Research on the intervention practice of the school physical education environment on the physical activity of college students

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ABSTRACT

Purpose: This study discusses the main factors that affect the physical education environment of universities and college students' physical activity levels.

Design/Methodology/Approach: This study used the questionnaire method and the experimental method to conduct exploratory research on 286 college students (boys = 141, girls = 145) in eight teaching classes from new comers to senior students at Chongqing Normal University (one experimental class and one control class in each grade).

Findings: The main factors of the school's physical education environment were the interpersonal social environment, the natural physical environment and the physical education system environment. There was no significant statistical difference before the experiment. The experimental group showed statistical differences after the experiment. A substantial effect size was found in the intervention's effectiveness tests (2 * 2 ANOVA) and (2 * 3 ANOVA).

Conclusion: The school physical education environment can efficiently promote the improvement of the physical activity level of college students and the improvement effect has specific time persistence. The interpersonal social environment, the natural physical environment and the physical education system environment can be carried out when participating in the school's physical education environment.

Research Limitations: The limitation is that the experiment period needs to be longer.

Practical Implications: Intervention practice can effectively improve college students' physical activity through the school sports environment.

Contribution to Literature: This paper explores a new way to promote college students' physical exercise.

Keywords: *College students, Interpersonal social environment, Natural physical environment, Physical activity, Physical education system environment, Physical health, School physical education environment.*

1. INTRODUCTION

According to scholars' perspectives, increasing physical exercise is considered one of the fastest and most effective means to improve teenagers' physical health. Many studies have highlighted the importance of physical activity (Kim & Kang, 2021). A survey report published by the World Health Organization (2018) found that approximately 23% of adults aged 18 years and older worldwide are still at risk of physical inactivity. Pengpid et al. (2015) surveyed college students in 23 countries. They found that 41.4% of college students were physically inactive, 37% of college students in China are also experiencing physical inactivity. More than two-thirds of college students in South Korea do not exercise or engage in regular physical activities contributing to the country's serious physical inactivity problem (Kim, Kim, & Park, 2021). This demonstrates how the physical inactivity of college students has grown into a serious global crisis that affects all countries and how to successfully increase the level of physical activity among college students has emerged as a critical issue that must be resolved immediately in all nations. School Physical Education Environment (SPEE) is the sum of all environmental factors that carry out physical activity in schools in which sports are conducted. According to Jennifer, Lucie, and Ronald (2007), the school physical education environment refers to the surrounding space centered on the school's physical activity and the situation of things that are related to or interrelated with school physical education. The school physical education

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environment is an essential factor affecting the physical activity of youth. In this study, we will investigate the main factors that influence the school physical education environment on college students, determine the influence of the school physical education environment intervention on physical activity practice and promote the improvement of college students' physical activity levels.

2. METHODS

2.1. Participants and procedure

2.1.1. Test objects

286 students from Chongqing Normal University's eight teaching classes in four grades ranging from juniors to seniors were chosen as the research participants in order to minimise disparities in regional cultures, educational attainment, curriculum, the skills of specific teachers and the calibre of the students. The primary method of convenient sampling was used. One experimental and one control class were assigned to each grade level. Questionnaires were distributed and collected before and after the experiment.The details of the experimental subjects are shown in Table 1.

Table 1. Basic information about subjects (N=286).

Grouping		**N**	**Percentage**
Grade	Freshman	63	22.03%
	Sophomore	81	28.32%
	Junior	82	28.67%
	Senior	60	20.98%
Gender	Male	141	49.30%
	Female	145	50.70%
Experimental condition	Experimental group	142	49.65%
	Control group	144	50.35%

2.1.2. Intervention Program

In this study, the school physical education environment intervention program is formulated with the basic research idea of "asking questions,investigating questions, analyzing problems and solving problems" to formulate the program of school physical education environment intervention in college students' physical activity. First, I reviewed the previous research to provide the necessary theoretical support for the central part of the later period including the investigation of the problem, the purpose and importance of the research. The research method, the elaboration of the object, etc., are then elaborated on with the related concepts and theories. Secondly,the research subjects are the first to fourth grade students at Chongqing Normal University who are participating in surveys, interviews and observations. The intervention control practice research was conducted using the principle of convenient sampling at Chongqing Normal University and the questionnaire's content was developed in accordance with the needs of the study. The test was carried out before and after the teaching experiment. Finally, the factors affecting sports activities of college students are analyzed in order to solve the problem of insufficient the sports activities of college students. The results show that these factors include personal and external factors (social sports factors, family factors and school factors). The following are the specific ways in which the school physical education environment can intervene in the physical activity of college students after analysing the constituent factors of that environment that specifically affect physical activity such as the natural material environment, sports system environment, interpersonal social environment and others: 1. Provide adequate venue equipment, optimize sports curriculum, create a positive sports atmosphere, encourage peer support from teachers and students and enhance positive personal psychology to intervene. The overall block diagram is shown in Figure 1.

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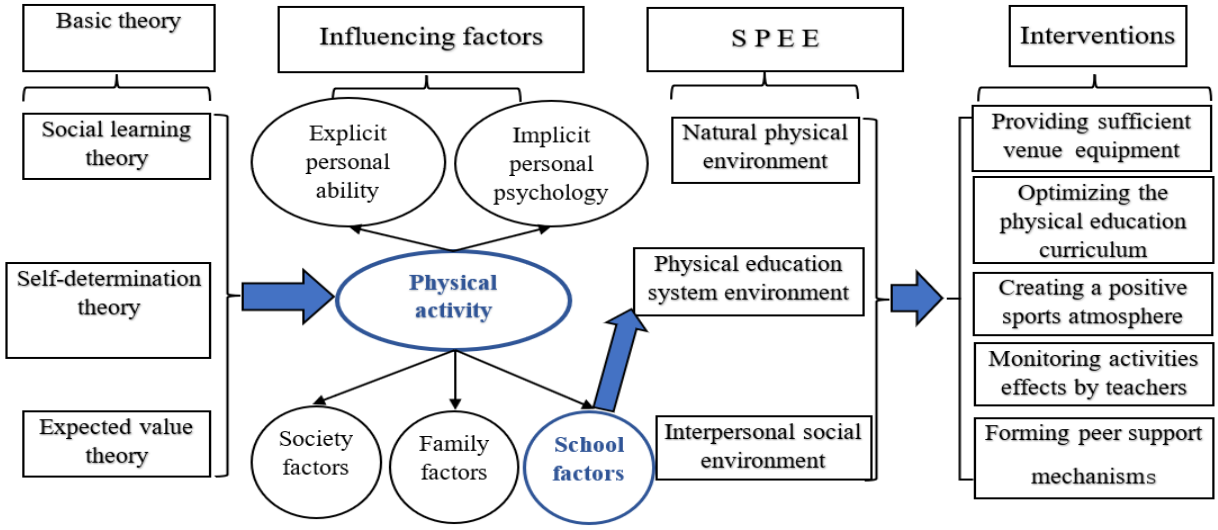

Figure 1. Campus physical education environment intervention program of college students' physical activity.

2.1.3. Process of Intervention

Experimental grouping: Each of the two classes at Chongqing Normal University's new students to senior students had eight teaching classes: one teaching class for the experimental class and one teaching class for the control class.

Intervention content: 1. Provide sufficient and convenient venue equipment, physical activity facilities and equipment for the experimental class both in and out of class. 2. Optimize the physical education curriculum: Take students' interests as a guide to choose the class content. The experimental class focuses on a basketball-related project, uses a blended online and offline teaching method to ensure close class integration. 3. Create a positive sports atmosphere: Organize circular teaching competitions in two teaching classes to create a positive atmosphere for the experimental class. 4. The effect of teacher supervision activities: In the experimental class, teachers supervise each student's active participation as part of the physical education assessment. Each exercise after class must last for at least 30 minutes and be completed at least three days a week. 5. Form a peer support mechanism: Participate in physical activities as a team and implement a joint reward and punishment mechanism.

Intervention process: 1. The main sports venues on campus are: basketball halls, badminton halls, table tennis halls, swimming pools and gyms which are paid to enjoy. Issue specially formulated signs for the experimental class and holds the signs in any indoor and outdoor sports venues on campus. 2. The physical education course adopts an online and offline mixed teaching mode. The teacher uses a computer or mobile phone for the intervention group to distribute the course content to the teaching group. Use the camera to record the decomposed and complete teaching video and upload it to the "learning group" for the classmates to use. Use the computer to mix and play the recorded teaching video with the teaching video downloaded from the Internet. Let the classmates discuss and learn by themselves in groups. The video can be moved forward or backward at any time, facilitating the classmates to study in places where they cannot learn at any time. Turn passive learning into active learning. Use computers or mobile phones to record the learning content into videos and submit assignments for completion. Teachers can evaluate the quality of students' action completion online or offline. 3. During the experiment, organize a circular basketball teaching competition for the experimental class every weekend to create a positive atmosphere of physical activity. 4. In combined online and offline mixed teaching modes, teachers supervise the physical activity of students and use it as an integral part of the curriculum assessment. 5. Participate in physical activity as a team and implement a joint reward and punishment mechanism. If one of the team members exceeds the physical activity task this week, everyone will be rewarded; if one fails to complete the task, everyone will be punished.

Experimental control: Eight teaching classes (four experimental classes and four control classes) in the four grades taught by the author himself were selected for the teaching in order to facilitate the teaching. Teaching adopted a single-masked method and the students in the experimental class and the control class were not taught. The purpose of the experiment was explained. Students in the control group voluntarily participated in physical activity

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adopted the traditional physical education model and did not supervise extracurricular physical activity. Moreover, in the fourth week after the experiment, a follow-up test was carried out to monitor the continuity of the effect. Experiment time: April 2022-June 2022. Two classes per week of 40 minutes were scheduled for 12 weeks.

2.2. Measurements

2.2.1. Demographic Information

The demographic questionnaire gathered participants' age, gender, grade and professional experiences.

2.2.2. International Physical Activity Questionnaire (IPAQ)

The International Physical Activity Questionnaire (IPAQ) was recommended as a cost-effective scale for evaluating physical activity (Craig et al., 2003). The questionnaire consists of two parts: a lengthy and segmented questionnaire. In this study, a short questionnaire comprising seven items was used. Among them, six of them focused on the subjects' physical activity and one question was to evaluate the subjects' sedentary time. According to the evaluation standard of the short questionnaire in the international physical activity scale, each physical activity is measured for 3 hours (180 minutes) per day. If it exceeds the online line, it will be calculated according to the upper limit value and if it is lower than the offline line, it will be calculated as 0. The maximum time for various physical activities is 21h (1260 minutes) per week. Physical activities vary with time, frequency and metabolic equivalent (MET). The MET assignments for walking, moderate and high physical activity are 3.3, 4.0, and 8.0 respectively. According to several categories of physical activity, physical activity = MET * weekly frequency (d/w) * time per day (min/d), and the physical activity evaluation criteria are shown in Table 2:

Table 2. Physical activity equivalence evaluation criteria.

Activity level	**Evaluation criteria**
High- intensity (Meet any one of the two evaluation criteria).	1) High intensity physical activity≥3d/w and the total physical activity level of the week≥1500MET-min/w.
	2) Total physical activity of 3 intensities≥7d/week and total physical activity level of the week≥3000MET-min/w.
Moderate- intensity (Meet any one of the three evaluation criteria).	1) High-intensity physical activity≥20min/d，total≥3d/w.
	2) Moderate-intensity or walking activity≥30min/d， total≥5d/w.
	3) A total of 3 intensities of physical activity≥5d/w and total weekly physical activity level≥600MET-min/w.
Low- intensity (Meet any one of two criteria).	1) Did not engage in any physical activity 2) Do some physical activity but not meeting moderate to high physical activity standards.

2.2.3. Self-Made Questionnaire

According to the purpose and needs of this paper, conduct a targeted questionnaire design to investigate the physical activity of college students in these eight classes before and after the intervention and the impact on physical activity in the school physical education environment. Eight sports research experts were invited to evaluate the questionnaire in three aspects: the content of the questionnaire, the structure of the questionnaire and the design of the questionnaire to check the reliability and validity of the questionnaire. Conduct the necessary tests. If the reliability is high, it indicates that the material is authentic and practical. The reliability coefficient Cronbach's alpha is 0.842 indicating that the survey has good reliability and validity. The results are shown in Table 3.

Table 3. Questionnaire effectiveness evaluation test results: statistical table.

Variable	**Item effectiveness test value**			
	Very reasonable	**Reasonable**	**Normal**	**Unreasonable**
Structure of the questionnaire	2	5	1	0
Contents of the questionnaire	2	4	2	0
The overall structure of the questionnaire.	3	3	2	0

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2.3. Analytical Strategy

2.3.1. Statistical Software

The SPSS 26.0 software was used to determine the difference analysis and factor analysis on the research data revealing the current situation of college students' physical activity and the factors that affect the physical activity of the school's physical education environment.

2.3.2. Coefficient of Variation

The "standard margin" also known as the coefficient of variation is typically used to assess how two or more sets of data differ from one another (Jia & Li, 2022). If the measured data is from the same category and the unit of measurement is the same, we can directly compare the change in the data. However, if we want to compare different types of data, we need to calculate the C.V. In this paper, the impact of different school physical education environments on students is examined. The calculation formula is shown in Equation 1.

$$C.V = \frac{S}{\bar{x}} \times 100\% \tag{1}$$

2.3.3. Skewness

Sleekness measures the direction and degree of skewness of statistical data distribution and is a digital feature of the degree of asymmetry of statistical data distribution (Konno & Suzuki, 1995). Under normal circumstances, when the statistical data is a right-skewed distribution, S_k>0 and when the statistical data is a right-skewed distribution, S_k<0 (Tsafarakis et al., 2017). In this paper, before the in-depth analysis of the data, the skewness should be tested first to ensure the validity of the data. The calculation formula is shown in Equation 2.

$$S_k = \frac{\mu_3}{\mu_2^{\frac{3}{2}}} = \frac{\mu_3}{\sigma^3} \tag{2}$$

S_k -------- Skewness.

μ_3 --------3rd order central moment.

σ -------- Standard deviation S_k.

2.3.4. Weighted Average Harmonic Index.

1)The weighted average harmonic index can also be divided into two types according to the different forms of weight: the harmonic average index used to report the number of surveys and the harmonic average index with a fixed weight (Li, Nie, Chang, & Yang, 2017).

2) Report the harmonic mean index of the number of options

$$I_q = \frac{\sum q_1 p_1}{\sum \frac{q_0}{q_1} q_1 p_1} = \frac{\sum q_1 p_1}{\sum \frac{1}{K_q} q_1 p_1} \tag{3}$$

$$I_p = \frac{\sum q_1 p_1}{\sum \frac{p_0}{p_1} q_1 p_1} = \frac{\sum q_1 p_1}{\sum \frac{1}{K_p} q_1 p_1} \tag{4}$$

3）Harmonic mean index with fixed weights. This weighted harmonic mean index is rarely used in work (Morrison & Mahadevan, 2011).

$$I_p = \frac{\Sigma W}{\Sigma \frac{1}{K_p} W} \tag{5}$$

$$I_q = \frac{\Sigma W}{\Sigma \frac{1}{K_q} W} \tag{6}$$

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It is required to carry out weighting treatments for various influence elements since the proportion of influence represented by various school physical education environments varies. The weighted average harmonic index is shown as Equations 1, 2, 3 and 4. In this paper, the weighted processing of different school physical education influencing factors is discussed. The calculation formula was mainly adopted from Equations 3 and 4.

3. RESULTS

3.1. School Physical Education Environment Affects College Students' Physical Activity Weight Index

We selected four grade students at Chongqing Normal University (with one experimental class and one control class) in each grade for a total of eight teaching classes to avoid differences in local customs, educational attainment, curriculum and student quality. A questionnaire was used before and after the teaching experiment. The questionnaire surveyed students in the essential information part on the international physical activity scale, the self-made scale, etc.

According to research and statistics, Table 4 shows the weight of the elements that influence college students' physical activity in the context of physical education in schools. The calculation formula is shown in Equation 7. The variance contribution rates of the three common factors of interpersonal social environment, natural material environment and sports system environment are 30.67%, 22.16% and 18.59% respectively and the cumulative contribution rate of the three factors is 71.42%. According to the normalization formula in mathematical statistics

$$D_J = \frac{b_j}{\sum_{z=1}^{n} a_z} \quad (7)$$

Where n is the number of extracted factors and bj is the contribution rate of the jth factor.

The variance contribution rates of the interpersonal social environment, natural material environment and physical education system environment are 0.406, 0.362, and 0.232 respectively. Similarly, according to the linear regression equation of the relationship between common factors and hidden factors reflected in the component fraction coefficient matrix, the weight values of potential factors in common factors can be obtained as shown in Table 4.

The order of weight values of the factors that affect the physical activity level of college students in the school physical education environment is as follows: the interpersonal social environment is the largest followed by the natural material environment and the sports system environment is the smallest. In the interpersonal social environment, the critical order is peer support, extracurricular sports atmosphere, physical education curriculum setting and teacher support. In the natural material environment, the critical order is venue equipment, geographic climate and intramural environmental planning. In the sports system environment, the critical order is school execution, school sports system and national sports system.

Table 4. Analysis of influencing factors of school physical education environment on college students' physical activity.

Common factor weight value D_J	**Latent factor**	**Factor score coefficient bj**	**The weight value of the latent factor on the common factor**
Interpersonal social environment 0.406	Q3: Peer support Q9: Extracurricular sports atmosphere Q6: Physical education curriculum Q10: Teachers' supporting	0.566 0.546 0.415 0.476	0.662 0.588 0.476 0.452
Natural material environment 0.362	Q1: Venue equipment Q4: Geographical climate Q7: On-campus environmental planning	0.522 0.501 0.489	0.649 0.548 0.481
Physical education system environment 0.232	Q8: School enforcement Q5: School physical system Q2: National physical education system	0.474 0.422 0.313	0.475 0.438 0.402

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Table 5. Baseline comparison of physical activity between experimental and control groups before intervention.

Variables	Exp (N=142)	Con (N=144)	F	P
	M±SD	M±SD		
Duration of physical activity /min	36.12±23.15	42.15±18.36	1.09	0.25
Amount of physical activity /MET-mins	197.24±89.52	183.56±103.25	1.12	0.16

Note: Con = Control, Exp = Experimental, the same as below.

3.2. Comparison of Baseline Tests between the Experimental and Control Group before Intervention

In order to determine whether there are differences between the experimental group and the control group before the intervention of the school physical education environment, the homogeneity test of the physical activity levels (duration and activity) of the students in the experimental group and the control group was carried out and the SPSS software was used to conduct a one-way analysis of variance. The results showed no differences between groups in the duration and activity volume factors of physical activity as shown in Table 5.

3.3. Effectiveness Test of the Intervention

Repeated measurement means that an observation indicator of the same subject is measured multiple times on different occasions (such as at different time points). The analysis of variance based on the results of multiple measurements is called repeated measurement (Schuster & Von, 2001). Taking the group (experimental group vs. control group) as the inter-group variable and the time factor (pre- vs. post-tests) as the intra-group variable, the 2 * 2 repeated measure analysis of variance (ANCOVA) was used to test the effectiveness of a school physical education environment intervention on college students' physical activity. The results showed that after 12 weeks of the experiment, repeated measures of ANOVA were performed for the duration of physical activity, time ($F = 13.53$, $p < 0.001$, $\eta 2 = 0.095$) and group * time ($F = 13.15$, $p < 0.001$, $\eta 2 = 0.052$). Repeated measures of ANOVA were performed for the amount of physical activity, time ($F = 11.08$, $p < 0.001$, $\eta 2 = 0.043$) and group * time ($F = 10.72$, $p = 0.001$, $\eta 2 = 0.036$) as shown in Table 6.

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Table 6. Effects test of school physical education environment intervention on college students' physical activity.

Variable	Section	Exp	Con	Time			Time*Group		
		M±SD	M±SD	F	P	η 2	F	P	η^2
Duration of physical activity /Min	Pre-test	36.12±23.15	38.15±18.36	13.53	P<0.001	0.095**	13.15	P<0.001	0.052***
	Post-test	56.44±18.76	42.34±20.17						
Amount of physical activity/MET-mins	Pre-test	197.24±89.53	183.56±103.26	11.08	P<0.001	0.043***	10.72	0.001	0.036**
	Post-test	287.37±83.54	202.37±114.36						

Note: *** p<0.001,**p<0.01,*p<0.1, the same as below.

Table 7. Persistence test of school physical education environment intervention on college students' physical activity.

Variable	Section	Exp	Con	Time			Time*Group		
		M±SD	M±SD	F	P	η 2	F	P	η^2
Duration of physical activity /Min	Pre-test	36.12±23.15	38.15±18.36	12.28	0.001	0.072**	11.65	0.012	0.047*
	Post-test	56.44±18.76	42.34±20.17						
	Track-test	50.37±33.64	40.28±19.62						
Amount of physical activity /MET-mins	Pre-test	197.24±89.53	183.56±103.26	10.82	0.023	0.037*	9.84	0.045	0.021**
	Post-test	287.37±83.54	202.37±114.36						
	Track-test	248.69±104.88	195.63±98.62						

Note: **p<0.01, *p<0.1.

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3.4. Continuous Testing of Interventions

Grouping (experimental and control group) was used as the inter-group variable and the time factor (pre- vs. post-tests vs. follow-up) was used as the intra-group variable. A 2 * 3 repeated measurement analysis of variance (ANOVA) was used to test the effect of school physical education environment intervention on college students. The results showed that repeated measures ANOVA had a significant time interaction effect on the duration of physical activity ($F = 12.28$, $p = 0.001$, $\eta^2 = 0.072$) and the duration of physical activity was also very significant in the interaction of grouping * time ($F = 11.65$, $p = 0.012$, $\eta^2 = 0.047$).

Before the test, the experimental and control groups had no significant difference in duration or physical activity. After the test, the experimental group's duration and physical activity were higher than those in the control group. In terms of duration, both the duration of physical activity and the amount of physical activity decreased after the experiment but remained at a high level as shown in Figure 2.

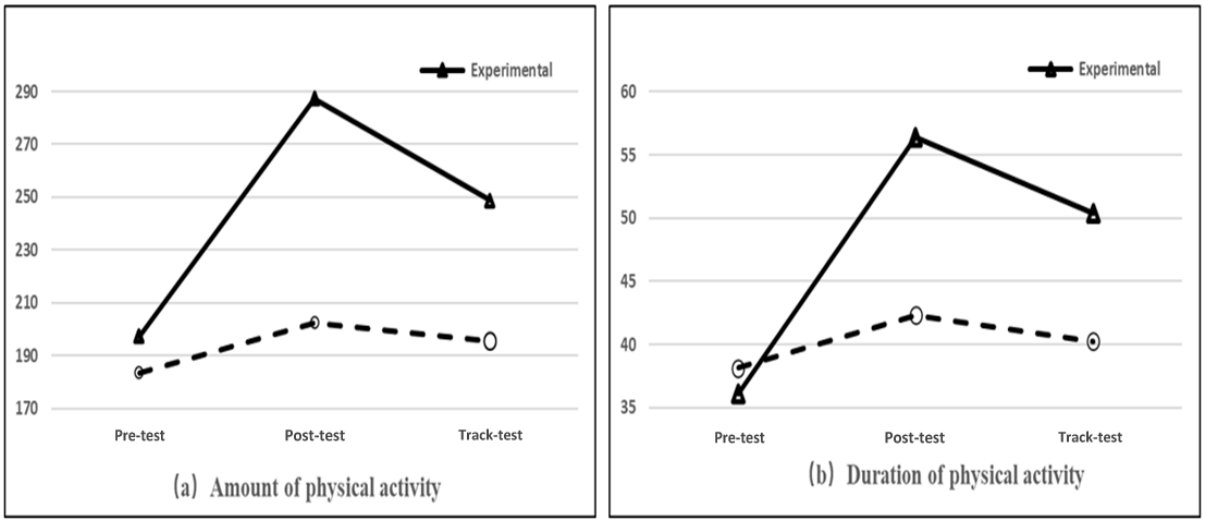

Figure 2. Changes in physical activity during pre-, post-tests, and follow-up tests in the experimental and control groups.

4. DISCUSSION

It has been discovered from this research that factors such as the interpersonal social environment, the natural material environment and the sports system environment can all be used to influence how the school physical education environment intervenes with college students' physical activities. Peer support, extracurricular activity atmosphere and physical education all play a significant role in the interpersonal social environment. Curriculum design, teacher support and other intervention aspects, venue equipment, geographic climate, and environmental planning for intramural activities, the national sports system, the school sports system and school execution efforts can all be used to influence the natural material environment. Li, Yang, and Yang (2018) and other studies have shown that family and friend support and environmental factors are potential factors affecting the physical activity of ordinary college students in the campus environment. Guo (2019) believes that the school physical education environment is an essential factor affecting young people's participation in extracurricular activities and most school physical education environmental factors can promote the occurrence of youth physical activity behaviors. Environmental factors such as sports venues, transportation infrastructure, equipment and sporting goods have varying degrees of influence on the physical activity of ordinary college students. The ability to effectively encourage students to participate in physical activities at school is important for predicting the development of physical exercise habits (Raynor, Coleman, & Epstein, 1998). This can be done by improving the accessibility and convenience of school sports facilities, equipment and venues. Jeffrey, Martinsupa, Flory, Murphy, and Wisdom (2011) show in this article that the school physical education environment is an essential factor affecting youth physical activity mainly through physical education courses, physical activity before and after class, physical education teachers and other parts to intervene in youth physical activity. Teacher support is mainly reflected in the professional quality of teachers, teaching concepts and teaching methods and is a critical guiding factor for establishing correct sports values and forming healthy behavior habits (Mâsse, Nigg, Basen-Engquist, & Atienza,

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2011). Behavioral learning theory also explains that in the stage of social adaptation and development, young people tend to follow and imitate the intentions and behaviors of high-authority people and develop regular behavior patterns under a specific interpersonal support atmosphere (Bandura & Walters, 1963) and peer support provides external motivation for developing good physical activity habits which helps young people to improve society in the context of sharing happiness and meeting needs. Teacher support and peer relationships in school are also essential factors in developing physical activity habits.

There is a significant interaction between the duration of physical activity and the amount of physical activity indicating that the school physical education environment has a high effectiveness in interfering with the physical activity level of college students. Evans and Wilkinson (2022) also stated that improving the school physical education environment will help improve youth's physical activity abilities. A follow-up test was carried out in the fourth week after the end of the experiment in order to test the sustained effect of the intervention. Four weeks after the experiment, the students were preparing for final exams and all physical activity decreased. The ultimate goal of the intervention is to change behavior and it has a specific sustained effect based on changing behavior. The results of the variance analysis of heavy load measurement showed that there was still a significant interaction between physical activity time and activity volume in the time and time * groups. It shows that the school's physical education environment intervention has certain continuity. Si, Li, and Deng (2022) have effectively improved adolescents' physical activity duration through comprehensive intervention measures in extracurricular sports. The 4-week tracking test also showed the comprehensive intervention of extracurricular sports in schools.

5. CONCLUSION

The energy efficiency of the school physical education environment can promote the improvement of the physical activity level of college students and the improvement effect has a specific time persistence. The specific intervention measures can be carried out by providing sufficient venue equipment, optimizing the sports curriculum, creating a positive sports atmosphere having teachers supervise the effects of activities and forming a peer support mechanism.

FUNDING

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INSTITUTIONAL REVIEW BOARD STATEMENT

The Ethical Committee of the International College, Krirk University, Thailand has granted approval for this study on 4 March 2022 (Ref. No. 2022-0304).

TRANSPARENCY

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

The ideas, concepts, and design of the research, instrument development, and data analysis, L.C; the data analysis, and formatting of the article, Y.H.C. Both authors have read and agreed to the published version of the manuscript.

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