Design and Validation of an Integrated Physical Education Teaching Module Based on Motivation Theory: A Course Development Study Guided by the ADDIE Framework

Bao Guo Chen

School of Physical Education, Hanshan Normal University, China
Corresponding Author Email: baoguochen6609@gmail.com

Abstract
This study developed and evaluated an Integrated Physical Education (PE) Teaching Module grounded in Self-Determination Theory (SDT) and the ADDIE instructional design framework to enhance university students' physical fitness (PF) and exercise motivation. The module combined in-class fitness training, out-of-class exercise tasks, and an evaluation-based incentive mechanism. An 8-week intervention was conducted in a natural university setting. Results indicated high feasibility and acceptability (completion rate = 94.03%, S-CVI/Ave = 0.952). Compared with the control group, participants in the experimental group showed significant improvements in physical activity (PA) level, exercise self-efficacy, and overall PF ($p < 0.05$), although endurance indicators (800m/1000m run) did not differ significantly. These findings demonstrate the effectiveness of the SDT-based integrated PE module in promoting students' motivation and fitness. The study provides a validated, theory-driven pedagogical model that bridges psychological theory with instructional design, offering practical implications for improving university PE curricula.
Keywords: Integrated PE Teaching Module, Self-Determination Theory, ADDIE framework, Physical Fitness, University Students

Introduction
Over the past decade, the physical fitness (PF) level of Chinese university students has shown a continuous decline, becoming a public health issue of growing concern across society. According to the *National Student Physical Fitness Sampling Report* (2016–2020), by 2020, approximately 30% of university students failed to meet the national fitness standards, and only 7% were rated as "good" or "excellent" in the national assessment (Wang, 2021). Several large-scale and regional studies have reported similar findings. Dong et al. (2023) found that from 2013 to 2019, the physical fitness indicators of male university students in Chongqing and Hebei—such as vital capacity, standing long jump, and 50-meter sprint—showed a significant downward trend. Similarly, Sun et al. (2025) reported a marked decline in the overall PF level of university students in Anhui Province over ten years (2013–2023). A

nationwide analysis conducted by Cai et al. (2025) on data from more than 240,000 university students across 30 provinces revealed that the median composite PF index of Chinese university students decreased significantly from −0.16 in 2000 to −1.99 in 2019, with male students exhibiting a faster rate of decline than females.

To address this issue, educational authorities at all levels in China have issued a series of policy documents and established explicit objectives requiring universities to enhance students' PF through educational practices. However, most of these policies are general and directive in nature rather than providing concrete and executable strategies. Consequently, universities have to independently explore feasible solutions. Nevertheless, current physical education (PE) curricula in Chinese universities exhibit several structural deficiencies, making them ineffective in curbing the decline in students' PF. The existing PE curriculum content fails to meet the diverse needs of students and remains largely dominated by traditional sports activities. The course organization is relatively uniform and lacks systematic endurance and aerobic training—components that are essential for improving students' cardiopulmonary function (Cai et al., 2025). Moreover, the PE curriculum lacks an integrated design. The three major avenues of implementation—classroom instruction, extracurricular activities, and competitive training—operate in isolation, with limited interaction and coordination, which undermines students' motivation to engage in regular physical activity (Jian & Xu, 2019). The current assessment system for PE also places excessive emphasis on sports skill testing, while neglecting students' daily exercise habits, health behavior development, and progressive improvements in physical fitness (Wei, 2022). Therefore, reforming existing PE curricula has become an urgent and essential pathway for universities to enhance the PF levels of their students.

The factors contributing to the continued decline in university students' PF are multifaceted and complex, with insufficient physical activity (PA) being the most direct cause and manifestation. A fitness assessment involving 17,928 undergraduates from 24 universities across 23 countries revealed that 41.4% of university students were physically inactive. Moreover, insufficient physical activity was associated with overweight or obesity, negative health perceptions, and low levels of physical self-control (Pengpid et al., 2015). Among students who did not engage in exercise, only 1.6% achieved an "excellent" fitness rating, compared to 13.4% among those who exercised more than five times per week (Qiao, 2022). These findings suggest that previously acquired physical fitness may deteriorate without regular training, underscoring the crucial role of consistent physical activity in maintaining physical fitness (Mitrović et al., 2016). Therefore, promoting sustained participation in PA among university students has become a key focus and direction for PE curriculum reform in higher education.

A substantial body of research has shown that motivation-based interventions play a vital role in promoting students' participation in physical exercise. Autonomous motivation is particularly important for sustaining regular engagement in physical activity (PA), which is closely associated with positive health outcomes (Teixeira et al., 2012). Among various motivational theories, Self-Determination Theory (SDT) has emerged as one of the most widely applied and empirically supported frameworks in PE, exercise, sport, and coaching contexts. Numerous studies have confirmed its effectiveness and cultural applicability in the Chinese setting (Chu & Zhang, 2022; Liu et al., 2017; Tao et al., 2018; Yuan et al., 2023; Liang

et al., 2025). Although these studies demonstrated that motivation enhancement strategies can positively influence university students' exercise participation and physical fitness (PF), their overall outcomes have remained modest. Motivation alone appears insufficient to elicit significant and sustained behavioral or PF improvements, as factors such as time constraints, limited motor skills, and low self-efficacy may hinder intervention effectiveness (Chen & Kasim, 2025). Therefore, it is essential to integrate mechanisms that foster autonomous motivation while addressing exercise barriers within PE curricula. Developing an instructional module that systematically incorporates both motivational regulation and behavioral facilitation may provide a more comprehensive and effective approach to enhancing university students' long-term engagement in physical activity.

The ADDIE model is a widely cited instructional design framework that provides a structured and systematic approach to developing educational tools or intervention modules. It has been extensively applied across various disciplines to create stable and reliable training programs. Many scholars have also adopted this model to develop many physical education modules for implementing teaching interventions (Yu & Jee, 2020; Li & Cheong, 2023; Ferdiansyah, Kurniawan, & Darmawan, 2024; Maliki et al., 2025). ADDIE was first developed as a process model for the military. It was proposed by Branson in 1975 and later developed and revised by Dick, Cary, and Russell Watson, among others. ADDIE clearly divides five iterative phases: Analysis, Design, Development, Implementation, and Evaluation. These five stages enable instructional designers to apply the model flexibly, including how to perform different steps or procedures, which makes it key to the development of education and training programs (Hannum, 2005). Therefore, this framework was adopted in the present study to guide the development of the physical education instructional module.

The continuous decline in Chinese university students' physical fitness has become a major concern for educators and policymakers. Although the importance of physical activity (PA) is widely recognized, many students still demonstrate low participation and poor fitness due to insufficient autonomous motivation and a lack of systematic support in PE curriculum design. These challenges highlight the urgent need for innovative teaching approaches that not only improve students' physical fitness but also promote sustainable behavioral change. To address this issue, the present study developed and evaluated an integrated PE teaching module grounded in motivational theory and guided by the ADDIE model. Based on the principles of Self-Determination Theory (SDT), the module aimed to enhance students' autonomous motivation toward PA, reduce perceived exercise barriers, and improve their physical fitness through systematic and sustainable instructional design. The findings are expected to offer empirical evidence and practical insights for optimizing university PE curricula and fostering students' long-term engagement in physically active lifestyles.

Materials and Methods
Participants
A total of 133 university students (72 males and 61 females) from Hanshan Normal University in China were recruited as participants. These students were all sophomores, came from 12 faculties, and were randomly assigned to four teaching classes. Two classes were randomly designated as the experimental group, while the remaining two served as the control group, with each class consisting of approximately 30 to 35 students. During the experiment, four participants in the experimental group missed classes for at least two weeks or failed to

complete at least 75% of the assigned tasks and were therefore excluded from the study. In addition, four participants in the control group missed the posttest and were also excluded. In the end, a total of 125 participants effectively completed the experiment.

Instruments

Two questionnaires and one set of electronic physical fitness testing equipment were employed in the research and served as the primary research instruments of this study. The International Physical Activity Questionnaire-Long Form Chinese version (IPAQ-LC) was adopted to measure the PA level of university students. IPAQ was available in multiple language versions (www.ipaq.ki.se) and had been tested for reliability and validity across 12 countries. In the previous studies of this research, a four-week test–retest was conducted among 158 university students, and the results demonstrated good reliability and validity. The ICCs for walking, moderate, vigorous, and total PA-MET ranged from 0.725 to 0.883, and the Spearman correlation coefficients (ρ) ranged from 0.728 to 0.839 (Chen & Kasim, 2025). The data collected through the questionnaire were scored using both continuous and categorical approaches according to the Guidelines for Data Processing and Analysis of IPAQ (www.ipaq.ki.se/scoring.pdf). Each individual's PA-MET minutes/week score was used to determine their PA level.

The Self-Efficacy for Exercise (SEE) Scale was employed in this study to measure participants' perceived ability to overcome barriers and maintain regular exercise, thereby assessing the acceptability of the newly developed module. The SEE scale is a self-report instrument designed to evaluate individuals' confidence in maintaining their exercise habits. It consists of nine items, each rated on a scale from 0 ("not confident") to 10 ("very confident"). The total score is obtained by summing the responses to all items, with possible scores ranging from 0 to 90. Higher scores indicate greater self-efficacy for exercise. Prior research demonstrated strong internal consistency ($\alpha = 0.92$; Resnick & Jenkins, 2000). In the previous studies of this research, the SEE scale also displayed excellent reliability (Cronbach's $\alpha = 0.900$; Spearman–Brown $\rho = 0.874$) and construct validity (KMO = 0.905). Exploratory factor analysis further confirmed the adequacy of its factor structure, indicating that the SEE scale is a reliable and valid instrument.

The TSN200 professional electronic physical fitness testing system was employed to assess participants' PF in this study. This system comprised multiple testing subsystems, including height/weight measurement, vital capacity assessment, sit and reach flexibility, one-minute sit-ups, pull-ups, standing long jump, 50m run, 800m run, and 1000m run. The system was developed and generated by Beijing Fitness Sports Technology Co., Ltd. (http://www.bjtsn.com). The TSN200 provided precise measurements of participants' PF parameters and generated immediate test results. The system had been reviewed and certified by the Chinese Ministry of Education and had been widely implemented in PF assessments and health evaluations for students at over 500 universities across China. All fitness test items and scoring criteria adhered to the National Physical Fitness Testing Standards established by the Chinese government.

Module Development Process
   Analysis Phase. This phase examined university students' current physical activity (PA), physical fitness (PF), exercise motivation, perceived barriers, and intervention needs.

Preliminary findings displayed that most students engaged in PA at a moderate level, typically participating in one 90-minute structured session per week, indicating insufficient activity. PF results revealed that most students achieved only a Pass level, with about 20% reaching Good or above, below national standards. Male students performed poorly in upper-body strength, muscular endurance, and flexibility, whereas females lacked core, lower-body strength, and cardiovascular endurance (Chen & Kasim, 2025).

In addition, most students were mainly driven by autonomous motivation—identified, integrated, and intrinsic regulation—reflecting personal value and internalized importance of PA. However, major barriers hindered consistent participation, including lack of willpower (63.35%), energy (59.77%), time (43.63%), and social influence (31.71%) (Chen & Kasim, 2025). These results correspond with prior findings emphasizing psychological and environmental constraints on exercise behavior (Ryan & Deci, 2000; Teixeira et al., 2012). These analyses provided key evidence and theoretical grounding for the subsequent design of the SDT-based teaching module.

Design Phase. In this phase, the teaching module was developed to address issues identified in the analysis phase, aiming to enhance university students' PA and PF. Grounded in SDT, the design sought to reduce perceived barriers and satisfy the basic psychological needs of autonomy, competence, and relatedness to foster sustained PA motivation. To ensure the design directly addressed the key problems identified in the analysis phase, Table 1 outlines the correspondence between problems and solutions.

Table 1

Design Phase: Identified Problems and Corresponding Strategies

Identified Issue	Design Strategy
1. Low frequency and duration of PA	Introduce structured out-of-class intervention tasks and weekly challenges to increase overall PA participation.
2. Poor physical fitness	Integrate key fitness components (strength, endurance, and flexibility) into PE sessions through moderate-to-vigorous activities.
3. Autonomous motivation (identified, integrated, intrinsic) is already present	Maintain and strengthen intrinsic motivation by incorporating peer-group competitions, collaborative games, and health knowledge sessions.
4. Lack of willpower	Provide self-selected tasks with progressively achievable goals to enhance persistence and intrinsic interest.
5. Lack of energy	Emphasize short and manageable exercise routines, offer energy-boosting options, and deliver motivational prompts.
6. Lack of time	Elevate the status of PA within academic life; provide flexible and time-efficient PA tasks; and encourage greater participation in campus sports activities
7. Negative social influence	Encourage participation in peer-group activities, team-based challenges, and campus-wide events to foster belonging and positive reinforcement.

Motivational strategies were embedded in structured PA practice, serving as both a validation of the theoretical model and a practical framework for improving fitness outcomes.

The module comprised two complementary components: in-class and out-of-class interventions. The in-class component was incorporated into regular PE sessions, featuring gamified, diverse, and moderately to vigorously intense activities lasting 20–30 minutes. The out-of-class component used a task-oriented approach, including weekly exercise challenges, health-related video prompts, and encouragement to engage in extracurricular PA.

Development Phase. The development phase aimed to transform the designed intervention plan into concrete and operable modules, ensuring that activities, materials, and implementation strategies could be systematically applied during the intervention. Based on the principles of SDT, the development process emphasized translating motivational strategies into practical training sessions, supplementary tasks, and supportive materials. Table 2 outlines the key outcomes of the development phase and illustrates the correspondence between the identified problems and the developed solutions.

Table 2
Development Phase: Teaching Module Components and Deliverables

Identified Issue	Deliverables
1. Low frequency and duration of PA	Weekly PA challenge tasks: mobile-based activity tracking.
2. Poor physical fitness	Standardized exercise packages (20–30 min fitness training); digital PA guides.
3. Autonomous motivation (identified, integrated, intrinsic) is already present	Peer-group competition modules; structured group games; health education resources.
4. Lack of willpower	Self-paced progress tracking templates; incremental goal-setting; motivational feedback system.
5. Lack of energy	Short-duration exercise video tutorials; online motivational reminders.
6. Lack of time	Micro-workout guidebook; flexible schedule templates for PE participation; Exercise included in course grades.
7. Negative social influence	Peer-support networks, team-based challenge, recognition and reward system.

The development consists of three steps. First, structured in-class activity plans were created, including 20–30-minute moderate-to-vigorous fitness training emphasizing variety (e.g., circuit, group challenges, gamified formats) to meet autonomy, competence, and relatedness needs. Second, out-of-class activities extended engagement through weekly exercise challenges, online health videos, and participation in extracurricular sports. These flexible, task-oriented activities reinforced habit formation. Finally, a motivational evaluation and reward mechanism based on course performance points was implemented to encourage completion of both in-class and out-of-class exercise tasks.

Implementation phase. This phase aimed to implement the developed instructional module in physical education (PE) classes and to examine its effectiveness. An 8-week intervention experiment was carried out, and participants were divided into experimental and control groups. The experimental group received the full teaching module, which was carried out in the natural context of a university physical education course to ensure ecological

validity. All sessions were delivered and supervised by the researcher, who coordinated in-class fitness training, assigned and monitored weekly out-of-class PA tasks, shared motivational and instructional videos, and provided continuous feedback and encouragement. The control group followed their regular PE curriculum without additional exercise guidance, motivational materials, or extra assignments, and was only contacted for pre- and post-tests. To ensure fidelity, the researcher maintained a detailed implementation log documenting attendance, task completion, engagement observations, and any deviations from the intervention plan with explanations. These field records provided a valuable reference for the real-time operation of the intervention and were also an important basis for evaluation.

Evaluation Phase. A summative evaluation was primarily employed to assess the teaching module in terms of its acceptability, feasibility, and effectiveness. Table 3 provides an overview of how these objectives were operationalized, specifying the evaluation focus, indicators, data sources, and assessment methods. To evaluate the acceptability, a questionnaire survey using the Self-Efficacy scale was conducted before and after the intervention experiment. The scale asked the experiment group's students to rate their confidence in completing the intervention tasks and their willingness to continue similar activities in the future.

Table 3
Summary of Evaluation Phase Objectives, Indicators, and Assessment Methods

Research Objective	Focus of Evaluation	Indicators / Measures	Assessment Methods
Examine the feasibility and acceptability of the teaching module among university students	Acceptability Feasibility	Self-efficacy change (experimental group, pre–post); Expert rating scores; Participant completion rate	Pre–post comparison within experimental group (self-efficacy); Expert ratings analysis (cvi, s-cvi/ave); Descriptive adherence metrics (completion rate over 8 weeks).
Verify the effectiveness of the teaching module in enhancing PA and PF levels	Effectiveness	Physical activity (PA) levels; Physical fitness (PF) outcomes	Pre- and post- questionnaires (PA); Pre- and post- PF tests; Inter-group (experimental vs. control) and intra-group comparisons

To systematically assess the feasibility of the teaching module in the university context, a quantitative analysis was employed based on two aspects: a panel of seven experts assessed the content of the module, employed the Content Validity Index (CVI) and the average scale-level CVI (S-CVI/Ave). The completion rate of participants in the experimental group was calculated, with feasibility defined as at least 75% of the participants completing the intervention. To evaluate the effectiveness of the teaching module in improving PA behaviors and PF outcomes, pre-test and post-test comparisons were conducted between the experimental group and control group. Statistical methods (e.g., paired sample t-test, independent sample t-test) were used to determine whether the experimental group had significant improvements in PA participation and PF compared to the control group.

Data Collection and Analysis
A quantitative research design was employed in this study, and two questionnaires were administered through an online survey format. Participants accessed the survey platform (Wenjuanxing) to complete the questionnaires. A total of 133 valid responses were collected during the pretest and 125 valid responses during the posttest. PF data were obtained through field-based measurements. The pretest yielded 133 valid PF records, whereas 125 valid records were collected in the posttest. In total, eight participants (four from the experimental group and four from the control group) did not complete the intervention experiment

Statistical analyses were performed using SPSS V27.0. Paired-sample t-tests and independent-sample t-tests were conducted to compare pretest and posttest differences between the experimental and control groups. The comparison indicators included participants' physical activity levels, SEE scores, and various components of PF. Before conducting the main analyses, the Kolmogorov–Smirnov test was used to examine the normality of all variables. The p-values ranged from 0.058 to 0.200, all exceeding the 0.05 threshold, indicating that the data followed a normal distribution.

Results
Composition of the Integrated PE Teaching Module
The Integrated PE Teaching Module was grounded in SDT and constructed following the ADDIE instructional design framework. Its primary aims were to increase students' participation in PA, improve PF, and foster autonomous PA motivation. In addition, an assessment and reward mechanism was integrated as a key component of the module to stimulate students' motivation for engaging in both in-class and out-of-class PA. The final Integrated PE Teaching Module consisted of five interrelated components, as illustrated in Figure 1.
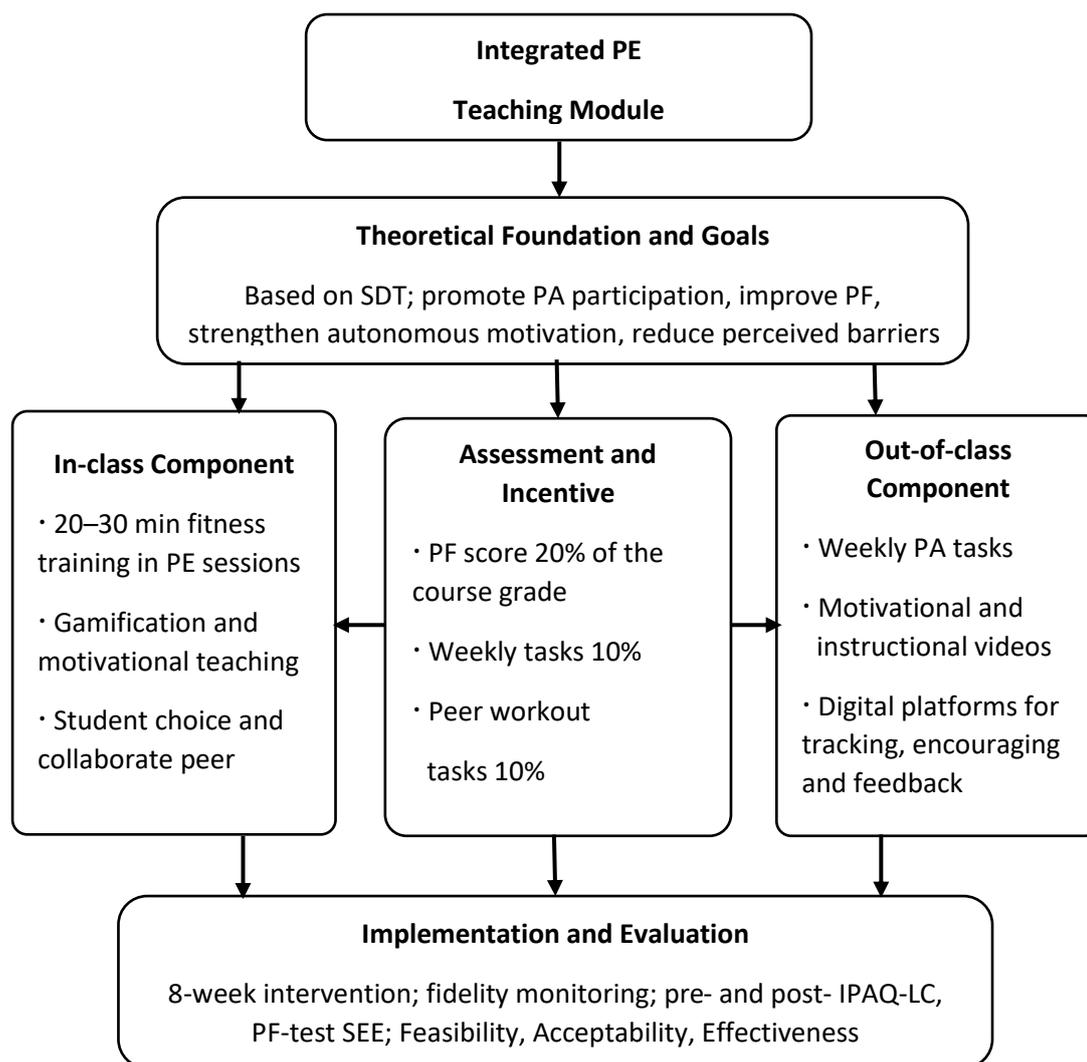
Figure 1 Integrated PE Teaching Module: In-Class and Out-of-Class

Theoretical Foundation and Goals. The Integrated PE Teaching Module is grounded in SDT, which posits that autonomy, competence, and relatedness are fundamental psychological needs driving behavior (Deci & Ryan, 2000, 2012). Satisfying these needs enhances autonomous motivation, leading to positive behavioral outcomes. SDT offers a strong framework for understanding and fostering motivation, guiding the module's design to meet students' PA needs and strengthen identified and integrated regulation. Empirical evidence from SDT-based PA interventions further informed its development. The module aims to increase university students' participation in PA and improve PF, while simultaneously promoting autonomous motivation and reducing perceived barriers as core intervention objectives.

Intervention Contents. The detailed in-class and out-of-class intervention contents of the module were formulated into an 8-week experimental plan, as presented in Table 4.

Table 4
Intervention Experimental Plan

Weeks	In-class (Teaching interventions)	Out-of-class (Assign exercise tasks)
Week1	**Pre-test** **(**PA level: IPAQ-LC; Self-Efficacy: SEE scale; PF score: PF test**)**	
Week2	1. 1 km jog. 2. Girls: 40s-plank × 2 sets, 20s rest. Boys: Push-ups, 15 × 2 sets, 20s rest. 3. 20m frog jumps × 2 sets, 1min rest.	1. 1.5km long-run × 2. 1 km ≤ 7 min. 2. Watch a video about Exercise and health. 3. Exercise with partners at least 2 times, 1 time ≥ 20 min.
Week3	1. Agility ladder exercises × 3 sets, 15s rest. 2. 20s Russian twist × 3 sets, 10s rest. 20s seated scissor kick×3 sets, 10s rest. 3. Game: 30m head-on relay run.	1. 1.5km run × 2, 1 km ≤ 7 min. 2. Exercise with partners at least 2 times. 3. Push scientific exercise knowledge and encouragement through WeChat groups.
Week4	1. 30s Quick high leg raise ×3 sets, 15s rest. 2. 30-meter sprint × 2 sets, 1min rest. 3. Girls: Single pole Hanging×2 sets, 20s rest. Boys: Pull-ups, 7×3 sets, 30s rest.	1. 2km long-run × 2, 1 km ≤ 7 min. 2. Watch a video about the Olympic spirit. 3. Exercise with partners at least 2 times, 1 time ≥ 20 min.
Week5	1. Agility ladder exercises × 3 sets, 15s rest. 2. 20s Russian twist × 3 sets, 15s rest. 20s seated scissor kick ×3 sets, 15s rest. 3. 5×10m Shuttle run × 2 sets, 1min rest.	1. 2km long-run × 2, 1 km ≤ 7 min. 2. Exercise with partners at least 2 times, 1 time ≥ 20 min. 3. Push scientific exercise knowledge and encouragement through WeChat groups.
Week6	1. 6-point step movement 12× 2 sets, 1min rest. 2. Girls: 40s-plank × 2 sets, 20s rest. Boys: Push-ups, 15 × 3 sets, 20s rest. 3. Game: Standing long jump relay.	1. 2km long-run × 2, 1 km ≤ 7 min. 2. Watch videos about Regular exercise and lifestyle. 3. Exercise with partners at least 2 times, 1 time ≥ 20 min.
Week7	1. 30s Quick high leg raise ×3 sets, 15s rest. 2. 30-meter sprint × 2 sets, 1min rest. 3. Girls: Single pole Hanging×3 sets, 20s rest. Boys: Pull-ups, 8 × 3 sets, 30s rest.	1. 2km long-run × 2, 1 km ≤ 7 min. 2. Exercise with partners at least 2 times, 1 time ≥ 20 min. 3. Push scientific exercise knowledge and encouragement through WeChat groups.
Week8	1. 6-point step movement 12×2 sets, 1min rest. 2. 20s Russian twist × 3 sets, 15s rest. 30s Prone jumping jack × 3sets, 15s rest. 3. Game: 30m head-on relay run.	1. 2km long-run × 3, 1 km ≤ 7 min. 2. Watch videos about Exercise habit formation. 3. Exercise with partners at least 2 times.
Week9	1. Agility ladder exercises × 3 sets, 15s rest. 2. Girls: 1minute Sit-ups × 2 sets, 30s rest. Boys: Push-ups, 15×3 sets, 30s rest. 3. 5×10m Shuttle run × 2 sets, 1min rest.	1. 2km long-run × 3, 1 km ≤ 7 min. 2. Exercise with partners at least 2 times, 1 time ≥ 20 min. 3. Push scientific exercise knowledge and encouragement through WeChat groups.
Week10	**Post-test** **(**PA level: IPAQ-LC; Self-Efficacy: SEE scale; PF score: PF test**)**	

Assessment and Incentive Mechanisms. To guide and sustain student engagement, a structured performance-based reward system was implemented for both in-class and out-of-class activities. Incentive details were communicated to the experimental group before the intervention. First, the final PF test accounted for 20% of the PE course grade. Second, weekly long-distance running tasks completed outside class contributed 10% of the grade, requiring a pace not slower than 7 minutes per kilometer. Participants submitted running app screenshots as verification; each completed week earned 1%, with the 8th and 9th weeks worth 2% each. Third, exercising with peers (excluding the 2 km run) comprised 10% of the grade, with 1% awarded for every two verified sessions lasting at least 20 minutes. Participants were required to submit group exercise photos. Finally, participation in official sports competitions or events organized by universities or higher institutions earned an additional 5% per event, up to a maximum of 10%, with valid proof required.

Implementation Strategies and Evaluation Indicators. The 8-week intervention was conducted in a natural university setting using an experimental–control group design. Students were randomly assigned to either the experimental group, which received the intervention, or the control group, which continued regular PE classes. For the experimental group, a WeChat communication group was established to facilitate coordination and support. The intervention's content, procedures, and evaluation criteria were clearly explained, and students with health limitations or unable to perform high-intensity activities were excluded. Participants absent for two weeks or completing less than 75% of the assigned tasks were also excluded. An online course was created on the Xuexitong platform to assist instruction, and all experimental group participants were required to join.

All classes were taught by the researcher, who also conducted pre-tests, implementation, and post-tests. Except for the intervention content, teaching materials, timing, and measurement tools were identical for both groups. Experimental participants submitted weekly exercise task results, which the researcher verified and used to provide individualized feedback and motivation. Pre- and post-tests were conducted for all participants. Self-efficacy, PA level, and PF were selected as evaluation indicators. Self-efficacy was assessed using the SEE scale, and PA level was measured with the IPAQ-LC. PF was tested by a professional team according to the National Student Physical Fitness Standard (NSPFS). The reliability and validity of all measures had been previously established. Differences between groups and between pre- and post-tests were analyzed to evaluate the effectiveness of the Integrated PE Teaching Module.

Feasibility of the Integrated PE Teaching Module
In this study, the item-level content validity index (I-CVI) and Scale-Level Content Validity Index, Average method (S-CVI/Ave) were used to assess the relevance of each item based on expert ratings. According to Polit, Beck, and Owen (2006, 2007), an I-CVI of ≥ 0.86 and an S-CVI/Ave of ≥ 0.90 were considered acceptable, indicating good scale-level content validity for the panel of seven experts.

As shown in Table 5, the I-CVI of nine indicators ranged from 0.86 to 1, all met the acceptable threshold, and the S-CVI/Ave was 0.952, higher than 0.90, indicating excellent content validity. Additionally, the mean ratings provided by the seven experts for the nine indicators ranged from 4.00 to 4.57, indicating that the experimental plan received positive

evaluations. Furthermore, the Coefficient of Variation (CV) for each indicator was all below 0.20, indicating a high level of consistency among the experts' evaluations of these indicators.

In addition, a total of 67 participants in the experimental group were initially enrolled in the intervention. Four participants were excluded during the implementation process, resulting in 63 students who completed the entire intervention. The completion rate reached 94.03%, providing additional support for the feasibility of the teaching module among university students.

Table 5
Expert Rating of Teaching Module

Experts Indicators	A	B	C	D	E	F	G	M	SD	CV	I-CVI	S-CVI /Ave
1.Fesitable	5	5	4	4	5	5	4	4.57	0.53	0.12	1	
2. Targeted	4	4	4	3	4	4	5	4.00	0.58	0.14	0.86	
3. Effectively	4	5	5	4	5	4	4	4.43	0.53	0.12	1	
4. In-class affect PF	4	5	5	5	4	4	5	4.57	0.53	0.12	1	
5. Enhance autonomy	5	5	4	4	5	5	4	4.57	0.53	0.12	1	0.95
6. Out-of-class affect PF	4	4	5	4	5	4	4	4.29	0.49	0.11	1	
7.No negativity	5	4	4	4	3	4	4	4.00	0.58	0.14	0.86	
8. Completable	4	4	5	4	4	5	3	4.14	0.69	0.17	0.86	
9. Beneficiality	4	5	5	4	4	4	5	4.43	0.53	0.12	1	

Note, M, Mean, SD, Standard Deviation; CV, Coefficient of Variation, CV = SD/M; I-CVI, Item-Level Content Validity Index; S-CVI/Ave, Scale-Level Content Validity Index, Average method, S-CVI/Ave = ∑I-CVI/Items.

Acceptability of the Integrated PE Teaching Module
The teaching module's acceptability among university students was assessed by comparing participants' self-efficacy before and after the experiment. A pre- and post-test asked, "How confident are you in completing a similar physical activity intervention?" Results (Table 6) showed that the experimental group's mean SEE score increased significantly from 42.24 to 51.38, a gain of 9.14 points ($p = 0.000$), indicating a statistically significant improvement. The large effect size (Cohen's $d = 1.54$) further supported this result. Post-intervention, the mean SEE score exceeded the overall average score of 45, reflecting a notable rise in confidence. These findings demonstrate that participants sustained strong confidence in completing the intervention despite potential challenges, confirming the module's acceptability among university students.

Table 6
Participants' SEE Score Between Pre-Test and Post-Test

Variable		Experimental group				
		Mean	ΔM	T	*P*	Cohen's d
SEE Score	Post-	51.38	9.14	12.296	0.000	1.54
	pre-	42.24				

Note, post-, post-test; pre-, pre-test; ΔM, the difference between post-mean and pre-mean; T, t-test. Cohen's d, 0.20, 0.50 and 0.80 correspond to small, medium and large critical points, respectively.

Effectiveness of the Integrated PE Teaching Module
Pre-test Comparison. There was no significant difference in PA-MET, PF score and SEE scores between the experimental and control groups in the pre-test. As shown in Table 7, the independent samples t-test results for three variables yielded p-values of 0.715, 0.673, and 0.934, all greater than 0.05, confirming that the difference between the two groups was not statistically significant. This indicates that both groups were comparable across all indicators before the intervention.

Table 7
Participants' PA-MET, PF Score and SEE Score in Pre-Test

Variables	Groups	Mean	SD	T	*P*
Total PA-MET	EG	2815.81	1258.76	-0.366	0.715
	CG	2898.91	1278.98		
PF score	EG	71.20	9.37	0.423	0.673
	CG	70.48	9.65		
SEE scores	EG	42.24	11.825	0.083	0.934
	CG	42.06	11.436		

Note, SD, Standard Deviation; T, t-test. EG, Experimental Group, CG, Control Group

Within-group Changes. Table 8 presents the changes in Total PA-MET and SEE score of the experimental and control groups before and after the experiment. After the experiment, After the intervention, the experimental group's Total PA-MET and SEE scores increased significantly by 649.59 and 9.14, respectively (p = 0.000, p < 0.05). In contrast, the control group's Total PA-MET decreased significantly by 240.17, while no significant change was observed in its SEE score (p = 0.079, p > 0.05).

Table 8
Participants' PA-MET Between Pre-Test and Post-Test

Variables		Experimental group				Control group			
		Mean	ΔM	T	*P*	Mean	ΔM	T	*P*
Total PA-MET	post-	3465.40	649.59	6.728	0.000	2658.74	-240.17	-2.500	0.015
	pre-	2815.81				2898.91			
SEE score	post-	51.38	9.14	12.296	0.000	43.45	1.39	1.789	0.079
	pre-	42.24				42.06			

Note, post-, post-test; pre-, pre-test; ΔM, the difference between post-mean and pre-mean; T, t-test.

Table 9 demonstrates the pre- and post-intervention PF score changes. The experimental group's mean PF score increased by 5.15 (p = 0.000), indicating a significant improvement. Mean gains in PF sub-items ranged from 0.67 to 10.84, with most showing statistical significance except for the 800m and 1000m runs (p = 0.591 and 0.488, respectively). In contrast, the control group's mean PF score showed minimal change (−0.02, ns), with sub-indicator differences from −6.29 to 12.08. Vital capacity improved significantly by 4.85 (p = 0.017), while standing long jump, 800 m run, and 1000 m run declined significantly by 5.26, 6.29, and 4.23 (p = 0.009, 0.010, and 0.012, respectively). No significant differences were observed in BMI, 50 m run, sit-and-reach, or 1-minute sit-up performance.

Table 9

Participants' PF Score Between Pre-Test and Post-Test

Variables		Experimental group				Control group			
		Mean	ΔM	T	*P*	Mean	ΔM	T	*P*
BMI score	post-	95.24	2.86	3.215	0.002	92.26	0.00	0.000	1.000
	pre-	92.38				92.26			
Vital capacity score	post-	83.43	6.67	3.373	0.001	80.18	4.85	2.466	0.017
	pre-	76.76				75.32			
50m run score	post-	80.40	4.10	3.628	0.001	74.82	**-0.05↓**	-0.025	0.980
	pre-	76.30				74.87			
Stand long jump score	post-	63.56	3.22	2.127	0.037	57.87	**-5.26↓**	-2.713	**0.009**
	pre-	60.33				63.13			
Sit and reach score	post-	83.98	6.40	3.344	0.001	80.08	3.48	1.353	0.181
	pre-	77.59				76.60			
800m run score	post-	35.16	0.67	0.540	**0.591**	22.73	**-6.29↓**	-2.677	**0.010**
	pre-	34.49				29.02			
1000m run score	post-	33.46	0.94	0.698	**0.488**	33.53	**-4.23↓**	-2.588	**0.012**
	pre-	32.52				37.76			
1min sit-ups score	post-	32.40	5.39	3.286	0.002	27.71	1.45	0.990	0.326
	pre-	27.02				26.26			
pull-up score	post-	17.51	10.84	3.958	0.000	16.27	12.08	4.294	0.000
	pre-	6.67				4.19			
PF score	post-	76.3548	5.15	10.943	0.000	70.4685	**-0.02↓**	-0.018	0.985
	pre-	71.2032				70.4839			

Note, post-, post-test; pre-, pre-test; ΔM, the difference between post-mean and pre-mean; T, t-test.

Post-test Comparison Between Groups. After eight weeks of intervention, a significant difference in PA-MET and SEE scores was observed between the experimental and control groups. As shown in Table 10, the experimental group's mean Total PA-MET (3,465.40) exceeded that of the control group (2,658.74), with a significant difference (p = 0.000, Cohen's d = 0.682). Similarly, the experimental group's mean SEE score (51.38) was higher than the control group's (43.45), also showing a significant difference (p = 0.000) and a large effect size (Cohen's d = 0.791).

Table 10
Participants' PA-MET and SEE Score After Experiment

Variables	Groups	Mean	SD	T	P	Cohen's d
SEE Score	EG	51.38	9.947	0.764	0.000	0.791
	CG	43.45	10.102			
Total PA-MET	EG	3465.40	1146.14	3.812	0.000	0.682
	CG	2658.74	1219.25			

Note, SD, Standard Deviation; T, t-test. EG, Experimental Group, CG, Control Group. Cohen's d, 0.20, 0.50 and 0.80 correspond to small, medium and large critical points, respectively.

Table 11
Participants' PF Score After Experiment

Components	PF index	Groups	Mean	SD	T	P	Cohen's d
Body Shape	BMI score	EG	95.24	9.98	1.423	0.157	0.255
		CG	92.26	13.23			
Physical Function	Vital capacity score	EG	83.43	13.13	1.268	0.207	0.227
		CG	80.18	15.45			
Speed	50m run score	EG	80.40	10.87	2.116	0.036	0.379
		CG	74.82	17.81			
Bounce	Stand long jump score	EG	63.56	22.10	1.511	0.133	0.270
		CG	57.87	19.88			
Flexibility	Sit and reach score	EG	83.98	10.78	1.673	0.097	0.299
		CG	80.08	15.00			
Endurance	800m run score	EG	35.16	37.94	1.974	0.050	0.353
		CG	22.73	32.18			
	1000m run score	EG	33.46	35.20	-0.012	0.991	-0.002
		CG	33.53	33.51			
Strength	1min sit-ups score	EG	31.89	33.25	0.703	0.484	0.126
		CG	27.71	33.24			
	Pull-up score	EG	17.51	29.40	0.242	0.809	0.043
		CG	16.27	27.52			
All	PF score	EG	76.35	8.92	3.450	**0.001**	**0.617**
		CG	70.47	10.13			

Note, SD, Standard Deviation; T, t-test. EG, Experimental Group, CG, Control Group. Cohen's d, 0.20, 0.50 and 0.80 correspond to small, medium and large critical points, respectively.

Table 11 presents the post-test PF scores and component scores for both groups. The experimental group showed a significantly higher mean PF score (76.35) than the control group (70.47; p = 0.001, Cohen's d = 0.617), indicating a medium effect. Except for Endurance (1000m run), all PF sub-index means were higher in the experimental group; however, only Speed (50m run) showed a significant difference (p = 0.036, Cohen's d = 0.379). Other PF components showed no significant differences. The significant overall PF difference may reflect the cumulative effect of minor, nonsignificant improvements across individual indicators.

Discussion

The Integrated PE Teaching Module

The module comprised three interrelated components—in-class training, out-of-class tasks, and an evaluation-based incentive mechanism—grounded in SDT. According to Deci and Ryan (2000, 2012), satisfying autonomy, competence, and relatedness fosters self-determined motivation and sustained behavioral engagement. The in-class component adopted structured moderate-to-high intensity interval training, supported by studies confirming its efficacy in enhancing students' physical fitness (Yun, 2021; Xu & Sun, 2021; Li et al., 2023; Wen, 2023; Sun et al., 2025). Gamified activities and peer collaboration were integrated to promote autonomy and relatedness, thereby improving both performance and learning motivation. This is consistent with findings by Arufe-Giráldez et al. (2022) and Harris (2019) that gamified blended PE enhances fitness and intrinsic motivation.

The module also linked the PF assessment with academic performance through grade-based incentives and competitive rewards, offering clear goals and feedback that enhanced competence. Similar to the PESO trial (Fortier et al., 2012) and findings by Ntoumanis and Moller (2025), such SDT-supportive and credit-based environments can effectively promote persistence in physical activity. To extend engagement beyond class, the module utilized digital tools (Xuexitong, WeChat, and a fitness app) for task tracking, teaching videos, and performance feedback. These media, together with peer-supported tasks, enhanced enjoyment and relatedness, aligning with Wang and Chen (2022), who found that peer support fosters autonomous motivation. Likewise, Althoff et al. (2017) noted that online social competition boosts short-term participation, supporting the module's digital incentive design.

In summary, this integrated PE teaching module, anchored in SDT principles and empirical evidence, strengthened autonomy (gamified, peer tasks), competence (feedback and incentives), and relatedness (collaborative and digital engagement). By converting PF outcomes into academic rewards, the module fostered autonomous motivation, sustained participation, and elevated the perceived academic value of PE—demonstrating a scalable SDT-based approach for enhancing students' fitness and motivational quality.

Feasibility and Acceptability of the Module

This study provides strong evidence for the feasibility and acceptability of the Integrated PE Teaching Module among university students. The high I-CVI values (0.86–1.00) and overall S-CVI/Ave (0.952) met Lynn's (1986) validity standard (>0.78) for excellent item relevance, confirming strong expert consensus (Polit & Beck, 2006). Moreover, a low coefficient of variation (CV < 0.20) across all indicators reflected consistent expert evaluation, indicating that the module's design was coherent, targeted, and professionally acceptable.

In terms of implementation, the 94.03% completion rate among the experimental group demonstrated high feasibility, surpassing rates reported in similar interventions. For instance, Yan (2021) reported an 83% completion rate in an 8-week peer health coaching study, while Kelley and Kelley (2013) noted about 20% dropout in exercise-only programs. These comparisons suggest that the module's integrative and adaptable structure effectively promoted sustained engagement. Regarding acceptability, the significant increase in exercise self-efficacy (Cohen's d = 1.54) not only indicated statistical significance but also strong

practical relevance, exceeding the threshold for a large effect (Cohen, 1988). This improvement reflected enhanced psychological readiness and confidence for physical activity, consistent with previous SDT-based PE findings that promoted persistence and self-confidence (Ntoumanis et al., 2017; Teixeira et al., 2020; Ntoumanis & Moller, 2025).

Overall, these findings validate the feasibility and acceptability of the module while extending prior research. Unlike earlier studies focused solely on structured or extracurricular programs, this hybrid module integrated formal PE with SDT-based motivational strategies, achieving greater sustainability and contextual adaptability. Nevertheless, as results were derived from a single institution, replication across diverse university settings is recommended to strengthen external validity.

Effectiveness of the Module
Post-test analysis revealed that the experimental group displayed significantly higher PA-MET, PF, and SEE scores than the control group, while no pre-test differences existed, indicating that improvements were attributable to the intervention rather than group factors. These results confirmed the effectiveness of the module in enhancing PF and motivation toward PA.

This finding aligns with prior studies demonstrating that structured, theory-based interventions substantially improve students' PA and PF. Yüksel et al. (2020) found that systematic school-based interventions effectively enhanced PF and reduced obesity risk. Similarly, Li et al. (2023) showed that a 12-week PE program integrating functional training improved students' speed, coordination, and strength, suggesting that even short, structured sessions yield measurable benefits. Numerous systematic reviews have confirmed that comprehensive interventions enhance participation and PF (Shaikh & Mondal, 2012; Baron et al., 2020; Türker & Yüksel, 2021; Lu et al., 2021; Vasconcellos et al., 2020; Rhodes, 2022). However, unlike most prior studies that focused solely on physical outcomes, the present research integrated Self-Determination Theory (SDT) principles to simultaneously target motivational and behavioral dimensions. This dual-focus approach may explain the greater improvements observed in both physical and psychological indicators.

Overall, the results provide robust evidence for the effectiveness of the modules in enhancing PF and PA participation among university students. More importantly, they bridge the gap between traditional fitness-oriented and motivation-centred approaches, offering a comprehensive model for addressing persistent PA in higher education.

Limitations in Endurance Improvement
The findings revealed that the intervention failed to significantly enhance students' 800 m and 1000 m run scores, both of which assess aerobic endurance. Prior studies suggest that endurance improvement requires structured, progressive training with sufficient volume and duration (Stöggl & Sperlich, 2015). Interventions emphasizing mainly moderate or low-intensity activity may lack the progressive overload needed for aerobic adaptation (Seiler, 2010; Tsz-Chun Poon et al., 2024). Although low-volume HIIT can improve cardiorespiratory fitness in short periods, sustained enhancement requires longer and more intense stimuli (Sabag et al., 2022).

In this study, participants completed 2 km runs twice weekly at a 7 min/km pace, classified as low-to-moderate intensity according to the American College of Sports Medicine (Ozemek et al., 2025). While this ensured feasibility and safety, it may have been insufficient to elicit significant aerobic adaptation. Moreover, endurance development typically requires longer training durations than anaerobic performance (Sabag et al., 2022), and the 8-week timeframe likely limited improvements. Another plausible explanation is that some students may not have exerted maximal effort, as these endurance tests posed substantial challenges. Obviously, the 800 m and 1000 m run remain difficult areas for university students to improve. Future interventions should adopt longer, progressive endurance programs with adequate intensity to promote meaningful aerobic gains.

Conclusion

This study developed and validated an Integrated PE Teaching Module grounded in SDT and the ADDIE instructional design framework. The module consisted of three core components: in-class training, out-of-class tasks, and an evaluation-based incentive mechanism. The feasibility and acceptability of the module were well supported by empirical evidence. Seven expert validations showed high content validity (S-CVI/Ave = 0.952), and the participant completion rate reached 94.03%, indicating strong feasibility. Moreover, participants' self-efficacy in completing the experiment significantly improved (pre-test 42.24 to post-test 51.38, p = 0.000, d = 1.54), confirming the intervention's psychological acceptability.

Additionally, effectiveness was further tested through post-test data of an 8-week intervention experiment. The experimental group exhibited significantly higher Total PA-MET (3,465.40 vs. 2,658.74), SEE (51.38 vs. 43.45), and PF scores (76.35 vs. 70.47, p = 0.001) compared with the control group, providing strong evidence that the integrated module effectively enhanced students' PA engagement and fitness outcomes. However, endurance-related indicators (800m/1000m run) did not show significant improvements, likely due to the intervention's moderate intensity and limited 8-week duration. Future studies should extend intervention length, incorporate progressive aerobic training, and validate the model across diverse university contexts. Overall, the SDT–ADDIE-based Integrated PE Teaching Module demonstrates promising potential as a scalable, theory-driven approach for improving university students' motivation and physical fitness.

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