024 academic year. Previous research suggests that there are large differences in academic mood among students with different academic performance thus the academic performance variable needs to be controlled when negative academic mood is used as an outcome variable in the relationship exploration. Through the field investigation of colleges and universities, it is found that the schools generally adopt the grading system for the evaluation of academic performance, that is, three grades of A, B and C are used to evaluate the comprehensive performance of students in various disciplines, in which A represents "excellent", B represents "good", and C represents "qualified". Thus, this study set up a survey item of academic achievement level to reflect the status of students' academic achievement by investigating their total score in the most recent important exam (midterm exam). The Physical Activity Habits Scale for Colleges and Universities. The scale contains two dimensions of repetitiveness of exercise behavior and volitional nature of exercise behavior, with 7 items for each dimension, totaling 14 items, scored on a Likert 5-point scale with a total score range of 15-80 points. The scale was accompanied by the compilation of interval division criteria for physical activity habits as shown in Table 1. The higher the score on the basis of the above criteria, the relatively stronger the physical activity habit of the subjects. The scale is suitable for measuring

the physical activity habits of the secondary school student population. The Cronbach's of this scale in this study were 0.847, 0.884, and 0.864 for the overall and two dimensions, respectively.

Table 1: The standard of physical exercise habits

	First interval	Second interval	Third interval	Fourth interval
Interval scoring range exercise habits	15-30	31-40	41-57	58-80
	Never participate in physical exercise	Occasionally take part in physical exercise	Preliminary entry to regular exercise	Be able to stick to exercise for a long time

Stratified cluster sampling was used to select students from four junior high schools in S city for the survey. The questionnaire data were collected through both online questionnaires and on-site organization of students to fill in the questionnaires. The web-based questionnaire was distributed to the home-school communication groups of each class by the class teacher or classroom teachers, and students voluntarily filled in the questionnaire after giving their informed consent. Since some classes in the surveyed secondary schools were not convenient for online questionnaire completion, the questionnaires were distributed and collected on-site by the teachers or the classroom teachers during the study sessions of the surveyed classes, explaining the purpose of the survey. The collected questionnaire data were entered into SPSS and manually screened, and questionnaires with short answer time (less than one minute), concentrated options (most questions with the same option), and incomplete answers (which appeared during the on-site survey) were excluded to obtain valid survey data. The questionnaire collection and valid sample are shown in Table 2.

Table 2: Effective sample

	Classification	Number	Percentage
Gender	Male	480	59.26%
	Female	330	40.74%
Grade	Freshman year	350	43.21%
	Sophomore	260	32.10%
	Junior	200	24.69%
Performance	A	288	35.56%
	B	402	49.63%
	C	120	14.81%

III. B. 3) Field survey methodology

This study conducted an in-depth investigation of the learning and living environment of the college group in S city through the field investigation method, and the main investigations included such things as the school sports work, students' physical exercise and negative academic emotions. Observations and interviews were conducted to understand students' physical exercise habits, academic emotions, and daily emotional regulation, and descriptive records were made through audio recordings and notes. The fieldwork lasted 45 days, during which more than 20,000 words were recorded, providing rich qualitative materials and realistic basis for the implementation of this study and the analysis and discussion of the findings.

III. B. 4) Mathematical and statistical methods

Survey data were entered, reliability tests, descriptive statistics, and correlation analyses through Excel, SPSS 23.0; validation factor analyses were conducted for each survey scale through AmOS 24.0. Hierarchical regression analysis with Bootstrap mediation effect test was performed through SPSS Process plug-in.

IV. Findings and analysis

IV. A. Survey data statistics

The statistical results of the survey data are shown in Table 3.

Boys had significantly higher frustration distress regulation efficacy and expression inhibition strategy use than girls, as well as significantly higher exercise commitment and exercise adherence. The results of fitting the model are shown in Figure 3.

Table 3: Statistical results of various survey data and variance analysis

	Female		Male	
	M	SD	M	SD
Positive emotional expression efficiency	4.03	0.78	4.12	0.76
Frustration and pain regulation	3.56	0.78	3.22	0.70
Angry regulation efficiency	3.51	0.98	3.42	0.89
Cognitive review	3.78	0.70	2.89	0.75
Expression inhibition	3.02	0.99	3.12	1.02
Exercise commitment	3.78	0.99	3.05	1.04
Exercise persistence	3.78	0.96	2.85	0.96

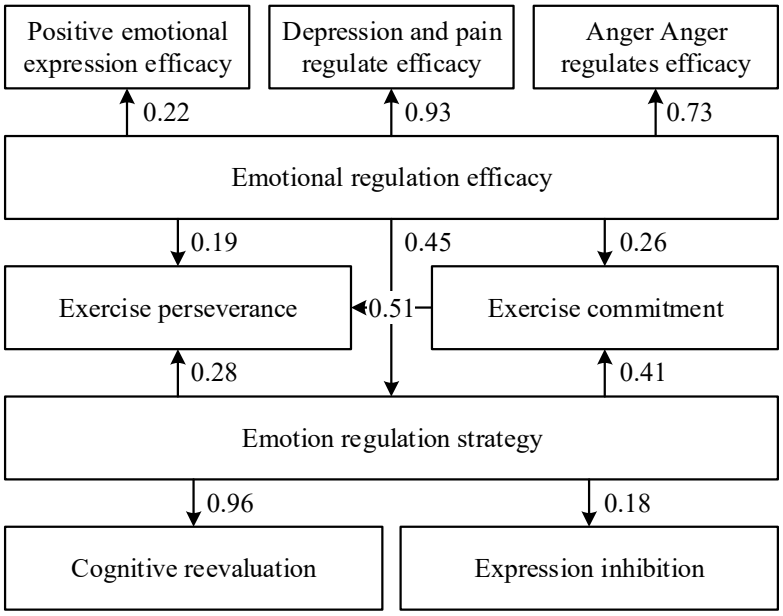

Figure 3: shows the standardized fitting results of model parameters

Based on the results of this study, it is clear that emotion regulation efficacy can have both a direct effect on exercise adherence and an indirect effect on exercise adherence through emotion regulation strategies and exercise commitment, with the most prominent pathway being an indirect effect on exercise adherence through emotion regulation strategies. Emotion regulation strategies can have both a direct effect on exercise adherence and an indirect effect on exercise adherence through exercise commitment. Exercise commitment can have a direct effect on exercise adherence. It can also be seen that exercise commitment has the most significant direct effect on exercise adherence, and other factors have an effect on exercise adherence mainly through exercise commitment.

Among the factors of emotion regulation efficacy, the most important one is frustration and pain regulation efficacy, followed by anger and rage regulation efficacy, while positive emotion expression efficacy has less influence, which indicates that the ability to control negative emotions has a greater influence on emotion regulation efficacy. Among the emotion regulation strategies, the use of cognitive reappraisal strategy had a very significant positive effect, while the expression inhibition strategy had a lesser effect. This suggests that the use of cognitive reappraisal strategies should be emphasized more than expressive inhibition strategies in emotion regulation strategies.

Based on the results of this study, it can be found that the better the emotion regulation efficacy and strategy use, the more it will help to strengthen the level of exercise commitment and exercise adherence of college students. Therefore, in order to enhance students' exercise adherence in college physical education, students should be actively guided to improve their emotion regulation efficacy and use appropriate emotion regulation strategies. The cultivation of emotion regulation strategies can be carried out by teachers before class or during physical exercise. Teachers should actively learn relevant psychological and kinesiological knowledge, strengthen their own mastery of emotional regulation strategies and teaching methods, so that in teaching, they can effectively guide students to enhance the effectiveness of emotional regulation, master the appropriate emotional regulation strategies, improve the level of commitment to exercise, and ultimately achieve the goal of exercise adherence.

IV. B. Analysis of Factors Influencing College Students' Anxiety

The questionnaire survey mode adopted for the study of the factors influencing college students' anxiety and depression negative emotions, with the 16 items in the self-administered questionnaire as the independent variables, and the SAS and HAMA scores as the dependent variables. After quantitative processing of the relevant information obtained, multiple step-by-step regression analysis was carried out, which in turn filtered out the influencing factors affecting the negative emotions of anxiety and depression in student patients. Three factors influencing anxiety, such as personality traits, academic stress and family upbringing styles, were selected at the level of α=0.05 as shown in Table 4. As can be seen from the table, employment pressure and family education style have a positive contribution to college students' anxiety, with regression coefficients of 0.642 and 0.401, respectively. Students' personality traits have a negative effect on college students' anxiety, i.e., personality traits are effective in reducing students' anxiety.

Table 4: The progressive regression analysis of the main factors of anxiety

Influencing factor	Regression coefficient	Standard error	Correlation coefficient	*t*	*p*
Personality characteristics	-0.425	0.063	0.065	5.613	<0.05
Employment pressure	0.642	0.068	0.058	7.379	<0.05
Family education	0.401	0.042	0.056	6.338	<0.05

IV. C. Comparison of SAS scores after Smart PE teaching intervention

In this paper, 810 students randomly selected in the previous paper were divided into observation and control groups, each with 405 cases. Among them, the observation group adopts intelligent physical education teaching intervention, and the control group adopts traditional physical education teaching mode. Comparison of SAS scores after intelligent physical education teaching intervention is shown in Table 5, by comparing the SAS scores after and before the intervention of the two groups, the results show that the differences are statistically significant (P<0.05). Among them, the SAS score of the observation group after intervention is significantly lower than that of the control group, and the difference between the two groups is significant (P<0.05).

Table 5: The SAS score was compared before and after the two groups intervened

Group	n	Preintervention	After intervention	*t*	*p*
Observation group	405	61.42±8.06	36.34±5.69	13.362	<0.05
Control group	405	62.25±8.49	50.24±7.96	6.487	<0.05
t		1.389	11.987		
p		>0.05	<0.05		

IV. D. Comparison of HAMA scores after smart physical education intervention

Comparison of HAMA scores before and after intervention between the two groups is shown in Table 6, as shown in the table comparing the post-intervention and pre-intervention HAMA scores of the observation group and the control group, and the difference is statistically significant (P<0.05). The post-intervention HAMA score of the observation group was significantly lower than that of the control group, and the difference between the two groups was significant (P<0.05).

Table 6: Two groups of interventions before and after the HAMA score

Group	n	Preintervention	After intervention	*t*	*p*
Observation group	405	18.41±4.32	6.25±1.58	9.469	<0.05
Control group	405	18.46±4.45	11.49±2.89	4.372	<0.05
t		1.009	6.478		
p		>0.05	<0.05		

V. Conclusion

Intelligent physical education teaching mode significantly improves the mental health of college students through multi-dimensional emotional intervention strategies. The experimental data confirmed that the SAS score of the observation group after the smart physical education teaching intervention decreased from 61.42±8.06 to

36.34±5.69 before the intervention, which was much higher than that of the control group with traditional teaching, which was 50.24±7.96; the HAMA score decreased from 18.41±4.32 to 6.25±1.58, which was significantly lower than that of the control group, which was 11.49±2.89.Emotion regulation Ability is a key factor influencing the formation of physical activity habits, with frustration pain regulation efficacy having the most significant effect on emotion regulation, and the use of cognitive reassessment strategies having a positive effect on exercise adherence. Multiple stepwise regression analysis showed that employment pressure and family education style had a positive contribution to college students' anxiety, with regression coefficients of 0.642 and 0.401, respectively, while personality traits could effectively reduce students' anxiety.

Intelligent physical education teaching in colleges and universities should focus on AI identification and analysis of students' emotional state, accurately grasp students' psychological needs, and implement personalized emotional intervention strategies. Physical education teachers should improve the ability of emotion education, integrate the cultivation of emotion regulation ability in physical education, especially strengthen the guidance and application of cognitive reassessment strategy. Colleges and universities should strengthen the construction of intelligent sports infrastructure, build a sports learning environment supported by artificial intelligence, and provide technical support for emotional intervention. At the same time, they should establish a perfect emotion monitoring and early warning mechanism, design differentiated intervention programs for different emotional problems, and form an all-round and multi-level intelligent sports mental health promotion system.

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