

RESEARCH ARTICLE

Examining the Relationship of Physical Exercise Peer Support, Physical Activity, and Perceived Instructional Quality with Badminton Playing Skill

Ma. Teresa N. Bontuyan

ORCID: 0009-0007-1671-0276

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ABSTRACT

In post-pandemic Physical Education (PE) contexts where online and hybrid setups continue, skill development is often challenged by reduced structured physical engagement. These conditions reshape how peer support, daily physical activity, and perceived instructional quality relate to sport-specific skill development, such as badminton playing skill. The study employed a quantitative descriptive–correlational research design and involved 137 students from a public secondary school. Data were collected using validated questionnaires to measure peer support, physical activity levels, and perceived instructional quality, while badminton playing skills were assessed using a structured skill evaluation rubric. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to describe the variables, while canonical correlation analysis was utilized to examine the relationships among the predictor and criterion variable sets. Results revealed that students generally demonstrated moderate to high levels of physical exercise peer support, moderate levels of physical activity, good perceived quality of instruction in PE, and approaching proficiency in badminton playing skills. Canonical correlation analysis indicated that physical exercise peer support was not significantly associated with badminton playing skills. Similarly, physical activity showed a weak and non-significant relationship with badminton playing skills. Likewise, perceived instructional quality in PE showed the strongest, but still non-significant, relationship with badminton playing skills. These findings suggest that although students experience moderate physical activity and supportive instructional environments, these factors alone may not be directly associated with badminton skill performance among non-athlete students. The study highlights the importance of sport-specific training opportunities and structured skill-development activities to enhance students' badminton skills.

KEYWORDS Physical Exercise Peer Support, Physical Activity, Instructional Quality, Badminton Playing Skill, Online and Hybrid Physical Education

INTRODUCTION

Badminton is a complex sport requiring the integration of technical execution, perceptual-motor coordination, tactical awareness, and physical conditioning. Beyond its recreational value, badminton has emerged as a multifaceted sport that contributes to physical conditioning, cognitive development, and social interaction, making it increasingly relevant in educational and competitive settings (Farrel *et al.*, 2023; Hidayat *et al.*, 2022). Beyond competition, it has become a core activity in school-based Physical Education (PE) due to its accessibility, adaptability across skill levels, and contribution to physical literacy and psychosocial development (Farrel *et al.*, 2023; Hidayat *et al.*, 2022). Understanding the determinants of badminton skill acquisition is therefore essential in contemporary educational contexts.

Traditional PE instruction in badminton has emphasized technical drills and teacher-led demonstrations. However, emerging pedagogical perspectives indicate that motor skill development is influenced not only by instructional design but also by learners' physical activity behaviors and social learning environments (Caetano *et al.*, 2024; Wong *et al.*, 2019). Fragmented instructional approaches that focus solely on technical elements may limit the attainment of higher performance levels, as they often overlook behavioral, social, and motivational factors that influence sport participation and learning (Chen *et al.*, 2023; Liu *et al.*, 2021). Instruction that overlooks these contextual factors may limit progression, particularly in movement-intensive sports.

Physical activity is a well-established determinant of motor competence and sport performance. Regular engagement enhances neuromuscular efficiency, coordination, and endurance, which are critical for effective badminton performance (Piggin, 2020; Sandercock *et al.*, 2022). Yet, adolescents increasingly exhibit insufficient activity levels due to academic demands, sedentary lifestyles, and screen exposure (Coyoca *et al.*, 2024; Stiglic & Viner, 2019). Studies indicate that heavy academic workloads, increased digital device use, and limited supportive environments contribute to declining participation in regular physical activity among adolescents (Sember *et al.*, 2020; Stiglic & Viner, 2019).

Peer support represents an important social influence on youth physical engagement. Through encouragement, shared participation, and modeling, peers can enhance motivation, enjoyment, and persistence in physical activity (Bandura, 1986; Zhang *et al.*, 2022). Peer-supported activity has also been associated with improved adherence and psychological well-being (Ando *et al.*, 2020). In educational settings, positive peer interactions may strengthen participation in sports and exercise activities by creating socially supportive environments that foster motivation and engagement (Lin *et al.*, 2024; Zhang *et al.*, 2022).

Despite its motivational benefits, the direct contribution of peer support to sport-specific skill acquisition remains unclear. Evidence suggests that social support promotes engagement but does not necessarily translate into technical or perceptual-motor improvement without deliberate and structured practice (Robertson *et al.*, 2022). This highlights the need to examine how behavioral factors such as physical activity and social influences such as peer support interact with instructional conditions to influence sport-specific skill development. This distinction warrants closer examination in skill-based sports such as badminton.

Instructional quality is another critical factor influencing learning in Physical Education. High-quality instruction—characterized by clear demonstrations, structured progression, and individualized feedback—supports motor learning and skill refinement (Chen *et al.*, 2023; Liu *et al.*, 2021). However, instructional effectiveness may be limited when not accompanied by sufficient movement volume and practice intensity

(Dudley *et al.*, 2022; Howley *et al.*, 2022). Consequently, contemporary Physical Education research emphasizes the importance of integrating pedagogical, behavioral, and social factors in the development of sport skills.

These relationships are supported by multiple theoretical frameworks. Social Cognitive Theory emphasizes reciprocal interactions between personal, behavioral, and environmental influences (Bandura, 1986), while Dynamic Systems Theory highlights physical activity as a driver of motor skill emergence and stabilization (Thelen, 1989). Gagné's Conditions of Learning further underscore the role of instructional structure and feedback in learning readiness and performance (Gagné, 1985).

In the Philippine context, research on badminton skill development at the secondary level remains limited and often examines isolated predictors. Few studies integrate behavioral, social, and instructional factors despite their relevance to holistic Physical Education outcomes (Banawan & Barcelona, 2023; Potenciando *et al.*, 2024). Furthermore, the integration of behavioral and social perspectives in sport-specific skill acquisition remains underexplored in developing educational environments, where students often encounter barriers such as limited motivation, insufficient program design, and inadequate social support during physical activities (Penglee *et al.*, 2019). Thus, this study examined the relationships of physical exercise peer support, physical activity, and perceived instructional quality with badminton playing skill among Filipino high school students.

Statement of the Problem

This study aimed to determine the relationship between physical exercise peer support, physical activity, perceived quality of instruction, and badminton playing skill among the participants. Specifically, it seeks to answer the following research questions:

1. What is the level of the participants' physical exercise peer support in terms of:
 - 1.1. interest support;
 - 1.2. material support;
 - 1.3. emotional support; and
 - 1.4. behavioral support?
2. What is the participants' level of physical activity
 - 2.1. at work or study;
 - 2.2. during travel; and
 - 2.3. during leisure?
3. What is the participants' level of perceived quality of instruction in their Physical Education classes in terms of
 - 3.1. classroom management;
 - 3.2. motivational and emotional support;
 - 3.3. general cognitive-motor support;
 - 3.4. adjusted support for motor skill execution; and
 - 3.5. cognitive motor activation?
4. What is the participants' level of badminton playing skill in terms of:
 - 4.1. foot work & court movement
 - 4.2. stroke accuracy; and
 - 4.3. control?

5. Are physical exercise peer support, physical activity, and perceived quality of instruction significantly associated with badminton playing skills?

METHODS AND MATERIALS

This study employed a quantitative descriptive–correlational research design to examine the relationship of physical exercise peer support, physical activity, and perceived instructional quality with badminton playing skill among high school students. The design was appropriate because it allowed the researcher to describe naturally occurring variables and determine the relationships among them without manipulating any conditions within the school setting.

Participants were 137 high school students aged 15–18 years enrolled in Physical Education at a public high school in Cagayan de Oro City, Philippines, during the 2025–2026 school year. The participants represented a broader population of approximately 4,800 students enrolled in the institution and were selected because badminton is included as part of their Physical Education curriculum. The participants were general Physical Education students rather than varsity or competitively trained badminton athletes.

A simple random sampling technique was used so that each eligible student had an equal chance of selection. A certified list of eligible PE students was obtained from the school registrar and PE teachers, and each student was assigned a unique identification code; using Microsoft Excel's RAND function, the coded names were assigned random values, sorted, and the first set corresponding to the required sample size was selected. The resulting sample of 137 participants was considered adequate for the 15 variables examined in the canonical correlation analysis. Inclusion criteria required participants to be officially enrolled in PE during the 2025–2026 school year, aged 15–18 years, medically cleared for moderate physical activity, and willing to participate with signed parental consent and student assent.

Data were collected using four instruments. Physical exercise peer support was measured using the Physical Exercise Peer Support Questionnaire (PEPSQ), which includes 24 items across interest, material, emotional, and behavioral support dimensions rated on a five-point Likert scale. The PEPSQ has demonstrated strong construct validity and excellent internal consistency in prior validation research (Luo *et al.*, 2022). Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ), developed by the World Health Organization and previously shown to have acceptable reliability and validity (Thuy *et al.*, 2010), which was adapted into a five-point Likert format to measure the frequency of engagement in work/school-related, travel-related, and recreational physical activities.

Perceived instructional quality was measured using an adapted Perceived Instructional Quality in Physical Education Scale that assessed classroom management, motivational and emotional support, cognitive–motor support, adjusted support for motor skill execution, and cognitive–motor activation. Badminton playing skill was evaluated using a modified criterion-referenced version of the Lockhart and McPherson Badminton Skill Test focusing on footwork, stroke accuracy, and shuttle control. The original Lockhart and McPherson Badminton Skill Test has established reliability and validity, with a reported test–retest coefficient of 0.90 and validity coefficients ranging from 0.60 to 0.70 (Savitribai Phule Pune University, 2015). During the skill assessment, two trained raters independently evaluated each participant's footwork and court movement, stroke accuracy, and control using a five-point rubric.

Prior to the main data collection, a pilot test involving 30 students with similar characteristics to the target participants was conducted to assess clarity and reliability of the instruments. Cronbach's alpha results

indicated acceptable to very good reliability for peer support ($\alpha = .745$), physical activity ($\alpha = .852$), and perceived instructional quality ($\alpha = .924$), supporting their suitability for use in the study.

Data collection was conducted during scheduled Physical Education classes following standardized procedures. Participants first completed the questionnaires, which required approximately 20–30 minutes, followed by the badminton skill assessment consisting of warm-up exercises, three 30-second performance trials with rest intervals, and a short cool-down period.

Data were analyzed using descriptive and multivariate statistics. Frequencies, percentages, means, and standard deviations were computed to describe the participants' levels of physical exercise peer support, physical activity, perceived quality of instruction, and badminton playing skill. To examine the multivariate relationships between each set of predictor variables (peer support, physical activity, and perceived instructional quality) and the set of badminton-skill dimensions (footwork and court movement, stroke accuracy, and control), three separate canonical correlation analyses were conducted. For each analysis, the reported canonical correlation (R) refers to the first canonical function, and the statistical significance of the overall canonical relationship was evaluated using Wilks' Lambda and its associated chi-square (χ^2) approximation at the .05 level. Prior to analysis, diagnostic checks confirmed that the data met the assumptions for multivariate analysis, including the absence of missing data, acceptable normality, and no extreme outliers.

Ethical approval was obtained from the institutional research committee and permission was secured from school authorities. Participation was voluntary, and participants were informed of their right to withdraw at any time without penalty. Confidentiality was ensured through coded identifiers, and all data were securely stored in compliance with the Philippine Data Privacy Act of 2012.

RESULTS

Table 1 presents the summary of participants' physical exercise peer support across four dimensions: interest support, material support, emotional support, and behavioral support.

Table 1. Summary of Participants' Physical Exercise Peer Support

Dimension	Mean	SD	Interpretation
Interest Support	3.52	0.78	High
Material Support	3.36	0.88	Moderate
Emotional Support	3.59	0.90	High
Behavioral Support	3.31	0.84	Moderate
Overall Peer Support	3.45	0.85	Moderate to High

The results show that the overall level of peer support experienced by participants was moderate to high ($M = 3.45$, $SD = 0.85$). Among the four dimensions, emotional support obtained the highest mean score ($M = 3.59$), followed by interest support ($M = 3.52$), both interpreted as high levels of peer support. In contrast, material support ($M = 3.36$) and behavioral support ($M = 3.31$) were interpreted as moderate, suggesting that tangible assistance and active participation in exercise activities were less consistently experienced.

Table 2 presents the summary of participants' physical activity across three domains: work or study, travel, and leisure activities.

Table 2. Summary of Participants' Physical Activity

Domain of Physical Activity	Mean	SD	Interpretation
Work or Study	3.20	0.80	Moderately Active
Travel	3.52	0.72	Active
Leisure	3.23	0.89	Moderately Active
Overall Physical Activity	3.32	0.80	Moderately Active

The results indicate that the overall level of physical activity among participants was moderately active ($M = 3.32$, $SD = 0.80$). Among the three domains, physical activity during travel recorded the highest mean score ($M = 3.52$) and was interpreted as active, while physical activity during work or study ($M = 3.20$) and leisure-time physical activity ($M = 3.23$) were both interpreted as moderately active.

Table 3 shows that the participants generally perceived the quality of instruction in their Physical Education classes as good across all five dimensions, with an overall mean of 3.92 ($SD = 0.73$).

Table 3. Summary of Participants' Perceived Quality of Instruction in Physical Education Classes

Dimension of Instructional Quality	Mean	SD	Interpretation
Classroom Management	3.77	0.75	Good Instructional Quality
Motivational and Emotional Support	4.00	0.70	Good Instructional Quality
General Cognitive-Motor Support	4.01	0.77	Good Instructional Quality
Adjusted Support for Motor Skill Execution	3.88	0.74	Good Instructional Quality
Cognitive-Motor Activation	3.92	0.71	Good Instructional Quality
Overall Quality of Instruction	3.92	0.73	Good Instructional Quality

Among the dimensions, general cognitive-motor support obtained the highest mean ($M = 4.01$), followed closely by motivational and emotional support ($M = 4.00$) and cognitive-motor activation ($M = 3.92$). Adjusted support for motor skill execution ($M = 3.88$) and classroom management ($M = 3.77$) were likewise rated as good. These findings indicate that the participants generally viewed their PE teachers as organized, supportive, and effective in guiding both understanding and performance during class activities.

Table 4 shows that the participants' badminton playing skill was generally at the approaching proficiency level, with an overall mean of 2.64 ($SD = 0.81$).

Table 4. Frequency, Percentage, and Mean Distribution of the Participants' Badminton Playing Skill

Dimension of Badminton Playing Skill	Mean	SD	Interpretation
Footwork and Court Movement	2.68	0.75	Approaching Proficiency
Stroke Accuracy	2.76	0.86	Approaching Proficiency
Control	2.49	0.82	Developing
Overall Badminton Playing Skill	2.64	0.81	Approaching Proficiency

Among the three skill dimensions, stroke accuracy obtained the highest mean ($M = 2.76$), followed by footwork and court movement ($M = 2.68$), both interpreted as approaching proficiency. In contrast, control obtained the lowest mean ($M = 2.49$) and was interpreted as developing. These findings suggest that the participants had begun to acquire the fundamental technical and movement-related skills required in badminton, but their performance remained inconsistent and still required further refinement.

Table 5 summarizes the canonical correlation analyses examining whether physical exercise peer support, physical activity, and perceived quality of instruction in Physical Education were significantly associated with badminton playing skills, which included footwork, stroke accuracy, and shuttle control.

Table 5. Summary of Canonical Correlation Analysis Between Predictor Variables and Badminton Playing Skills

Predictor Variable	Canonical Correlation (R)	R ²	χ^2	df	p-value	Interpretation
Physical Exercise Peer Support	0.159	0.025	4.528	12	.972	Not Significant
Physical Activity	0.257	0.066	16.389	9	.059	Not Significant
Perceived Quality of Instruction	0.342	0.117	23.599	15	.072	Not Significant

The results revealed that none of the predictor variable sets showed a statistically significant relationship with badminton playing skills at the 0.05 level. Consequently, the null hypothesis stating that physical exercise peer support, physical activity, and perceived quality of instruction are not significantly associated with badminton playing skills cannot be rejected.

DISCUSSION

The relatively high levels of interest support indicate that many participants share common exercise interests, preferences, and encouragement with their peers. Such shared interests foster social bonding and collective engagement in physical activities. Previous studies have shown that peer networks play an important role in promoting physical activity participation by strengthening motivation, shared goals, and collective efficacy (Li, 2024; Sheng *et al.*, 2023; Zhang *et al.*, 2022). When students interact with peers who share similar exercise interests, they are more likely to sustain participation and develop positive attitudes toward physical activity.

Similarly, the high level of emotional support suggests that participants commonly receive encouragement, empathy, and reassurance from peers during exercise activities. Emotional peer support can help individuals cope with physical challenges, fatigue, or performance-related frustrations while enhancing psychological well-being and motivation. Research indicates that emotional encouragement from peers promotes persistence and enjoyment in sports participation, which can contribute to sustained engagement in physical activity (Peng *et al.*, 2025; Zeng, 2025; Wei *et al.*, 2025).

In contrast, material support and behavioral support were only moderately experienced by participants. Material support refers to tangible assistance such as providing sports equipment, transportation, or access to exercise facilities. Previous studies suggest that such resources are more commonly provided by family members rather than peers (Lin *et al.*, 2024). Meanwhile, behavioral support involves observable actions such as inviting friends to exercise, organizing group activities, or exercising together. The moderate level of behavioral support suggests that while peers may occasionally participate in sports-related activities together, they do not consistently organize or coordinate regular exercise routines.

Moreover, the moderately active level of physical activity at work or study suggests that students engage in physical movements such as walking, standing, or performing light physical tasks during academic activities. However, these activities generally occur intermittently and do not consistently reach vigorous levels of physical exertion. Previous studies indicate that academic environments often involve prolonged sedentary behaviors, with only occasional movement during routine tasks (Paul *et al.*, 2024; Kuruoğlu *et al.*, 2022). As a result, the physical activity accumulated during work or study is often insufficient to meet recommended activity levels for health benefits (Gay & Büchner, 2022).

In contrast, travel-related physical activity demonstrated the highest level of engagement, suggesting that many participants incorporate walking or cycling into their daily transportation routines. Active transportation provides practical opportunities for accumulating physical activity without requiring structured exercise sessions. Studies have shown that walking or cycling for transportation can significantly contribute to overall daily physical activity and support health promotion (Jessiman *et al.*, 2023; Mitáš, 2026). Nevertheless, some participants still reported moderate engagement in choosing active transportation, which may be influenced by environmental factors such as accessibility, distance, and safety conditions (Faber *et al.*, 2023; Nordengen *et al.*, 2021).

Meanwhile, leisure-time physical activity was also classified as moderately active, indicating that participants engage in recreational sports or exercise but not consistently at high intensity or frequency. Leisure-time activities often depend on personal motivation, time availability, and lifestyle habits. Previous research has shown that students' participation in vigorous recreational activities may be limited by academic workload, sedentary screen-based activities, and competing responsibilities (Coyoca *et al.*, 2024; Obra & Murcia, 2024). Consequently, although recreational activities provide opportunities for physical fitness development, students may not always sustain regular participation in high-intensity activities.

Regarding the good rating for classroom management, the result suggests that PE classes were perceived as orderly, safe, and well-structured. Effective classroom management in Physical Education is essential because it supports smooth transitions, minimizes disruptions, and creates a stable environment for participation and skill learning. The relatively strong ratings for safety reinforcement, class organization, and orderly learning conditions imply that teachers were able to establish clear expectations and maintain productive class routines. This supports previous findings that organized PE environments help improve student engagement and perceptions of instructional effectiveness (Chen & Zhou, 2021; Wang & Yong, 2024).

The participants also reported good motivational and emotional support, indicating that teachers were perceived as encouraging, responsive, and attentive to students' needs. This dimension reflects the role of the teacher in creating a positive emotional climate that fosters confidence, effort, and enjoyment in PE. The positive ratings for listening to students' concerns, motivating them to do their best, and making lessons engaging suggest that teachers contributed to a supportive atmosphere that may enhance students' willingness to participate in physical activities. Prior research has emphasized that emotionally supportive instruction promotes stronger engagement, confidence, and positive attitudes toward PE participation (Guo *et al.*, 2023).

Similarly, general cognitive-motor support received the highest rating, indicating that students perceived their teachers as effective in explaining exercises, emphasizing key movement concepts, and linking activities to meaningful application. This suggests that instruction did not focus only on physical performance but also on helping students understand how and why movements are performed. Such a finding is important because motor learning is enhanced when cognitive guidance is integrated with practice. Clear explanations, guided questioning, and meaningful demonstrations improve students' conceptual understanding and movement execution (Rahmaningrum, 2025; Wu *et al.*, 2025).

The findings further showed that adjusted support for motor skill execution and cognitive-motor activation were both rated as good. These dimensions reflect the teachers' ability to provide demonstrations, corrective feedback, alternative techniques, and opportunities for reflection during PE lessons. The results imply that students perceived instructional support as adaptive and responsive to their skill levels, while also encouraging them to think about their performance and how to improve it. Previous studies have shown that individualized feedback, reflective engagement, and cognitively stimulating tasks contribute to better motor skill acquisition, stronger confidence, and more meaningful learning experiences in Physical Education (Pontes *et al.*, 2023; Simpson *et al.*, 2025; Estevan *et al.*, 2023).

The footwork and court movement also indicate that most participants were still developing efficient positioning, balance, and movement patterns on the court. Footwork is a foundational component of

badminton performance because it enables players to respond quickly to the shuttle, maintain stability, and execute shots effectively. Previous studies have emphasized that agility, coordination, and movement efficiency are essential for successful badminton play (Akbari *et al.*, 2021; Wong *et al.*, 2019). The participants' scores suggest that while they had basic court movement abilities, many were still progressing toward more efficient and coordinated movement execution.

Similarly, stroke accuracy was also rated at the approaching proficiency level, indicating that participants had acquired basic striking skills but were still improving in terms of consistency and precision. Stroke accuracy is critical in badminton because it affects shuttle placement, rally control, and the ability to respond strategically during play. Research has shown that technical skills such as proper stroke execution, shot placement, and hand-eye coordination are central to badminton performance outcomes (Farrel *et al.*, 2023; Hidayat *et al.*, 2022). The current findings therefore suggest that although students can already execute basic strokes, they still need continued practice to achieve greater consistency and precision.

Among the three dimensions, control emerged as the weakest area, with participants classified only at the developing level. Shuttle control requires precise timing, racket control, body positioning, and coordination in order to regulate the speed, direction, and placement of the shuttlecock. As such, it is often one of the more challenging skills for beginner and intermediate learners to master. Previous literature has highlighted that control develops gradually through repeated practice, motor coordination training, and task-specific feedback (Jaworski *et al.*, 2020; Robertson *et al.*, 2022). The relatively lower rating for this dimension suggests that participants may still struggle with consistency in regulating their shots during play.

These findings may be understood in light of the participants' context as non-athlete high school students who engage in badminton primarily as part of their Physical Education classes rather than through specialized sports training. Their exposure to systematic drills, prolonged practice sessions, and competitive gameplay may therefore be limited. In addition, the frequency and duration of PE-based badminton instruction may not be sufficient to produce rapid gains in technical mastery, particularly in skills that require repetition and fine motor refinement. This may explain why the majority of participants clustered in the developing and approaching proficiency levels rather than in the proficient or advanced categories.

In the inferential part of the study, among the predictor variables, physical exercise peer support showed the weakest association with badminton playing skills ($R = 0.159$, $R^2 = 0.025$, $p = .972$), indicating that only 2.5% of the variance between the variable sets was shared. This finding suggests that while peer support may encourage participation in physical activity and foster motivation, it may not be directly associated with improvements in sport-specific technical skills. Previous studies have shown that peer support is often associated with exercise adherence, enjoyment, and psychological engagement rather than the direct development of technical sport performance (Li, 2024; Sheng *et al.*, 2023; Zhang *et al.*, 2022). In school settings, peer encouragement may help students remain active, but the acquisition of specialized skills such as badminton footwork and stroke execution typically requires structured practice and guided training.

Similarly, physical activity demonstrated a weak and statistically non-significant relationship with badminton playing skills ($R = 0.257$, $R^2 = 0.066$, $p = .059$). Although participants reported moderate to active levels of physical activity across domains such as work or study, travel, and leisure, these activities may not necessarily involve badminton-specific practice. General physical activity contributes to physical fitness, coordination, and overall movement capacity; however, sport-specific motor skills often develop through targeted training and repeated interaction with task-specific conditions (Piggin, 2020). Consistent with Dynamic Systems Theory, motor skill acquisition depends on the interaction between individual capabilities, environmental conditions, and task-specific constraints, meaning that general movement alone may not produce measurable improvements in specialized skills such as badminton stroke accuracy or shuttle control.

Among the predictor sets, perceived quality of instruction showed the strongest relationship with badminton playing skills, although the association remained statistically non-significant ($R = 0.342$, $R^2 = 0.117$, $p = .072$). This result suggests that while students perceived their PE instruction as supportive and well-

structured, such perceptions did not directly correspond to measurable differences in badminton performance. According to Gagné's Conditions of Learning, motor skill acquisition requires specific instructional events, including demonstrations, guided practice, and immediate feedback (Gagné, 1985). If opportunities for sustained hands-on practice are limited, instructional quality alone may not be sufficient for measurable improvements in technical skill performance.

These findings may also be interpreted within the broader context of the learning environment. As the participants were high school students who engaged in badminton primarily as part of their Physical Education classes rather than through specialized sports training, their opportunities for extended practice, intensive drills, and competitive play may have been limited. In such contexts, peer support, general physical activity, and positive instructional environments can enhance motivation and participation but may not independently account for technical skill development.

Several limitations should be considered when interpreting these findings. First, the three predictor sets were examined using separate canonical correlation analyses rather than a single combined model, and the shared variance for each function was modest ($R^2 = 0.025-0.117$); the canonical results should therefore be read as exploratory indicators of association rather than definitive multivariate effects. Second, although the badminton skill test was scored by two trained raters using a criterion-referenced rubric, inter-rater reliability was not formally quantified, which may affect the precision of the skill scores. Third, the data-gathering instruments were adapted from their original versions—the Global Physical Activity Questionnaire was converted into a five-point Likert frequency format, and the Lockhart and McPherson Badminton Skill Test was modified into a qualitative three-dimension rubric—so the established reliability and validity coefficients of the original instruments may not fully transfer to the adapted forms. Finally, the cross-sectional and correlational design precludes causal inferences, and the single-school sample limits the generalizability of the results to other contexts.

CONCLUSION

This study examined the relationships among physical exercise peer support, physical activity, perceived quality of instruction, and badminton playing skills among high school students. The findings indicated that participants generally experienced moderate to high levels of peer support, moderate levels of physical activity, and good instructional quality in Physical Education classes, while their badminton playing skills were mostly at the developing to approaching proficiency levels. However, the canonical correlation analysis revealed that physical exercise peer support, physical activity, and perceived instructional quality were not significantly associated with badminton playing skills. These results suggest that although social support, general physical activity, and positive instructional environments contribute to engagement in Physical Education, the development of sport-specific skills such as badminton performance may require more structured practice, targeted skill instruction, and consistent training opportunities within the learning environment.

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AI Declaration: This study utilized artificial intelligence tools to assist in preparing this article. Specifically, an AI assistant (ChatGPT) was used to help condense the full thesis manuscript into a reduced journal-article format and to enhance language quality, clarity, and tone, with human supervision and editing throughout. The author carefully reviewed and edited all outputs to ensure academic rigor and integrity.

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. Requests for access will be evaluated in accordance with ethical guidelines and data privacy policies.