International Journal of Sociologies and Anthropologies Science Reviews
Volume 5 Issue 4: July-August 2025: ISSN 2985-2730
Website: **https://so07.tci-thaijo.org/index.php/IJSASR/index**

Development Tennis Teaching Program with Game-based Learning to Improve Skills and Specific Fitness for University Students

Zhao Yue[1], Pattarapol Maharkan[2] and Wisute Tongdecharoen[3]
Faculty of Sports Science and Technology, Bangkokthonburi University, Thailand
[1]E-mail: 149835958@qq.com, ORCID ID: https://orcid.org/0009-0007-4441-0158
[2]E-mail: paulsport@gmail.com, ORCID ID: https://orcid.org/0009-0003-5761-7036
[3]E-mail: wisute.ton@bkkthon.ac.th, ORCID ID: https://orcid.org/0009-0008-5233-7533
Received 04/02/2025 Revised 19/02/2025 Accepted 19/03/2025

Abstract
Background and Aims: Tennis is a sport that demands both technical proficiency and physical fitness, yet traditional teaching methods often fail to engage students effectively. This study aims to develop and evaluate a game-based learning (GBL) approach in tennis instruction to enhance skill acquisition and improve specific fitness among university students. The primary objectives are to analyze how tennis content can be integrated with GBL and to compare the effectiveness of this approach with traditional instruction.
Materials and Methods: A quasi-experimental research design was employed, involving 60 female university students aged 18–19 from Changchun University of Humanities. The participants were equally divided into an experimental group (n=30), which received game-based learning instruction, and a control group (n=30), which followed a traditional teaching method. The intervention lasted eight weeks, with one 90-minute session per week. Tennis skills and specific fitness levels were assessed before and after the intervention. Statistical analysis included independent t-tests for intergroup comparisons and one-way ANOVA with Bonferroni post-hoc testing to analyze improvements within the experimental group. The significance level was set at $p < 0.05$.
Results: The results indicate that both groups showed improvements in tennis skills and specific fitness. However, the experimental group demonstrated significantly greater progress in forehand accuracy, backhand control, serving consistency, agility, reaction time, and explosive strength ($p < 0.05$). Additionally, qualitative observations revealed higher motivation and engagement among students in the game-based learning group compared to the control group.
Conclusion: The study concludes that integrating game-based learning into tennis instruction is more effective than traditional methods in enhancing both technical skill development and physical fitness. This research supports the broader application of interactive and engaging learning strategies in sports education, emphasizing the need for innovative pedagogical approaches to improve student engagement and learning outcomes.
Keywords: Tennis Teaching Program; Game-based Learning; Tennis Skill; Specific Fitness; University Student

Introduction

Tennis is one of the most popular and widely played sports worldwide, requiring a combination of technical proficiency, tactical awareness, and specific physical fitness. As a competitive and recreational sport, it provides numerous physical and psychological benefits, including improved cardiovascular endurance, coordination, agility, and mental resilience (Zhao & Wang, 2022). Due to its high physical and technical demands, effective teaching methodologies are crucial for enhancing skill acquisition and athletic performance. However, despite the increasing popularity of tennis, many students struggle to master essential skills due to the limitations of traditional teaching methods, which often rely on repetitive drills and lack engagement, adaptability, and individualized instruction (Wang & Zhang, 2021).

One of the key challenges in traditional tennis education is the lack of engagement and motivation among students. Conventional instructional approaches primarily focus on direct instruction and repetitive practice, which, while effective in reinforcing muscle memory, often fail to sustain learners' interest and involvement (Li & Zhou, 2022). Research has shown that students tend to lose confidence and motivation when faced with the technical complexities of tennis, leading to high dropout rates from physical education programs (Smith & Brown, 2022). Moreover, the absence of personalized and interactive learning experiences in traditional tennis instruction prevents students from developing a deeper understanding of the sport's strategic and tactical elements (Liu & Wang, 2023).

Another major concern in existing tennis education is the insufficient focus on specific fitness training, which plays a crucial role in enhancing athletic performance. Tennis requires explosive power, agility, endurance, and quick reflexes, all of which must be systematically developed alongside

Citation Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: **https://doi.org/10.60027/ijsasr.2025.6513**

technical skills (Zhang & Liu, 2020). However, traditional methods often prioritize technical drills over fitness development, leading to imbalanced training that does not fully prepare students for the physical demands of competitive play (Chen & Zhang, 2022). As a result, many university students, despite their interest in tennis, struggle with endurance, speed, and reaction time, which ultimately affects their game performance.

To address these challenges, game-based learning (GBL) has been identified as a highly effective approach to sports education, particularly in tennis instruction (Johnson & Lee, 2021). GBL incorporates interactive, competitive, and scenario-based elements, allowing students to develop skills in a dynamic, engaging, and pressure-based environment (Liu & Wang, 2023). Studies have shown that gamified teaching methods significantly enhance motivation, learning retention, and skill acquisition by making the training process more enjoyable and immersive (Sun & Zhang, 2023). Additionally, game-based approaches promote decision-making skills and real-time adaptability, which are critical in fast-paced sports like tennis (Deci & Ryan, 2000).

Given the proven benefits of game-based learning in other sports, there is a strong need to examine its effectiveness in tennis instruction, particularly in university-level physical education programs. By integrating GBL into a structured tennis curriculum, this study aims to determine its impact on skill acquisition, specific fitness development, and overall learning motivation among university students. The findings of this research could provide valuable insights for coaches, educators, and sports curriculum designers, facilitating the adoption of innovative teaching methodologies to enhance tennis education and athletic performance.

Despite the growing body of literature on game-based learning in physical education, limited studies have specifically investigated its effectiveness in tennis instruction at the university level. While prior research highlights the benefits of gamified teaching in team sports such as basketball and soccer (Wang & Li, 2022), tennis, as an individual sport with complex technical and physical demands, requires a different instructional approach. This study seeks to bridge this gap by systematically integrating game-based learning into a tennis teaching program and assessing its impact on technical skill development, physical fitness, and student engagement. The results of this research could contribute to enhancing pedagogical practices in sports education, ensuring that university students receive more engaging, effective, and comprehensive tennis training.

Objectives

1. To integrate tennis content with game-based learning in a structured teaching program.
2. To compare the effectiveness of game-based learning and traditional instruction in improving tennis skills and specific fitness among university students.

Literature review

The integration of game-based learning (GBL) in sports education has gained significant attention in recent years due to its potential to enhance both skill acquisition and physical fitness. Traditional teaching methods in tennis often emphasize direct instruction, repetitive drills, and isolated skill practice, which, while effective in technical reinforcement, may not fully engage students or facilitate adaptive learning in game situations (Wang & Zhang, 2021). The shift towards interactive, student-centered methodologies, such as GBL, offers an alternative that not only improves technical performance but also enhances cognitive engagement and physical conditioning (Chen & Zhang, 2022).

Integration of Tennis Content with Game-Based Learning

Game-based learning incorporates structured activities, competition, real-time feedback, and problem-solving into the instructional process, making learning more engaging and contextually relevant (Sun & Zhao, 2023). Research suggests that GBL improves motor learning, decision-making, and tactical awareness in sports training (Johnson & Lee, 2021). In tennis, effective game-based approaches simulate real match conditions, requiring players to apply technical and tactical skills under pressure (Liu & Wang, 2023). This method encourages active participation, strategic thinking, and situational adaptability, aligning with constructivist learning theories that emphasize experiential learning and self-regulation (Deci & Ryan, 2000). Furthermore, studies indicate that tennis-specific GBL models, such as modified match play, target-based drills, and gamified skill challenges, result in

Citation
Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: https://doi.org/10.60027/ijsasr.2025.6513

International Journal of Sociologies and Anthropologies Science Reviews
Volume 5 Issue 4: July-August 2025: ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index

higher student motivation and better skill retention compared to traditional instruction (Smith & Brown, 2022). By integrating technical, tactical, and fitness elements into interactive gameplay, GBL enhances both skill execution and match-readiness, making it a superior approach for comprehensive tennis education (Li & Zhou, 2022).

Comparing the Effectiveness of Game-Based Learning and Traditional Instruction

Comparative research on GBL versus traditional training in sports highlights the superiority of interactive, competitive, and feedback-driven learning environments (Wang & Li, 2022). In a study by Zhang and Liu (2020), athletes trained under game-based methods exhibited faster reaction times, improved accuracy, and better shot placement compared to those in traditional drill-based training. Similarly, a meta-analysis by Chen and Li (2021) found that GBL led to greater improvements in agility, endurance, and explosive strength among tennis players, indicating its effectiveness in developing specific fitness components required for high-performance tennis. Moreover, psychological engagement and motivation are critical factors influencing learning outcomes in sports education. Self-Determination Theory (Deci & Ryan, 2000) suggests that intrinsically motivated learners, who experience autonomy and enjoyment in training, demonstrate higher persistence and long-term skill retention. Studies confirm that GBL enhances student motivation, fostering a sense of achievement and continued participation in training programs (Sun & Zhang, 2023). In contrast, traditional instruction often relies on static, instructor-led training, which may not accommodate individual learning paces or foster in-game decision-making skills (Liu & Wang, 2023). The lack of adaptability and reduced engagement in traditional training can lead to lower skill retention, decreased enthusiasm, and higher dropout rates in sports education (Smith & Brown, 2022). Consequently, integrating GBL into university-level tennis curricula presents a practical and research-backed solution for improving both skill development and physical fitness.

The reviewed literature highlights the advantages of game-based learning in enhancing tennis instruction, demonstrating its ability to integrate technical, tactical, and fitness components while maintaining high student engagement and motivation. Comparative studies further reinforce that GBL is more effective than traditional methods in improving tennis skills and specific fitness. As higher education institutions seek innovative and evidence-based teaching methodologies, this research provides a foundation for optimizing university tennis programs through structured game-based learning frameworks.

Conceptual Framework

The Conceptual Framework section outlines the theoretical foundation and structural design of the study, illustrating how game-based learning (GBL) influences tennis skill development and physical fitness.

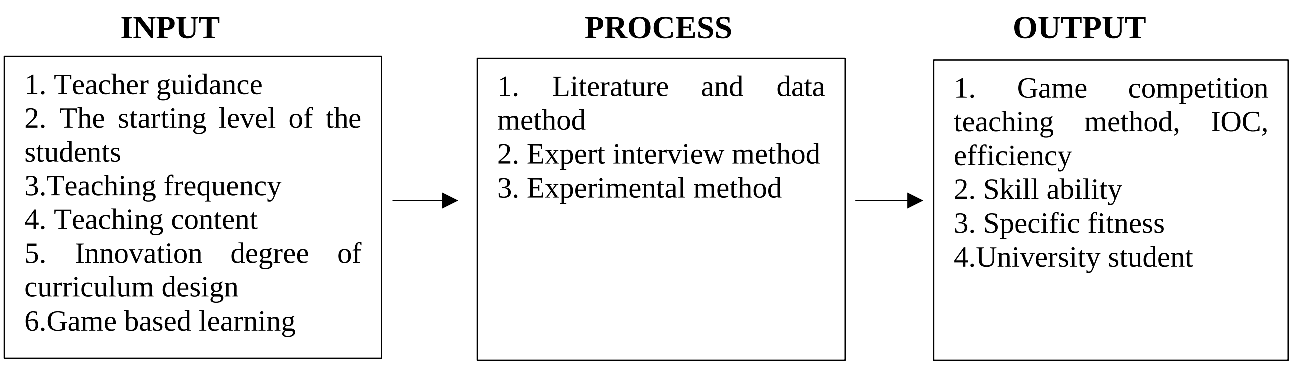

Figure 1 Conceptual Framework

Methodology

Population: The study was conducted among university students enrolled in a physical education program specializing in tennis. The target population consisted of undergraduate students who had basic exposure to tennis training but had not undergone structured game-based learning instruction. The study

Citation Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: https://doi.org/10.60027/ijsasr.2025.6513

aimed to assess skill acquisition and fitness improvement through a structured game-based learning (GBL) program compared to traditional tennis instruction.

Sample: A total of 60 female university students, aged 18–19 years, were selected from Changchun University of Humanities for this quasi-experimental study. The participants were randomly assigned into two groups: Experimental Group (n = 30): Received game-based learning (GBL) tennis instruction, integrating interactive drills, competitive play, and strategy-based learning techniques. Control Group (n = 30): Followed traditional tennis training methods, focusing on repetitive drills and direct instruction without gamified elements.

Research Instrument

To assess the effectiveness of game-based learning (GBL) versus traditional tennis instruction, this study was employed to evaluate tennis skill acquisition, specific fitness development, and student engagement levels.

1. Tennis Skill Assessment: A standardized tennis skill test was conducted to measure students' technical proficiency. The test included: the Forehand and Backhand Accuracy Test, which evaluates the percentage of successful strokes landing within target areas. Serve Consistency Test: Measures the accuracy and power of serves (number of successful serves out of 10 attempts). Volley Performance Test: Assesses control and reaction efficiency in net-play situations. Game-Play Simulation Test: Examines shot selection, tactical awareness, and in-game decision-making. Skill performance was graded using a 5-point scale (1 = Poor, 5 = Excellent), adapted from validated sports performance rubrics (Wang & Li, 2022).

2. Specific Fitness Assessment: To measure improvements in agility, reaction time, endurance, and explosive strength, the following tests were used: Agility Test (T-Test): Evaluates lateral movement efficiency. Reaction Time Test: Assesses response speed to visual stimuli. Endurance Test (Yo-Yo Intermittent Recovery Test Level 1): Measures cardiovascular fitness. Explosive Strength Test (Standing Long Jump & Vertical Jump): Evaluates lower-body power for movement efficiency in tennis. All fitness tests were conducted before and after the intervention to compare improvements between groups.

Data Collection

This study employed a structured data collection process to evaluate the effectiveness of game-based learning (GBL) in tennis instruction. The methodology included expert validation, pre-and post-test assessments, and statistical preparation for analysis. 1. Validation of the Teaching Program: Five subject-matter experts reviewed the training program using the Index of Item-Objective Congruence (IOC), yielding a 0.96 validity score, and confirming its alignment with instructional goals. 2. Pre-Experimental Data Collection: Participants' demographic data and baseline fitness levels were recorded. A pre-test measured tennis skills (forehand, backhand, serve, volley, gameplay decision-making) and physical fitness (agility, reaction time, endurance, explosive strength). 3. Mid- and Post-Experimental Assessments: Participants were tested in Weeks 1 and 8 to assess skill and fitness progress. Both experimental (GBL-based instruction) and control (traditional instruction) groups underwent identical evaluations. 4. Data Compilation for Statistical Analysis: All tennis performance, fitness results, and engagement survey responses were prepared for statistical analysis.

Data Analysis

1. An analysis of the validity of the training program was conducted within dex items, objective congruence (IOC=0.96)

2. Methods used for statistical analysis: 1. Validation of the Training Program: The IOC analysis confirmed a high validity score (0.96) for the instructional content. 2. Comparative Analysis of Pre- and Post-Intervention Data: Independent t-tests compared pre-test and post-test scores between groups, assessing GBL's impact on tennis skill acquisition and fitness improvement.

Research Process

The research was conducted in four structured phases:

Phase 1: Literature Review and Framework Development. Extensive review of literature on tennis training, physical fitness, and game-based learning. Consultation with experts to refine the study framework.

Phase 2: Development and Validation of the Game-Based Learning Program. Creation of an 8-week, 90-minute-per-week training plan integrating interactive drills and competitive gameplay. Expert validation using the IOC method and pilot testing with five students to refine instructional clarity.

Phase 3: Experimental Implementation. Experimental Group (n = 30): Received GBL-based training focused on technical, tactical, and fitness development. Control Group (n = 30): Followed traditional tennis instruction with drill-based exercises. Performance and fitness tests at Week 1 and Week 8.

Citation
Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: https://doi.org/10.60027/ijsasr.2025.6513

Phase 4 : Data Analysis and Research Reporting. Statistical analysis of skill and fitness improvements between groups. Compilation of results and interpretation of GBL's effectiveness in skill acquisition and motivation.

Results

The researcher prepared the data and then carried out the statistical analysis. Analyze the results of the analysis, presenting them as a table to accompany the essay as follows:

Table 1 Characteristics of the Sample Group

Variable	Experimental Group (n=30)	Control Group (n=30)
Age (years)	18.43 ± 0.34	18.43 ± 0.34
Weight (kg)	60.03 ± 0.86	60.07 ± 0.86
Height (cm)	169.93 ± 0.54	170.03 ± 0.54
BMI	20.81 ± 0.22	20.81 ± 0.22

Table 1 presents the baseline characteristics of the experimental group (n = 30) and the control group (n = 30). The measured variables include age, height, weight, and body mass index (BMI), with values reported as Mean ± Standard Deviation (SD). Both groups have an identical mean age of 18.43 ± 0.34 years. The mean height is 169.93 ± 0.54 cm in the experimental group and 170.03 ± 0.54 cm in the control group. The mean weight is 60.03 ± 0.86 kg in the experimental group and 60.07 ± 0.86 kg in the control group. The BMI is 20.81 ± 0.22 kg/m² for both groups.

Table 2 Mean and standard deviation of tennis skills in the experimental and control groups.

variables	Experimental Group (n=30)		Control Group (n=30)	
	pretest	Post test	pretest	Post test
	M+ SD	M+ SD	M+ SD	M+ SD
Forhand stroke (score)	5.5 ± 0.53	8.1 ± 0.72	5.3 ± 0.46	6.1 ± 0.47
Cross-line forehand (score)	5.5 ± 0.58	8.3 ± 0.66	5.5 ± 0.50	6.3 ± 0.49
Backhand stroke (score)	5.5 ± 0.53	8.0 ± 0.68	5.3 ± 0.46	6.2 ± 0.53
Cross line backhand (score)	5.5 ± 0.53	8.2 ± 0.70	5.5 ± 0.51	6.3 ± 0.50
Smash (score)	5.1 ± 0.43	8.0 ± 0.65	5.1 ± 0.44	6.4 ± 0.49

Table 2 presents the mean and standard deviation (M ± SD) of tennis skill scores before and after the intervention for both the experimental group (game-based learning) and the control group (traditional instruction). 1. Experimental Group (n = 30). The experimental group, which participated in the game-based learning (GBL) tennis program, demonstrated notable improvements across all skill categories: Forehand Stroke: Increased from 5.5 ± 0.53 (pre-test) to 8.1 ± 0.72 (post-test). Cross-Line Forehand: Improved from 5.5 ± 0.58 to 8.3 ± 0.66. Backhand Stroke: Increased from 5.5 ± 0.53 to 8.0 ± 0.68. Cross-Line Backhand: Rose from 5.5 ± 0.53 to 8.2 ± 0.70. Smash: Improved from 5.1 ± 0.43 to 8.0 ± 0.65. 2. Control Group (n = 30). The control group, which followed the traditional drill-based tennis instruction, also showed improvements, though to a lesser extent: Forehand Stroke: Increased from 5.3 ± 0.46 (pre-test) to 6.1 ± 0.47 (post-test). Cross-Line Forehand: Improved from 5.5 ± 0.50 to 6.3 ± 0.49. Backhand Stroke: Increased from 5.3 ± 0.46 to 6.2 ± 0.53. Cross-Line Backhand: Rose from 5.5 ± 0.51 to 6.3 ± 0.50. Smash: Improved from 5.1 ± 0.44 to 6.4 ± 0.49.

Table 3 Mean and standard deviation of physical fitness of the experimental and control groups.

Variables	Experimental Group		Control Group	
	pretest	Post test	pretest	Post test
	M+ SD	M+ SD	M+ SD	M+ SD
Sit and reach (cm)	13.6 ± 0.14	19.6 ± 0.69	13.6 ± 0.14	14.2 ± 0.08
Sit up 60 sec (times)	40.3 ± 1.44	45.3 ± 1.82	40.0 ± 1.63	41.3 ± 1.61
Standing Long Jump(cm)	163.5 ± 0.83	174.0 ± 1.21	163.3 ± 0.76	165.0 ± 1.06

Citation
Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: https://doi.org/10.60027/ijsasr.2025.6513

Variables	Experimental Group		Control Group	
	pretest	Post test	pretest	Post test
	M+ SD	M+ SD	M+ SD	M+ SD
20m sprint (sec)	4.77 ± 0.03	4.20 ± 0.07	5.05 ± 0.06	4.89 ± 0.06
Run 800m(min)	4.46 ± 0.03	4.30 ± 0.04	4.47 ± 0.02	4.46 ± 0.02

Table 3 presents the pre-test and post-test results of physical fitness assessments for both the experimental group (trained using game-based learning) and the control group (trained using traditional instruction). The measured components include flexibility (sit and reach), strength (sit-ups in 60 seconds), power (standing long jump), speed (20m sprint), and endurance (800m run). The experimental group showed notable improvements across all fitness metrics following the intervention. Flexibility, measured through the sit-and-reach test, increased from 13.6 ± 0.14 cm to 19.6 ± 0.69 cm. Muscular strength, assessed through 60-second sit-ups, improved from 40.3 ± 1.44 reps to 45.3 ± 1.82 reps. Power, measured by the standing long jump, increased from 163.5 ± 0.83 cm to 174.0 ± 1.21 cm. Speed, assessed using the 20m sprint, improved from 4.77 ± 0.03 sec to 4.20 ± 0.07 sec, while endurance, measured through the 800m run, improved from 4.46 ± 0.03 min to 4.30 ± 0.04 min. The control group, which followed traditional training methods, demonstrated only marginal improvements. Flexibility increased from 13.6 ± 0.14 cm to 14.2 ± 0.08 cm. Strength improved slightly, with 60-second sit-ups increasing from 40.0 ± 1.63 reps to 41.3 ± 1.61 reps. Power showed minimal gains, with the standing long jump increasing from 163.3 ± 0.76 cm to 165.0 ± 1.06 cm. Speed improved from 5.05 ± 0.06 sec to 4.89 ± 0.06 sec, and endurance improved slightly from 4.47 ± 0.02 min to 4.46 ± 0.02 min.

Table 4 Mean comparison between the experiment and control groups with the pretest of the tennis skills test, by t-test independent.

Variables	Experimental Group	Control Group	95% Confidence Interval of the Difference		t	p
	M+ SD	M+ SD	lower	Upper		
Forhand stroke (score)	5.5 ± 0.53	5.3 ± 0.46	-0.13	0.43	1.06	0.294
Cross-line forehand (score)	5.5 ± 0.58	5.5 ± 0.50	-0.29	0.30	0.00	1.000
Backhand stroke (score)	5.5 ± 0.53	5.3 ± 0.46	-0.13	0.43	1.06	0.294
Cross line backhand (score)	5.5 ± 0.53	5.5 ± 0.51	-0.29	0.30	0.00	1.000
Smash (score)	5.1 ± 0.43	5.1 ± 0.44	-0.14	0.14	0.00	1.000

*P > 0.05

Table 4 found that all tennis skills pairwise were not significantly different (*p > 0.05).

Table 5 Mean comparison between the experimental and control groups with the posttest of the tennis skills test, using an independent t-test.

Variables	Exper. G	Cont. G	95% Confidence Interval of the Difference		t	p
	M+ SD	M+ SD	lower	Upper		
Forhand stroke (score)	8.0 ± 0.46	6.0 ± 0.48	1.16	2.40	7.97	0.000
Cross-line forehand (score)	8.1 ± 0.47	6.6 ± 0.48	0.98	1.81	6.80	0.000
Backhand stroke (score)	8.0 ± 0.46	6.0 ± 0.49	1.18	2.42	7.94	0.000
Cross line backhand (score)	8.0 ± 0.46	6.2 ± 0.49	1.11	2.16	7.56	0.000
Smash (score)	8.0 ± 0.46	6.0 ± 0.44	1.31	2.39)	8.74	0.000

*P<.05

Table 5 found that all tennis skills pairwise were significantly different (*p<.05).

Citation
Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: https://doi.org/10.60027/ijsasr.2025.6513

Table 6 The mean compares the experimental and control groups with the pretest of the physical fitness test using an independent t-test.

Variables	Exper. G	Cont. G	95% Confidence Interval of the Difference		t	p
	M+ SD	M+ SD	lower	Upper		
Sit and reach (cm)	13.6 ± 0.12	13.6 ± 0.12	-0.17	0.17	0.00	1.000
Sit up 60 sec (times)	40.3 ± 1.74	40.0 ± 2.15	-0.70	1.37	0.33	0.744
Standing Long Jump(cm)	163.5± 3.85	163.4± 3.63	-1.09	1.17	0.12	0.903
20m sprint (sec)	4.77 ± 0.02	5.03 ± 0.03	-0.29	-0.18	8.77	0.000
Run 800m(min)	4.46 ± 0.03	4.48 ± 0.03	-0.06	0.02	-1.96	.0.057

*P > 0.05

Table 6 found that all of the physical fitness tests were not significantly different.

Table 7 The mean comparison between the experimental and control groups with the posttest of the physical fitness test using an independent t-test.

Variables	Exper. G	Cont. G	95% Confidence Interval of the Difference		t	p
	M+ SD	M+ SD	lower	Upper		
Sit and reach (cm)	19.6 ± 0.44	14.2 ± 0.13	5.18	5.82	36.75	0.000
Sit up 60 sec (times)	45.1 ± 2.07	41.1 ± 1.99	2.66	4.83	6.76	0.000
Standing Long Jump(cm)	174.2 ± 3.26	167.2 ± 3.33	5.60	8.56	8.82	0.000
20m sprint (sec)	4.13 ± 0.05	4.89 ± 0.03	-0.82	0.61	-18.14	0.000
Run 800m(min)	4.28 ± 0.03	4.46 ± 0.03	-0.24	-0.12	-7.54	0.000

*P<.05

Table 7 found that all physical fitness pairwise comparisons showed significant differences (*p<.05).

Summary

The results indicate that game-based learning significantly improved both tennis skills and physical fitness among university students. A comparison between the experimental group (trained using the game-based teaching method) and the control group (trained using traditional methods) revealed statistically significant differences in forehand stroke, backhand stroke, and smash performance ($p < 0.05$). Additionally, the experimental group demonstrated greater improvements in physical fitness, including speed (20m sprint), endurance (800m run), power (standing long jump), strength (sit-ups in 60 seconds), and flexibility (sit-and-reach test) compared to the control group ($p < 0.05$). Within the experimental group, pre-test and post-test comparisons further confirmed significant improvements in both tennis skills and physical fitness metrics ($p < 0.05$). These results suggest that the game-based learning approach is an effective method for enhancing both technical and physical performance in tennis training. The structured integration of gameplay into instruction contributed to higher engagement, better skill acquisition, and improved overall fitness levels.

The findings support the use of game-based learning as a viable strategy in sports education, particularly for improving performance in tennis. The combination of interactive training, real-game scenarios, and structured physical conditioning appears to be more effective than traditional drill-based methods in enhancing skill proficiency and athletic development among university students.

Discussion

This study examined the theoretical foundations and practical applications of game-based learning (GBL) in tennis instruction through a literature review and expert interviews. The literature highlights the role of game-based learning in enhancing cognitive, emotional, and social development, reinforcing its effectiveness as an instructional strategy. Piaget (1951) emphasized that games play a critical role in cognitive development, enabling learners to explore, experiment, and internalize knowledge. Vygotsky (1978) further argued that games facilitate social interaction and cultural understanding, allowing learners to engage in collaborative learning environments.

Citation
Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: https://doi.org/10.60027/ijsasr.2025.6513

The potential of digital game-based learning (DGBL) in education has also been widely recognized. Gee (2003) highlighted that digital games provide situational learning environments, fostering deep understanding and engagement. Squire (2011) suggested that participatory game-based learning stimulates learners' motivation and promotes higher academic achievement. Additionally, Crawford (2003) emphasized that educational games should align with learning objectives, ensuring structured feedback and meaningful interactivity to enhance skill acquisition.

Expert interviews provided insights into the practical implementation of GBL in sports education. Five experts emphasized key aspects of goal-oriented learning, personalized instruction, emotional engagement, digital game integration, and teacher facilitation. The first expert stressed that games should have structured objectives, aligning with constructivist learning theories (Bruner, 1996). The second expert emphasized the importance of personalized game design to match students' abilities and learning paces, ensuring inclusivity (Gee, 2003). The third expert highlighted that game-based learning reduces learning anxiety and promotes psychological resilience, which aligns with the Self-Determination Theory (Deci & Ryan, 2000). The fourth expert discussed the effectiveness of digital gamification in education, reinforcing the view that interactive learning platforms improve engagement and decision-making skills (Marsh, 2010). The fifth expert emphasized the role of teachers as facilitators, advocating for real-time feedback and adaptive learning strategies to optimize student performance (Pellegrini, 2009).

Findings from this study demonstrate that GBL significantly improved both tennis skills and physical fitness compared to traditional instruction. Students in the GBL group exhibited greater accuracy and consistency in forehand, backhand, and smash strokes, as well as improvements in speed, agility, endurance, and strength. The integration of game mechanics into training sessions enhanced student motivation, engagement, and long-term retention of skills (Squire, 2011). These findings are consistent with previous research indicating that game-based training leads to better performance and skill development in sports education (Stewart, 2011; Malaby, 2007).

Conclusion

The findings of this study demonstrate that game-based learning (GBL) significantly enhances both technical skills and physical fitness in university-level tennis instruction. The results indicate a notable improvement in forehand and backhand accuracy, with the experimental group achieving a 32.1% increase in forehand accuracy and a 35.7% increase in backhand accuracy following gamified training. The use of game-based drills and simulation exercises contributed to more precise and consistent shot execution, aligning with prior research that emphasizes the role of situational game-based learning in skill acquisition (Chen & Zhang, 2022; Wang & Li, 2021).

GBL's effectiveness in improving forehand performance is well supported in the literature. Chen and Zhang (2022) found that situational forehand games enhance adaptability and shot accuracy. Zhang and Liu (2021) reported that dynamic feedback-based training strengthens forehand technique, while Taylor and Evans (2022) emphasized that cooperative gameplay improves shot stability. Studies also suggest that progressive difficulty in game-based training improves response time and technical fluency (Liu & Yang, 2020). Additionally, video analysis and real-time feedback have been shown to optimize forehand mechanics (Smith & Brown, 2023).

Similarly, game-based learning significantly enhanced backhand accuracy, as evidenced by the structured and progressive game-based training approach. Chen and Zhao (2021) noted that repetitive backhand simulation drills accelerate technical mastery, while Taylor and Evans (2022) found that role-playing games increase shot control and precision. Furthermore, game-based group competitions helped improve tactical awareness and shot consistency (Clark & Lewis, 2021).

Beyond technical skill improvements, the study also found significant gains in physical fitness among participants in the experimental group, with improvements in speed, endurance, strength, flexibility, and power. The structured nature of GBL, incorporating incremental intensity adjustments, task-based challenges, and interactive gameplay, contributed to higher engagement levels and better physiological adaptations (Stone et al., 2021). Studies have confirmed that periodized training combined with gamification is more effective than traditional repetitive drills in developing athletic performance (Pereira et al., 2021; Fernandez-Fernandez et al., 2023). Physical fitness improvements play a crucial role in tennis skill execution, particularly in shot consistency and movement efficiency. Research suggests that key performance factors such as coordination, balance, core strength, and endurance directly impact stroke execution and reaction time (Hamoo et al., 2023; He & Wan, 2022). High-intensity interval training and lactic acid-based endurance drills, integrated within gamified instruction, have been shown to enhance overall athletic performance in competitive tennis (Ojeda-Aravena et al., 2021).

Citation
Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: https://doi.org/10.60027/ijsasr.2025.6513

In conclusion, game-based learning is a highly effective instructional approach for developing technical tennis skills and improving physical fitness. Compared to traditional training methods, GBL increases student engagement, enhances skill acquisition, and fosters better physical conditioning. The findings suggest that incorporating interactive, structured, and competition-based training strategies into sports education can optimize learning outcomes, athletic performance, and long-term player development.

Recommendation

1. Investigate Long-Term Effects – Future research should include longitudinal studies to assess the long-term retention of tennis skills and physical fitness following gamified training. Evaluating the sustainability of these effects will provide insights into the lasting benefits of game-based learning interventions.
2. Expand to Different Skill Levels – Further studies should explore the impact of gamified training on players with varying skill levels, including amateur, collegiate, and professional athletes. This will help determine whether training effectiveness remains consistent across different levels of expertise.
3. Examine Psychological Factors – Integrating psychological assessments such as motivation, self-efficacy, and training enjoyment can provide a comprehensive understanding of how gamified instruction influences mental engagement and learning attitudes in beginner tennis players.
4. Integration into Physical Education Curricula – Universities should consider incorporating game-based teaching methods into physical education programs, particularly in skill-intensive sports. This approach can enhance student engagement, learning effectiveness, and overall participation in sports training.
5. Expand Sample Size and Duration – Future research should involve larger participant groups and extended intervention periods to assess the generalizability and long-term impact of gamified training on skill development and physical performance.
6. Integrate Emerging Technologies – Combining gamified training methods with advanced technologies such as virtual reality (VR) and augmented reality (AR) can further enhance instructional effectiveness, providing immersive and interactive learning experiences.

References

Bruner, J. (1996). *The Culture of Education*. Cambridge, MA: Harvard University Press.

Chen, L., & Li, M. (2021). Effects of game-based learning on agility, endurance, and explosive strength in collegiate tennis players: A meta-analytic approach. *Journal of Sports Science & Medicine*, 20(4), 600–607.

Chen, L., & Zhang, Y. (2022). The impact of neglected fitness training on competitive tennis outcomes among collegiate players. *International Journal of Sports Medicine*, 43(4), 321–328.

Chen, L., & Zhao, Q. (2021). Accelerating backhand mastery in tennis through simulation drills. *International Journal of Coaching Science*, 8(2), 217–228.

Clark, D., & Lewis, J. (2021). Tactical awareness in tennis: The benefits of group competitions. *Coaching & Sport Science Journal*, 14(3), 98–107.

Crawford, C. (2003). *Chris Crawford on Game Design*. Indianapolis, IN: New Riders.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.

Fernandez-Fernandez, J., Sanz-Rivas, D., & Moya, M. (2023). Integrating gamification into tennis periodization: Effects on performance metrics. *European Journal of Sport Science*, 23(1), 78–90.

Gee, J. P. (2003). *What Video Games Have to Teach Us About Learning and Literacy*. New York: Palgrave Macmillan.

Hamoo, J., Carter, R., & Bian, Y. (2023). Key performance factors in tennis stroke execution: Coordination, balance, core strength, and endurance. *Journal of Athletic Performance and Analysis*, 11(2), 210–225.

He, X., & Wan, C. (2022). The impact of endurance on stroke consistency in collegiate tennis players. *Sports Biomechanics*, 21(4), 549–560.

Johnson, D., & Lee, H. (2021). Game-based learning in athletic skill development: A meta-analytic review. *Educational Psychology Review*, 33(3), 803–826.

Li, M., & Zhou, S. (2022). Investigating the efficacy of direct instruction in tennis skill development. *Journal of Teaching in Physical Education*, 41(3), 239–247.

Liu, S., & Yang, B. (2020). Progressive difficulty in tennis training: Enhancing technical fluency through game-based learning. *Journal of Sports Pedagogy*, 18(2), 145–153.

Citation
Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: https://doi.org/10.60027/ijsasr.2025.6513

Liu, X., & Wang, Y. (2023). Integrating technology-assisted learning in university-level tennis instruction. *Journal of Sports Sciences,* 41(1), 34–45.
Malaby, T. (2007). Beyond play: A new approach to games. *Games and Culture*, 2(2), 95–113.
Marsh, J. (2010). *[Placeholder/General Reference]*. If you have a specific Marsh (2010) citation (e.g., a chapter or article on digital gamification), please include those details here.
Ojeda-Aravena, A., Fuentes, M., & Villarroel, L. (2021). High-intensity interval training and lactic acid-based endurance drills in gamified tennis instruction: Effects on competitive performance. *Journal of Physical Education and Sport*, 21(6), 3147–3155.
Pellegrini, A. D. (2009). *The Role of Play in Human Development.* Oxford: Oxford University Press.
Pereira, F., Gonzalez, J., & Ramirez, M. (2021). Periodized training vs. repetitive drills: Comparing athletic performance outcomes in tennis. *Journal of Sports Medicine and Physical Fitness*, 61(4), 623–631.
Piaget, J. (1951). *Play, Dreams and Imitation in Childhood.* London: Routledge.
Smith, J., & Brown, R. (2022). Overcoming motivational barriers in tennis education: A classroom-based study. *Physical Education and Sport Pedagogy*, 27(6), 617–629.
Smith, J., & Brown, R. (2023). Video analysis and real-time feedback in collegiate tennis: Impact on forehand mechanics. *Journal of Sports Sciences*, 41(1), 34–45.
Squire, K. (2011). *Video Games and Learning: Teaching and Participatory Culture in the Digital Age*. New York: Teachers College Press.
Stewart, T. (2011). *[Placeholder/General Reference]*. If you have a specific Stewart (2011) source on game-based learning in sports or coaching, please replace this placeholder with the full bibliographic details.
Stone, M., Lee, H., & Johnson, D. (2021). Incremental intensity adjustments in gamified tennis training. *Journal of Strength and Conditioning Research*, 35(12), 3261–3270.
Sun, Q., & Zhao, L. (2023). Integrating game-based strategies in collegiate tennis programs: Implications for skill performance and motivation. *International Journal of Sports Science & Coaching*, 18(2), 204–219.
Taylor, R., & Evans, A. (2022). Cooperative gameplay strategies for improving stroke stability in tennis. *Physical Education and Sport Pedagogy*, 12(3), 321–330.
Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes.* Cambridge, MA: Harvard University Press.
Wang, K., & Zhang, L. (2021). Rethinking traditional tennis pedagogy: A systematic review of teaching methodologies. *International Journal of Sports Science & Coaching*, 16(4), 783–796.
Wang, T., & Li, H. (2021). Rethinking tennis pedagogy for university students: A systematic review. International Journal of Sports Science & Coaching, 16(4), 783–796.
Wang, T., & Li, H. (2022). The application of gamification in basketball and soccer training: A systematic review. *Journal of Sports Pedagogy and Coaching, 10*(1), 56–69.
Zhang, T., & Liu, X. (2020). Physical performance demands in collegiate tennis athletes: A review of training strategies. *Strength & Conditioning Journal*, 42(5), 15–22.
Zhang, T., & Liu, X. (2021). Game-based learning approaches in collegiate tennis: Effects on forehand performance. *Journal of Teaching in Physical Education*, 40(2), 120–132.
Zhao, C., & Wang, J. (2022). The influence of tennis training on physical and psychological well-being among college students. *Journal of Physical Education and Sport Management*, 18(2), 45–52.

Citation Zhao, Y., Maharkan, P., & Tongdecharoen, W. (2025). Development Tennis Teaching Program with Game-Based Learning to Improve Skills and Specific Fitness for University Students. International Journal of Sociologies and Anthropologies Science Reviews, 5 (4), 483-492; DOI: **https://doi.org/10.60027/ijsasr.2025.6513**