# Developing Physical Ability Curriculum Based on Exceeding Compensation to Enhance College Students' Sport Abilities

[1]Yuliang Zhang, and [2]Waiyawut Yoonisil

Graduate School, Srinakharinwirot University, Thailand

E-mail: zhang50325@126.com[1], wys959@gmail.com[2]

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## Abstract

Physical education is regarded as a crucial component of higher education in China. However, existing physical curriculums have not effectively improved college students' physical abilities, particularly in terms of strength, speed, endurance, and flexibility. This gap necessitates the development of a targeted curriculum to address these shortcomings. This study aimed to develop a Physical Ability Curriculum primarily based on exceeding compensation theory, designed to enhance college students' physical abilities (strength, speed, endurance, and flexibility) and to evaluate its effectiveness. This study employed a mixed-methods approach. A sample of 120 college students from Zhanjiang University of Science and Technology in Guangdong Province, China, participated in the study. Data were collected through literature review and physical ability tests. The data were analyzed using content analysis and comparative statistics to develop the curriculum and assess the impact of the curriculum. Based on the results, the development process of Physical Ability Curriculum includes five components, which are Overview, Necessity, and Feasibility Analysis, the Principle of Curriculum, Curriculum Content, Curriculum Implementation, and Assessment and Evaluation. Moreover, the results show that the implementation of the Physical Ability Curriculum significantly improved students' physical abilities, including strength, speed, endurance, and flexibility. The systematic approach used in developing the curriculum ensured measurable and consistent improvements. The study demonstrates that a well-designed Physical Ability Curriculum can effectively enhance college students' physical abilities. It provides a strong theoretical and practical framework for improving college physical

education programs, offering significant implications for future research and practice in physical pedagogy. This study also provides insights for developing targeted curricula in other disciplines.

**Keywords:** Physical Abilities; Physical Abilities Curriculum; Exceeding Compensation theory; College Physical Education

## Introduction

In recent years, there has been a growing emphasis on refining physical education curriculum to enhance the effectiveness of sports training programs among college students (Yang, 2023). Central to this endeavor is the concept of "exceeding compensation", which proposes a strategy for boosting athletic performance and physical ability. This approach involves designing training programs that challenge individuals to surpass their current capacities, thereby triggering physiological adaptations that lead to improved athletic prowess (Gu, 2017; Korey, 2019).

While traditional physical education curricula typically aim to maintain or enhance existing abilities, exceeding compensation suggests that optimal athletic development occurs when individuals are pushed beyond their current limits (Wang et al., 2023). By strategically integrating elements of overload and progression into training regimens, educators can stimulate physiological adaptations that result in significant gains in strength, endurance, agility, and overall athletic performance (Wang & Dong, 2023). The relevance of this approach is particularly pronounced in the context of college students, who represent a demographic with substantial potential for physical development. However, despite the theoretical promise of exceeding compensation, empirical research on its application within physical education curriculum, especially at the college level, remains scarce (Huang, 2022). Consequently, there is a critical need for comprehensive studies that investigate the efficacy and practical implications of developing physical ability curriculum based on the principles of exceeding compensation (Shi et al., 2022).

Despite the fact that previous studies have applied Constructivist Theory, Exceeding Compensation Theory, Blended Teaching Theory, and Self-Efficacy Theory in physical ability education (e.g., Dierdorff et al., 2010; Li et al., 2019; Yang, 2023), these theories have largely been employed independently or in parallel, lacking a systematic and integrative framework. This fragmented approach limits the potential for creating cohesive and effective curriculum aimed at enhancing physical abilities among university students. Moreover, although Exceeding Compensation Theory has been widely explored in the context of sports training, its application within college physical education remains under-researched (Mukhopadhyay, 2021; Wada et al.,

2020). Given the substantial physical development potential of college students, this theory offers a promising avenue for optimizing training programs. By integrating the principles of overload and progression into tailored curriculum, educators can stimulate physiological adaptations that address individual strengths and weaknesses, leading to measurable improvements in strength, speed, endurance, and flexibility (Hughes et al., 2017).

This paper aims to bridge these gaps in the literature by proposing a novel approach to designing physical education curriculum tailored to enhancing college students' athletic abilities through exceeding compensation. Drawing upon insights from exercise physiology, sports science, and educational psychology, we outline a systematic framework for developing and implementing curriculum interventions that maximize athletic development and performance outcomes. Through a synthesis of theoretical analysis, practical recommendations, and empirical evidence, this paper endeavors to equip educators and sports practitioners with valuable insights into the design and implementation of effective physical education programs that prioritize exceeding compensation. By deepening our understanding of the underlying mechanisms driving athletic adaptation and performance enhancement, we aspire to empower educators to optimize the physical development of college students and support their journey toward achieving peak athletic performance.

## Research Objectives

1. To develop a Physical Ability Curriculum to enhance college students' physical abilities by improving their strength, speed, endurance, and flexibility.

2. To study the effectiveness of Physical Ability Curriculum in enhancing students' physical abilities.

## Literature Review

### Physical ability

The term "physical ability" encompasses a multifaceted concept related to individuals' capacity to engage in activities requiring various attributes such as speed, endurance, power, and flexibility. It pertains to both motor skills and overall well-being, categorizing into movement skills-related attributes including speed, strength, agility, neuromuscular coordination, and balance, and health-related qualities encompassing cardiorespiratory endurance, flexibility, muscle strength, muscle endurance, and body composition (Columbia University, 2023). Physical ability is crucial for

participation in sports, everyday tasks, and maintaining overall health and vitality. The enhancement of physical ability involves a systematic approach, integrating training programs targeting different aspects such as strength, speed, flexibility, balance, agility, coordination, and endurance. This comprehensive understanding of physical ability serves as the foundation for designing effective physical education curriculum, aiming to develop students' athletic skills, overall physical fitness, and lifelong commitment to healthy behaviors (Huang, 2017). The physical fitness test includes several key indicators to comprehensively assess an individual's physical abilities. These indicators are BMI score, vital capacity results, performance in the 50–meter sprint, sit and reach, standing long jump, sit–up performance, and performance in the 800/1000–meter running test. These indicators together provide a comprehensive overview of an individual's physical abilities (Ministry of Education of the People's Republic of China, 2014).

**Theoretical background**

This study is underpinned by a theoretical framework that combines Constructivist theory, Exceeding compensation Theory, Blended Teaching theory, and Self–Efficacy theory. This integrated approach provides the groundwork for devising a Physical Ability Curriculum aimed at improving college students' physical capabilities.

Constructivism theory: Constructivism theory posits that students do not passively acquire knowledge through direct information transmission (Roschelle, 1997). Instead, they integrate new information with existing knowledge through experience and social interaction to construct understanding. In teaching, constructivism theory is recommended, where teachers facilitate students in creatively constructing meaning (Bada & Olusegun, 2015). Learners develop knowledge by asking questions, analyzing problems, solving them, reflecting, planning, and engaging in student–centered teaching to take control of their own learning, thus developing knowledge (Schreiber & Valle, 2013). Through constructivist approaches, learners can effectively master and apply knowledge. Teachers should implement educational theoretical models to support effective teaching methods and ensure genuine learning outcomes in physical education (Casey & MacPhail, 2018). The theoretical foundation of constructivism underpins the overall research framework, design of implementation strategies, research contents, and assessment methods in this study. It serves as the fundamental theoretical framework for this research endeavor.

Exceeding compensation theory: the exceeding compensation theory suggests that after proper physical activity, muscles may recover beyond their pre–exercise state, including strength,

structure, and function, with adequate rest (Jensen & Richter, 2012). This compensation phase involves increased muscle glycogen utilization and a period of exceeding compensation, where the body consumes more substances than initially (Deeb et al., 1992). Following 3–5 months of exceeding compensation training, middle to long-distance running exercises during the "exceeding compensation" phase have shown enhanced athletic performance (Thomas et al., 2016). Research indicates rapid phosphocreatine and muscle glycogen compensation post-exercise, along with excessive protein restoration after strength training (Thomas et al., 2016). This approach emphasizes enhancing sports performance through intensified training and energy expenditure (Gu, 2017). Exceeding compensation is integral to athletic training, signifying the body's adaptation to increased physical stress. It provides a theoretical basis for improving athletes' abilities through energy metabolism (Bompa, 2011). Through moderate stimulation, the body adapts, leading to fluctuations in exceeding compensation and internal balance (Gu, 2017). Integrating exceeding compensation concepts in physical education can enhance students' athletic abilities and overall health (Kasper, 2019).

Blended teaching theory: Blended teaching theory combines traditional classroom methods with modern AI-powered learning tools, aiming to enhance student learning experiences (Graham et al., 2013). It involves designing courses that strike a balance between online and face-to-face interactions (Ma'arop & Embi, 2016). Blended learning has been successfully applied in vocational education, introducing new strategies to improve student learning outcomes (Powell et al., 2015). By integrating online instruction, face-to-face teaching, and practice sessions, learners can deepen their understanding of course material (Cheung et al., 2010). This approach overcomes constraints of time and space, optimizing sports training effectiveness through a combination of traditional and digital learning methods.

Self-efficacy theory: Self-efficacy theory revolves around individuals' beliefs in their ability to successfully perform tasks (Wang et al., 2016). It influences health behaviors and academic performance (Rogers et al., 2020). Students with high self-efficacy demonstrate better physical health and motivation towards physical activity (Dierdorff et al., 2010). This theory suggests that altering self-motivation levels can impact individuals' perseverance and effort exertion based on task difficulty (Robinson et al., 2016). Therefore, understanding and enhancing self-efficacy are crucial in promoting healthier behaviors and improving task performance.

While previous studies have attempted to apply Constructivist theory, Exceeding compensation Theory, Blended teaching theory, and Self-efficacy theory in physical ability

education (e.g., Dierdorff et al., 2010; Li et al., 2019; Yang, 2023), these theories are often used in parallel or independently, lacking systematic integration. Therefore, this study aims to combine these theories with teaching methods to develop a curriculum aimed at enhancing physical abilities among Chinese university students.

Additionally, there is limited research specifically addressing the application of the Exceeding compensation theory in college physical education. While this theory has predominantly been studied in the context of sports training, its potential relevance to physical education among college students remains an area for further exploration and investigation. Integrating this theory into the design of physical education curriculum for university and college students could offer valuable insights into optimizing training programs to address individual strengths and weaknesses, thereby enhancing overall physical abilities and fitness levels.

## Conceptual Framework

This research employed a mixed methods approach. The researchers defined the research conceptual framework based on Constructivist theory, Exceeding compensation theory, Blended teaching theory, and Self-efficacy theory to develop a Physical Ability Curriculum to enhance college students' physical abilities by improving their strength, speed, endurance, and flexibility. The details are shown in Fig.1.

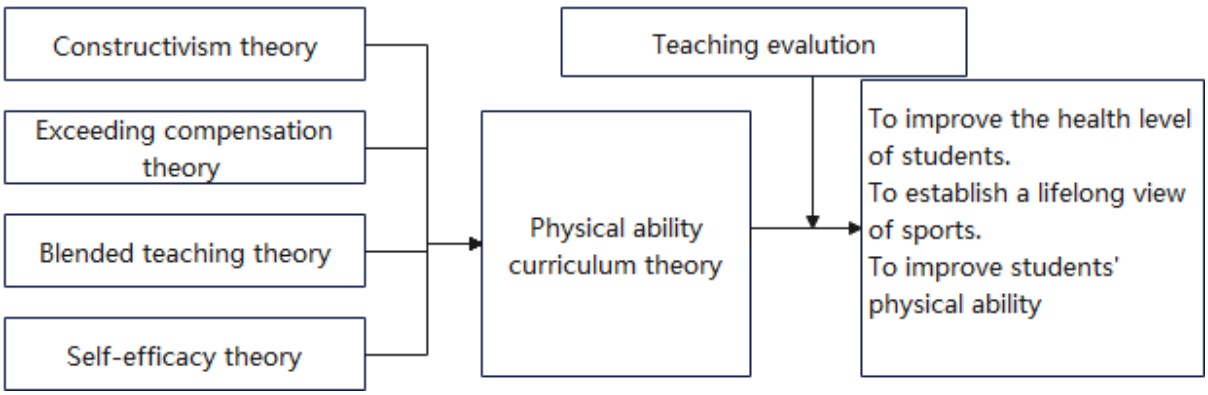


**Fig.1** Conceptual Framework

## Research Methodology

### Research Design

In this study, a mixed methods approach was employed, and the research design is outlined in Fig.2:

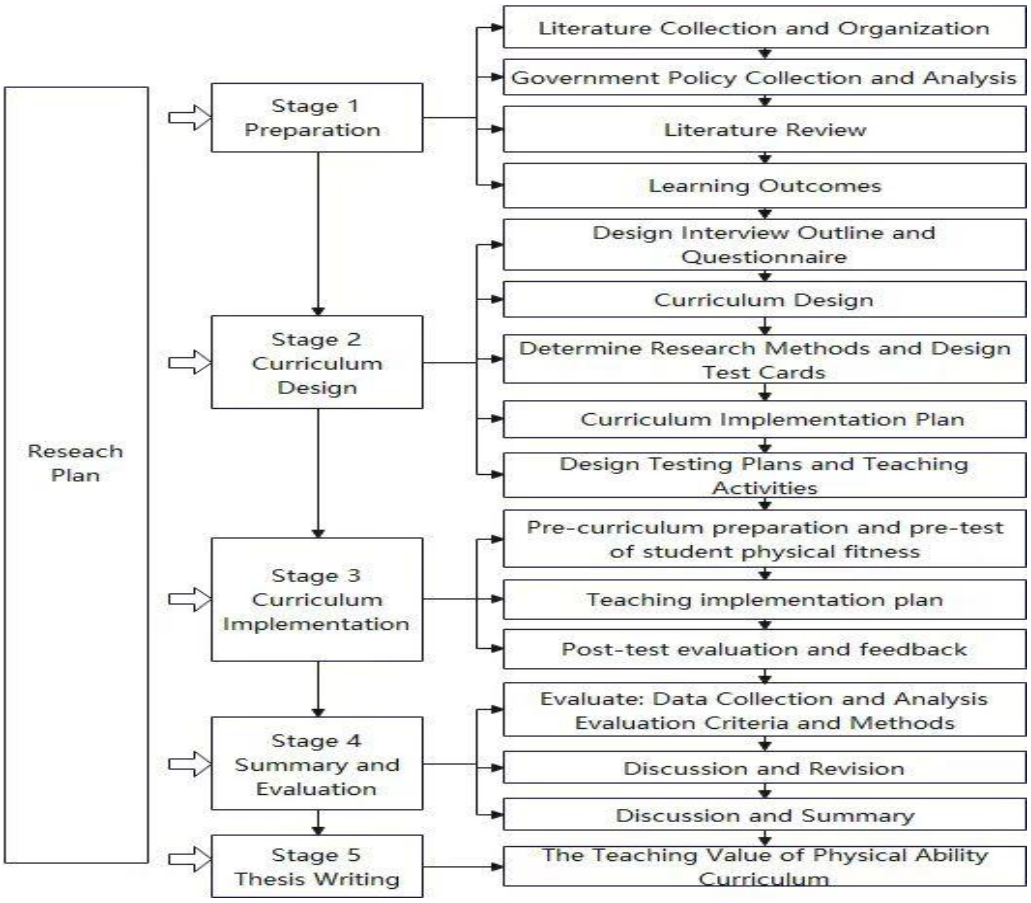


**Fig.2** Research design

### Research Population

The population of this study was accounting major students from 6 classes of 2023 academic year in the School of Education at Zhanjiang University of Science and Technology. The population consists of the classes taught by the researchers. By being familiar with the students' physical capabilities, fitness levels, and any pre-existing health conditions, the researcher can tailor the curriculum and exercises to suit the students' individual needs and abilities. Importantly, familiarity with the students and their abilities could indeed play a role in mitigating potential risks of injury

Research Sample

This study finally selected 120 accounting major students from 3 classes of 2023 academic year in the School of Education, Zhanjiang University of Science and Technology as research sample through cluster random sampling. The objective is to enhance students' physical abilities through the implementation of a tailored curriculum.

**Data Collection**

To understand how to develop physical ability curriculum to enhance college student's physical abilities, the researchers collected the data from previous literature and policy documents.

To evaluate the effectiveness of physical ability curriculum based on exceeding compensation theory, researchers collected data using a test scale set up by National Student Physical Health Standards (Ministry of Education of the People's Republic of China, 2014) to assess students' strength, speed, endurance and flexibility across the items such as BMI score (to calculate BMI, use student's weight in kilograms by the square of your height in meters), vital capacity results, resting heart rate, performance in the 50-meter sprint, sit and rich, standing long jump, sit-up performance, and performance 800/1000-meter running test. The students underwent a total of two times tests, including a pre-test and a post-test. These assessments occurred from Late October and mid-November of 2023.

**Data Analysis**

Firstly, researchers conducted content analysis on data gathered from the related literature and policy documents. The objective is to establish the theoretical foundation and policy directives for curriculum design. Additionally, paired-sample t-test was performed to evaluate the overall physical abilities score of students (pre-test and post-test) of 120 students from three classes.

The overall physical abilities score (Y) of students is determined through a specific formula. This formula comprises several variables, including the BMI score (X1), vital capacity results (X2), resting heart rate (X3), performance in the 50-meter sprint (X4), sit and rich (X5), standing long jump (X6), sit-up performance (X7), and performance 800/1000-meter running test (X8). Specifically, Y is computed as a weighted sum of these variables, aiming to reflect students' comprehensive physical abilities across various aspects. The formula for Y is a weighted sum of these variables: $Y = 0.15*X_1 + 0.10*X_2 + 0.05*X_3 + 0.20*X_4 + 0.10*X_5 + 0.10*X_6 + 0.10*X_7 + 0.20*X_8$. The study aimed to assess various aspects of students' physical indicators in order to provide a comprehensive understanding of their overall physical ability.

## Research Results

The first objective of this study is to develop a Physical Ability Curriculum to enhance college students' physical abilities by improving their strength, speed, endurance, and flexibility.

For the development of Physical Ability Curriculum, the researchers delineated four steps based on the findings from related literature and policy documents, which are shown as follows:

1. Overview, Necessity, and Feasibility Analysis: The main goal of this curriculum is to enhance students' physical abilities through systematic training, aligning with *National Student Physical Health Standards* (Ministry of Education of the People's Republic of China, 2014). Developing a physical ability course is crucial for university physical education as it promotes physical and mental development, improves ability, and helps establish healthy lifestyle habits. The school is well-equipped with sufficient resources and facilities to conduct the course effectively using scenario-based teaching, competitions, games, and inquiry-based methods.

2. Principle of Curriculum: The Physical Ability Curriculum developed in this study was based on Constructivist theory, Exceeding compensation Theory, Blended Teaching Theory, and Self-efficacy Theory, and adhered to the Chinese *National Student Physical Health Standards*. The researchers integrated the four theories to design the curriculum. The curriculum principles encompass the following modules:

*Integration of Online and Offline Learning:* Establishment of an online learning platform to provide teaching resources, complemented by practical training sessions offline.

*Periodic Training and Recovery:* Scientifically designed training plans include weekly schedules of high-intensity training, low-intensity training, and recovery periods.

*Goal Setting and Feedback:* Personal training goals are set, followed by feedback from teachers upon completion, and encouragement for students to share their successful experiences.

*Project Exploration and Reflection:* Students are grouped to explore sports projects, followed by group discussions and reflections at the end of each project.

3. Curriculum Content: The curriculum content is based on the *National student physical health standard* (Ministry of Education of the People's Republic of China, 2022). Four training units are designed around the seven weeks online and offline teaching plan of "Developing Physical Ability Curriculum Based on Exceeding compensation to Enhance College Students' Sport Abilities". *Teachers must ensure that all training activities are implemented in accordance with the exceeding compensation theory, while prioritizing the health and safety of students.* The specifics were as follows:

*A. Strength Training:* This course encompasses various strength training exercises including duck walks, 20-level leapfrogs, sit-ups, pull-ups, weight-bearing lunges, supine leg lifts, push-ups, weight-bearing squats, frog-leaping, burpees, and other exercises. These exercises aim to enhance students' muscular strength and explosiveness.

*B. Speed Training:* Students will engage in diverse speed training exercises such as 30-meter sprints, 60-meter accelerations, 100-meter runs, variable speed runs, and other activities. Through these drills, students will improve their acceleration and maximum velocity.

*C. Endurance Training:* In addition to strength and speed training, the curriculum covers various endurance training exercises including long-distance runs, medium-distance runs, and short-distance runs such as 1200-meter runs, 800-meter runs, 10-minute jogs, 400-meter runs, 15-minute jogs, and 2000-meter jogs. These exercises are designed to enhance students' stamina and endurance levels.

*D. Flexibility Training:* Lastly, the course includes flexibility training exercises such as static stretching, dynamic stretching, leg ligament stretches, shoulder ligament stretches, forward bending exercises, and foam roller exercises. These exercises aim to improve students' flexibility and joint range of motion.

4. Curriculum Implementation: In implementing the curriculum, a variety of teaching methods such as scenario-based instruction, gamified learning, and group collaboration were employed. The utilization of school sports facilities and resources were maximized, alongside the establishment of an online learning platform to supplement teaching resources. Additionally, personalized guidance was provided by tailoring training plans and feedback according to individual student abilities and interests.

5. Assessment and Evaluation: The evaluation and assessment of the course will be divided into two parts.

1) Physical Ability Assessment: Prior to the commencement, during, and upon completion of the course, a comprehensive evaluation of students' physical fitness status before and after the course implementation will be conducted through measurements of BMI, vital capacity, resting heart rate, and other indicators.

2) Curriculum Evaluation: Ensuring the accuracy and reliability of assessment data, an analysis of assessment data and feedback results were carried out to identify any issues within the course design and implementation.

In summary, this curriculum is developed to systematically improve the physical abilities of college students, ensuring a balanced and comprehensive approach to physical education through both theoretical foundations and practical applications.

The second objective of this study is to study the effectiveness of Physical Ability Curriculum in enhancing students' physical abilities. During October and November of 2023, the Physical Ability Curriculum was implemented by researchers among 120 accounting major students enrolled in three classes of the 2023 academic year at the School of Education, Zhanjiang University of Science and Technology. This study adopted cluster random sampling and conducted pre-test and post-test to measure students' physical abilities. The data collected before and after the curriculum were statistically analyzed and summarized using paired sample t-test.

According to Figure 3, both the first and second Q-Q plots indicate that students' physical abilities approximate a normal distribution before and after the course implementation. This demonstrates the consistency and stability of physical abilities score data pre- and post-curriculum implementation.

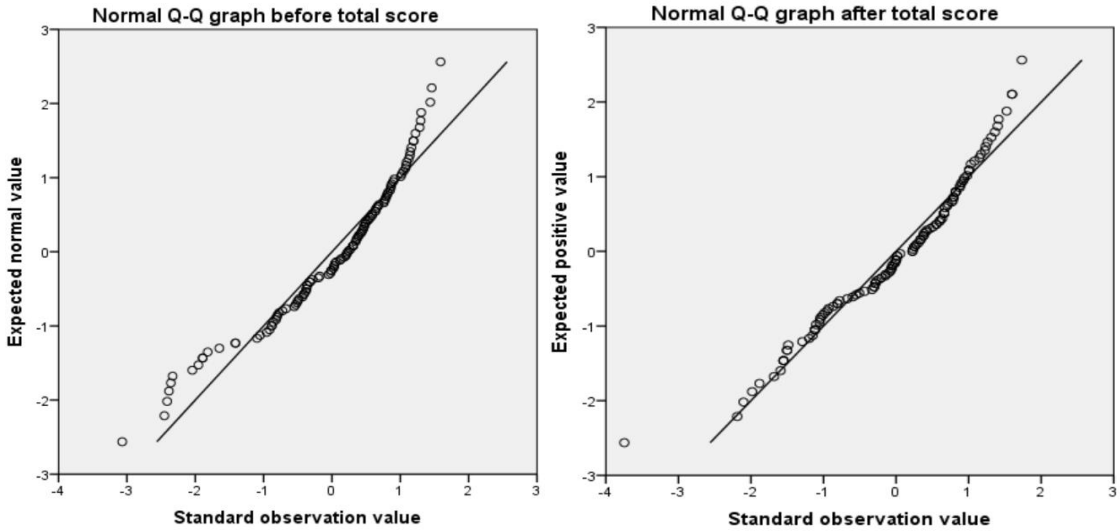


**Fig.3** Normal Q-Q charts of students' overall physical abilities scores

The table 1 offers a detailed analysis of pre- and post-intervention measures across a spectrum of physical performance metrics, accompanied by specific differences observed between the two time points. While no statistically significant change was detected in BMI ($t(119) = 1.323$, $p = 0.188$) or resting heart rate ($t(119) = 1.133$, $p = 0.185$), several key indicators displayed notable improvements following the intervention.

Vital capacity exhibited a substantial increase ($t(119) = -5.731$, $p < 0.001$), with participants showing an average improvement of 338.1 units (SD = 150.5) post-intervention. This suggests enhanced respiratory function consequent to the intervention. Similarly, participants demonstrated significant enhancements in explosive power and lower-body strength, as evidenced by a reduction in 50-meter sprint times by an average of 0.91 seconds (SD = 0.25) ($t(119) = 14.109$, $p < 0.001$) and an increase in standing long jump distances by an average of 12.99 centimeters (SD = 5.52) ($t(119) = -11.78$, $p < 0.001$).

Moreover, improvements were observed in flexibility, endurance, and muscular strength post-intervention. Sit and reach flexibility notably improved by an average of 3.00 centimeters (SD = 2.60) ($t(119) = -6.568$, $p < 0.001$), alongside reduced times for the 800/1000-meter run by an average of 0.58 minutes (SD = 0.05) ($t(119) = 11.641$, $p < 0.05$). Additionally, participants demonstrated increased muscular endurance, as evidenced by significant gains in sit-up counts by an average of 5.49 repetitions (SD = 1.50) ($t(119) = -8.000$, $p < 0.001$) and pull-up counts by an average of 6.55 repetitions (SD = 1.22) ($t(119) = -9.197$, $p < 0.001$)

Overall, these findings underscore the effectiveness of the intervention in enhancing various aspects of physical abilities, indicating improved overall physical fitness and functional capacity among the study participants.

**Table 1** Inferential statistics for Students' overall scores of pre-test and post-test (n=120)

| Item | Pre Mean±SD | Post Mean±SD | Mean Difference±SD | T-value |
|---|---|---|---|---|
| BMI | 21.28±3.54 | 21.12±3.19 | 0.16±0.35 | 1.323 |
| Vital capacity | 3798.4±1216.63 | 4136.5±931.39 | -338.1±150.5 | -5.731*** |
| Resting heart rate | 66.97±4.60 | 67.59±4.85 | -0.62±1.30 | 1.133 |
| 50-meter sprint | 9.18±1.10 | 8.27±0.85 | 0.91±0.25 | 14.109*** |
| Standing long jump | 173.34±27.62 | 186.33±27.97 | -12.99±5.52 | -11.78*** |
| Sit and reach | 15.72±10.01 | 18.72±6.83 | -3.00±2.60 | -6.568*** |
| 800/1000-meter running | 4.31±0.69 | 3.73±0.35 | 0.58±0.05 | 11.641* |
| Sit-ups (female) | 38.50±7.22 | 43.99±7.49 | -5.49±1.50 | -8*** |
| Pull-ups (male) | 5.83±0.64 | 12.38±0.45 | -6.55±1.22 | -9.197*** |
| Total physical ability test score | 68.56±10.27 | 78.70±6.86 | -10.14±1.67 | -15.134*** |

*Note: *p <0.05, **p <0.01, ***p <0.001*

## Discussions

This study aims to develop a Physical Ability Curriculum (PAC) to enhance college students' physical abilities by improving their strength, speed, endurance, and flexibility and to study the effectiveness of Physical Ability Curriculum in enhancing students' physical abilities. The development and implementation of the PAC has yielded promising results, indicating significant improvements in several key areas of physical abilities. This section will discuss the implications of these findings, the strengths and limitations of the study, and potential directions for future research.

*Improvement in Physical Abilities*

The PAC was designed with a comprehensive approach integrating Constructivist theory, Supercompensation Theory, Blended Teaching Theory, and Self-efficacy Theory. This multifaceted approach appears to have effectively contributed to notable enhancements in students' physical abilities, as evidenced by the pre- and post-intervention comparisons. Recent studies support the effectiveness of this multifaceted approach. For instance, Butz (2018) found that constructivist approaches significantly improve students' independent learning and physical fitness by involving them in active, real-world learning scenarios. Mukhopadhyay (2021) illustrated that using Exceeding compensation Theory in training schedules greatly enhances students' physical capacities and recovery through carefully planned exercise and rest cycles. Shi et al. (2022) showed that Blended Teaching Theory, which merges online and face-to-face learning, significantly increases student participation and outcomes in physical education settings. Additionally, Warner et al. (2014) highlighted that enhancing students' self-efficacy boosts their motivation and physical performance. Together, these recent studies indicate that the PAC's comprehensive design effectively enhances students' physical abilities, as demonstrated by pre- and post-intervention comparisons.

*Strength*: After finishing the PAC implementation, students' standing long jump performance significantly improved, with an average increase of 12.99 centimeters ($t(119) = -11.78$, $p < 0.001$). Recent studies by Wang and Dong (2023) supported this, indicating that standing long jump training effectively enhance lower body strength. Similarly, female students' sit-up repetitions significantly increased, with an average rise of 5.49 repetitions ($t(119) = -8.000$, $p < 0.001$). This aligns with findings from recent research by Suddee and Songkram (2023), highlighting the efficacy of sit-ups training in improving abdominal muscle strength among female populations. Furthermore, male students' pull-up repetitions significantly increased, with an

average rise of 6.55 repetitions ($t(119) = -9.197$, $p < 0.001$). Recent studies by Wang et al. (2023) also supported these findings, indicating the effectiveness of training programs in enhancing upper body strength among male students.

*Speed*: Students' 50-meter sprint performance significantly improved after implementation of PAC, with an average reduction of 0.91 seconds ($t(119) = 14.109$, $p < 0.001$). It was consistent with the study of Haugen et al. (2019), which indicated that sprint training effectively enhances students' acceleration and maximum speed. This highlights the efficacy of the program in improving students' sprinting abilities.

*Endurance:* Following the curriculum implementation, the curriculum significantly reduced students' completion time in the 800/1000-meter running task by an average of 0.58 minutes ($t(119) = 11.641$, $p < 0.05$). This finding was consistent with the studies of Haugen et al. (2022), affirming the efficacy of long-distance running training in improving aerobic endurance. Furthermore, there was a notable increase in students' vital capacity, with an average improvement of 338.1 units ($t(119) = -5.731$, $p < 0.001$). Recent studies by Hanley (2021) and Llanos-Lagos et al. (2024) supported this, indicating that aerobic training such as long running effectively enhances respiratory function and endurance. Although the change in resting heart rate lacked statistical significance pre and post-program ($t(119) = 1.133$, $p = 0.185$), it remains a crucial measure for assessing cardiorespiratory health and overall endurance, as highlighted in research by Melanson and Freedson (2001). Further investigation with longer interventions may provide deeper insights into its fluctuations.

*Flexibility:* There was a significant improvement in students' sit and reach performance, with an average increase of 3.00 centimeters ($t(119) = -6.568$, $p < 0.001$). Recent studies by Behm et al. (2023) and Suardi Shaharuddin and Mondam (2017) supported this, indicating that flexibility training such as sit and reach effectively enhances students' joint range of motion and overall flexibility.

*In summary,* the structured framework of the PAC, incorporating scheduled training and rest periods, goal setting, feedback mechanisms, and project exploration, played a pivotal role in attaining these results. The integration of both online and offline learning modes fostered sustained participation and offered a wide range of educational materials. Additionally, scenario-driven instruction and gamified learning techniques effectively maintained student motivation and involvement throughout the program. Adhering to the principles of supercompensation theory ensured optimal balance between training intensity and recovery intervals, enabling students to

reach their peak performance while mitigating the risk of overexertion. This methodical approach to training planning was essential in realizing the observed physical enhancements.

In evaluating the curriculum's effectiveness, it's essential to recognize its strengths and acknowledge its limitations.

*Strength:* The integration of multiple theoretical frameworks provided a robust foundation for curriculum development, ensuring credibility and effectiveness. Additionally, the diverse set of training activities targeted various aspects of physical fitness, facilitating comprehensive improvement. The blend of online and offline components allowed for flexible and continuous learning experiences.

*Limitations:* While the study showcased strengths, its scope was confined to accounting major students at a single university, potentially limiting generalizability. Furthermore, the seven-week duration of the intervention might not adequately capture long-term effects on physical fitness. Additionally, the assessment focused solely on physical abilities, overlooking potential benefits in mental health and academic performance.

## Knowledge from Research

This study aimed to develop a Physical Ability Curriculum (PAC) designed to enhance college students' physical abilities (strength, speed, endurance, and flexibility) and to evaluate its effectiveness. The development of PAC was based on Constructivist theory, Exceeding compensation theory, Blended teaching theory, and Self-efficacy theory and the five curriculum development steps (Overview, Necessity, and Feasibility Analysis, the Principle of Curriculum, Curriculum Content, Curriculum Implementation, and Assessment and Evaluation). This study verifies the effectiveness of the curriculum developed by combining multiple theoretical bases with reasonable curriculum development steps, and also confirms the key role of Exceeding compensation theory in college students' physical education curriculum.

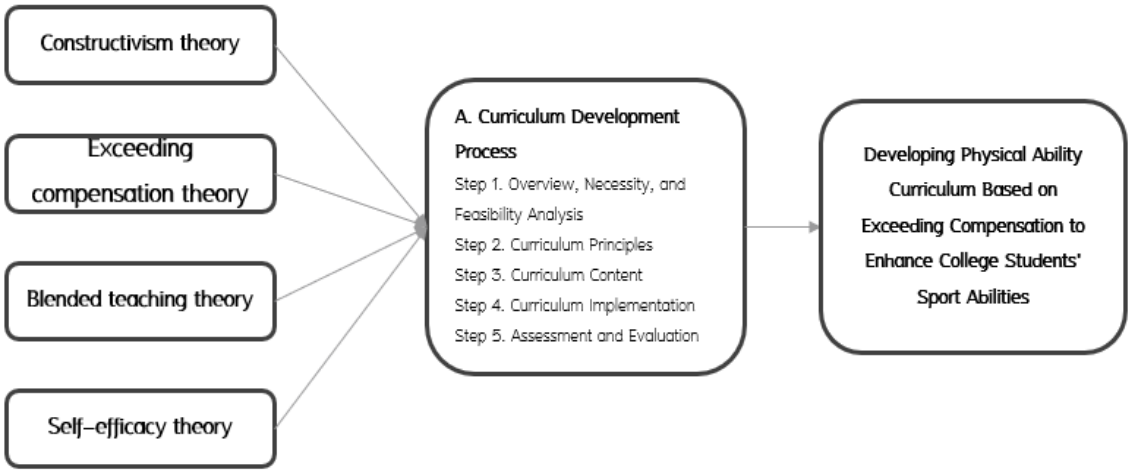


**Fig.3** Knowledge from Research

## Conclusion

The development and implementation of the Physical Ability Curriculum (PAC) have yielded notable improvements in college students' physical abilities, reflecting a holistic approach to physical education. By integrating various theoretical frameworks such as Constructivist theory, Supercompensation Theory, Blended Teaching Theory, and Self-efficacy Theory, the PAC has demonstrated its efficacy in enhancing strength, speed, endurance, and flexibility among students. The success of the PAC lies in its structured framework, which includes scheduled training and rest periods, goal setting, feedback mechanisms, and project exploration. By combining online and offline learning modes and employing scenario-driven instruction and gamified learning techniques, the curriculum has effectively engaged students and maintained their motivation throughout the program. Adherence to the principles of supercompensation theory ensured an optimal balance between training intensity and recovery intervals, facilitating peak performance while minimizing the risk of overexertion.

While the PAC has showcased strengths in improving physical abilities, it's essential to acknowledge its limitations. The study's confined scope to accounting major students at a single university may limit the generalizability of its findings. Additionally, the relatively short duration of the intervention may not fully capture the long-term effects of the curriculum on students' physical fitness. Moreover, the assessment focused solely on physical abilities, overlooking potential impacts on mental health and academic performance.

In conclusion, the PAC represents a promising approach to enhancing college students' physical abilities, underpinned by its structured framework and integration of diverse training

methods. While recognizing its successes, continued research and adaptation are necessary to maximize its potential and promote holistic development among students in diverse educational contexts.

## Suggestions

### 1. Practical Suggestions

Educational institutions should be encouraged to implement PAC or similar physical education programs. By sharing success stories and best practices from schools already adopting PAC, other institutions can be inspired to follow suit, potentially leading to enhanced student health and well-being across a wider range of educational settings.

### 2. Suggestions for Future Research

Future studies should assess the long-term sustainability of physical fitness improvements by extending the intervention period. This will provide more robust data on the lasting impact of PAC. Expanding research to include students from a variety of academic backgrounds and institutions will enhance the generalizability of findings, ensuring the PAC's relevance across diverse populations. Research should also explore the impact of PAC on mental well-being, cognitive function, and academic performance. These factors could be crucial in evaluating the full scope of PAC's benefits, which will inform improvements to physical education programs.

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