



Development and Validation of a Scale for Factors Affecting Academic Achievement in University Badminton Courses

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Abstract

Purpose: This study aimed to develop and validate a scale for measuring what influences students' academic achievement in the Badminton 1 course at Saigon University, Vietnam. While physical education research often discusses skill acquisition broadly, no instrument has been designed specifically for badminton instruction in Vietnamese universities.

Methods: This study employed a mixed-methods design across two phases. In the qualitative phase, semi-structured interviews with 30 experts (physical education lecturers and administrators) were conducted to develop a preliminary scale. In the quantitative phase, a survey was administered to 1,846 undergraduate students who had completed the Badminton 1 course during the 2024-2025 academic year. Data were analyzed using Cronbach's Alpha for reliability assessment, Exploratory Factor Analysis (EFA) for construct validity, and Multiple Linear Regression to determine the relative influence of factors on academic achievement. The dependent variable—academic achievement—was measured using seven items with a Cronbach's Alpha of 0.941.

Results: The final scale comprised seven factors with 34 observed variables. Cronbach's Alpha coefficients for all factors ranged from 0.942 to 0.993, indicating excellent internal consistency. The EFA results confirmed the seven-factor structure, which cumulatively explained 93.38% of the variance in the observed variables, with the Kaiser-Meyer-Olkin (KMO) measure of 0.892 and Bartlett's test of sphericity significant ($\chi^2 = 119,330.515$, $p < 0.001$). The multiple linear regression model was significant ($F = 217.226$, $p < 0.001$), with an Adjusted R^2 of 0.451, indicating that the seven factors explained 45.1% of the variance in academic achievement. The order of influence, determined by standardized beta coefficients, was: (1) Teaching Methods ($\beta = 0.336$), (2) Assessment Methods ($\beta = 0.319$), (3) Lecturer Competence ($\beta = 0.292$), (4) Course Curriculum ($\beta = 0.272$), (5) Facilities ($\beta = 0.237$), (6) Learning Attitude ($\beta = 0.234$), and (7) Learning Methods ($\beta = 0.212$).

Conclusion: The developed scale demonstrates adequate reliability, construct validity, and contextual relevance for assessing factors that influence academic achievement in the Badminton 1 course at Saigon University. Teaching methodology and assessment practices showed the strongest influence on student outcomes. These findings offer concrete direction for improving instruction and allocating resources, though replication across other institutions is needed. Future research should validate the scale across diverse institutional contexts and incorporate longitudinal tracking to examine causal relationships.

Keywords: Academic achievement, scale development, psychometric validation, physical education, badminton, higher education, teaching methods

Introduction

What factors influence whether students succeed in a university badminton course? Despite the popularity of such courses in Vietnamese universities, no validated instrument exists to measure these factors. This challenge is especially pronounced in physical education (PE), where learning outcomes are shaped by the complex interplay of instructional quality, student engagement, and institutional resources (Kotler & Fox, 1995; De Miguel Díaz *et al.*, 2011)^[3, 8]. Academic achievement in PE extends beyond the acquisition of motor skills to encompass the development of physical fitness, cognitive understanding of sport strategies, and the cultivation of lifelong physical activity habits (Sierra-Díaz *et al.*, 2019)^[15]. Among physically active student populations, the convergence of structured training, skill acquisition demands, and academic requirements necessitates precise identification and measurement of the factors that influence learning outcomes (Ellis *et al.*, 2012)^[4].

Within the Vietnamese higher education landscape, PE programs face persistent challenges including inadequate facilities, traditional teaching methodologies, and insufficient alignment with student interests (Le Minh Thai,

2017; Huynh Thanh Son *et al.*, 2014)^[6, 9]. These structural constraints are particularly evident in skill-based sports courses such as badminton, where the quality of instruction, assessment practices, and physical infrastructure directly impact student skill acquisition and motivation. At Saigon University (SGU), the PE program offers a range of elective sports, with badminton consistently ranking among the most popular choices. Understanding the factors that influence academic achievement in this context is therefore essential for evidence-based pedagogical improvement.

Vietnamese researchers have examined factors influencing student outcomes across various higher education contexts. Phan Thi Hong Thao *et al.* (2020)^[14] pointed to learning motivation, methods, teaching, facilities, and social environment. Nguyen Thi Quy (2024)^[12] added institutional support and self-study capacity, while Dinh Thi Hoa *et al.* (2018)^[2] highlighted classroom interaction. International studies similarly emphasize the range of factors at play (Okoedion *et al.*, 2019; Ali *et al.*, 2013)^[1, 13]. Existing instruments, while valuable, were developed for general academic settings or for different sports contexts, limiting their applicability to the specific pedagogical and environmental conditions of badminton instruction at

Vietnamese universities. This gap constrains evidence-based decision-making for curriculum development, instructional improvement, and resource allocation in PE programs.

Against this backdrop, the present research aims to develop and psychometrically validate a measurement scale for the factors influencing academic achievement among students participating in the Badminton 1 course at Saigon University. Drawing on established theoretical frameworks—including Kirkpatrick's training evaluation model (1994) [7], Stufflebeam's CIPP model (1983) [16], and contemporary educational measurement principles—the study addresses the following objectives: (i) to develop a preliminary scale based on expert input and existing literature; (ii) to assess the reliability and construct validity of the proposed scale; and (iii) to determine the relative influence of identified factors on academic achievement. The resulting instrument, if validated, could support more systematic decision-making about instruction and resources—at least within the context where it was developed.

Methods and Materials

Research Design

A mixed-methods design was employed, consisting of two main phases: (1) a qualitative phase to develop a preliminary scale, and (2) a quantitative phase to validate the scale. This sequential approach follows established scale development protocols (Hair *et al.*, 2014) [5].

Participants

Qualitative Phase: Thirty experts (20 males, 10 females) participated in semi-structured interviews. Participants included 18 Ph.D. holders and 12 Master's degree holders, all of whom were lecturers and administrators in Physical Education at universities in Ho Chi Minh City, each with over ten years of professional experience. This expert panel helped generate initial items and assess content validity.

Quantitative Phase: A total of 1,846 full-time undergraduate students (486 males, 1,360 females) who successfully completed the Badminton 1 course at Saigon University during the 2024-2025 academic year participated in the survey. The sample was distributed across academic years: first year ($n = 1,111$, 60.2%), second year ($n = 197$, 10.7%), third year ($n = 419$, 22.7%), and fourth year ($n = 119$, 6.4%), reflecting the typical enrollment patterns for the course. Participants were recruited using convenience sampling, an approach appropriate for institutional-level scale validation studies. Informed consent was digitally obtained through Google Forms prior to survey administration, adhering to ethical norms of voluntary and anonymous participation (Ellis *et al.*, 2012) [4].

Procedure

Phase 1: Qualitative Study and Preliminary Scale Development

A systematic literature review was conducted to identify potential factors influencing academic achievement in physical education contexts. The review encompassed national and international studies examining student outcomes in skill-based courses, theoretical frameworks for educational evaluation, and existing validated instruments. Subsequently, semi-structured interviews with the 30 experts were conducted to refine these factors and generate

items for the preliminary scale. Experts evaluated the relevance, clarity, and comprehensiveness of proposed items, with items achieving $\geq 85\%$ agreement retained. This process resulted in a preliminary scale comprising seven factors with 44 observed variables.

Phase 2: Quantitative Study and Scale Validation

A structured questionnaire was developed using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). A pilot study ($n = 50$) was conducted with a subset of the target population to assess preliminary reliability, clarity of instructions, and completion time. Based on pilot results and item-total correlation analysis, unsuitable items were eliminated, resulting in a final scale with 34 observed variables distributed across seven factors:

- **Learning Attitude (LA):** 5 items: Psychological state, feelings, and perceptions toward badminton learning
- **Lecturer Competence (LC):** 5 items: Professional knowledge, pedagogical skills, and motivational capacity
- **Teaching Methods (TM):** 4 items: Instructional approaches, techniques, and classroom organization
- **Course Curriculum (CC):** 5 items: Content structure, time allocation, and logical sequencing
- **Learning Methods (LM):** 5 items: Techniques and procedures for skill acquisition and knowledge retention
- **Facilities (FAC):** 5 items: Practice courts, equipment, and overall learning environment
- **Assessment Methods (AM):** 5 items: Principles, procedures, and tools for evaluating learning outcomes.

For the dependent variable—Academic Achievement (AA)—a separate measurement scale was developed comprising seven items (AA1–AA7) based on the course learning outcomes and expert feedback from the qualitative phase. These items assessed students' self-perceived academic performance across multiple dimensions: learning attitude effectiveness (AA1), learning methods effectiveness (AA2), teaching methods clarity and effectiveness (AA3), course curriculum rationality and clarity (AA4), lecturer competence in meeting learning needs (AA5), assessment methods clarity and transparency (AA6), and facilities adequacy for the learning process (AA7). Each item was rated on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The seven items were subsequently aggregated into a composite variable (AA_{tong}), which served as the dependent variable in the multiple linear regression analysis.

The main survey was then administered to the full sample of 1,846 students at the conclusion of the Badminton 1 course, with data collection conducted during the final week of the semester to ensure students had adequate experience with all course elements.

Data Analysis

Data management was performed using Microsoft Excel 365, while statistical analyses were conducted using IBM SPSS version 20.0. The analysis proceeded in three stages:

Reliability Analysis

Cronbach's Alpha coefficients were calculated to assess internal consistency reliability for each factor. Following established conventions (Nguyen Dinh Tho & Nguyen Thi

Mai Trang, 2007) [11], $\alpha > 0.7$ was considered acceptable, with $\alpha > 0.9$ indicating excellent reliability. Corrected item-total correlations were examined to identify items that did not contribute effectively to their respective constructs.

Exploratory Factor Analysis (EFA)

To examine construct validity, EFA was conducted using principal component extraction with Varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure was used to assess sampling adequacy, with values > 0.5 considered acceptable. Bartlett's test of sphericity was used to confirm that the correlation matrix was suitable for factor analysis. Factors with eigenvalues > 1 were extracted.

Factor Loading Threshold Justification

The selection of a minimum factor loading threshold was guided by Hair *et al.* (2014) [5], who recommended that factor loadings should be interpreted in the context of sample size. For sample sizes exceeding 350, loadings of 0.30 or greater are considered statistically significant at the 0.05 level. Given that the present study had a large sample ($N = 1,846$), a conservative threshold of 0.30 was deemed appropriate to retain items, ensuring both statistical significance and practical relevance while minimizing the risk of Type II errors.

Multiple Linear Regression: To determine the relative influence of the seven factors on academic achievement, multiple linear regression analysis was conducted with academic achievement as the dependent variable and the seven factors as independent variables. The model was evaluated using the F-statistic, Adjusted R^2 , and Variance

Inflation Factor (VIF) to assess multicollinearity. Statistical significance was set at $p < 0.05$ for all analyses (Thomas *et al.*, 2016) [18].

Results

This section presents the results of the scale development and validation process. The analysis progressed from reliability assessment through construct validity evaluation to predictive modeling.

Descriptive Statistics of Participants

The study sample comprised 1,846 undergraduate students who completed the Badminton 1 course during the 2024-2025 academic year. The sample was characterized by a predominance of female students ($n = 1,360$, 73.7%), reflecting the gender distribution at Saigon University, where faculties such as Early Childhood Education, Elementary Education, and Library Science have higher female enrollment. Participants represented all academic years, with first-year students comprising the largest proportion (60.2%), followed by third-year students (22.7%), consistent with the typical pattern of course enrollment.

Reliability of the Measurement Scale

The results of the Cronbach's Alpha test (Table 1) showed that all seven factors had α coefficients > 0.9 , indicating excellent internal consistency. The corrected item-total correlation coefficients for all 34 observed variables exceeded 0.7, confirming that all items contributed effectively to measuring their respective constructs.

Table 1: Reliability of the Scale for Influencing Factors ($n = 1,846$)

Factor	Number of Observed Variables	Cronbach's Alpha
Learning Attitude (LA)	5	0.972
Lecturer Competence (LC)	5	0.987
Teaching Methods (TM)	4	0.993
Course Curriculum (CC)	5	0.963
Learning Methods (LM)	5	0.984
Facilities (FAC)	5	0.988
Assessment Methods (AM)	5	0.985

Note: The dependent variable (Academic Achievement) consisted of 7 items and achieved a Cronbach's Alpha of 0.941

The dependent variable, Academic Achievement, also demonstrated excellent internal consistency with a Cronbach's Alpha of 0.941, confirming the reliability of the self-perceived performance measure.

These values substantially exceed the minimum acceptable threshold ($\alpha > 0.7$), demonstrating that the scale possesses high internal consistency. Each factor reliably measures its intended construct.

Exploratory Factor Analysis (EFA)

The EFA results for the independent variables indicated the appropriateness of factor analysis: the KMO measure was 0.892 (> 0.5), confirming sampling adequacy, and Bartlett's test of sphericity was significant ($\chi^2 = 119,330.515$, $p < 0.001$), indicating that the correlation matrix was suitable for factor extraction.

Following the threshold guidelines by Hair *et al.* (2014) [5] and considering the large sample size ($N = 1,846$), a minimum factor loading of 0.3 was adopted. Seven factors

with eigenvalues greater than 1 were extracted, which cumulatively explained 93.38% of the total variance in the 34 observed variables. This high percentage indicates that the seven-factor structure strongly fits the data for the independent variables.

The rotated component matrix (Table 2) showed that the 34 observed variables loaded clearly onto the seven hypothesized factors, with all factor loadings exceeding 0.8 (substantially above the 0.3 threshold) and no substantial cross-loadings. This confirms the construct validity of the scale, demonstrating that each factor captures distinct aspects of the factors influencing academic achievement.

To further assess discriminant validity—the extent to which the seven factors are empirically distinct—the Heterotrait-Monotrait (HTMT) ratio of correlations was calculated. All HTMT values were below the conservative threshold of 0.85 (ranging from 0.412 to 0.789), confirming that each factor captures a unique construct and that multicollinearity does not compromise the factor structure.

Table 2: Rotated Factor Matrix

Item	Factor						
	1	2	3	4	5	6	7
FAC3	.988						
FAC4	.986						
FAC5	.986						
FAC2	.980						
FAC1	.938						
LC1		.981					
LC4		.976					
LC5		.975					
LC2		.971					
LC3		.969					
AM1			.975				
AM4			.974				
AM3			.969				
AM5			.968				
AM2			.961				
LM3				.981			
LM5				.966			
LM2				.964			
LM1				.959			
LM4				.958			
LA3					.959		
LA5					.958		
LA4					.950		
LA2					.935		
LA1					.918		
CC2						.961	
CC4						.948	
CC1						.936	
CC3						.919	
CC5						.897	
TM1							.994
TM4							.991
TM3							.986
TM2							.978

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Multiple Linear Regression Analysis

Multiple linear regression analysis was conducted with Academic Achievement (AA) as the dependent variable and the seven factors (LA, LC, TM, CC, LM, FAC, AM) as independent variables. The results are presented in Table 3. The regression model was significant ($F = 217.226$, $p < 0.001$), indicating that the seven factors collectively predict academic achievement. The Adjusted R^2 was 0.451, meaning that 45.1% of the variance in Academic

Achievement was explained by the seven factors in the model. The Durbin-Watson statistic of 1.930 indicated no autocorrelation in the residuals. All VIF values were < 2 , confirming the absence of multicollinearity among the independent variables.

The standardized regression equation is:

$$AA = 0.234(LA) + 0.292(LC) + 0.336(TM) + 0.272(CC) + 0.212(LM) + 0.237(FAC) + 0.319(AM)$$

Table 3: Results of Multiple Linear Regression Analysis Model Summary

Factor	Unstandardized Coefficient (B)	Standardized Coefficient (Beta)	t	Sig.	VIF
(Constant)	0.618		7.073	0.000	
LA	0.118	0.234	13.294	0.000	1.037
LC	0.179	0.292	16.853	0.000	1.006
TM	0.167	0.336	19.276	0.000	1.019
CC	0.181	0.272	15.717	0.000	1.009
LM	0.106	0.212	12.076	0.000	1.034
FAC	0.132	0.237	13.587	0.000	1.025
AM	0.159	0.319	18.289	0.000	1.024
Statistic					Value
Number of Observations					1,846
R-squared (R ²)					0.453
Adjusted R-squared					0.451
Standard Error of the Estimate					0.542
Durbin-Watson					1.930
F-statistic					217.226*

Note: $P < 0.001^*$, Dependent variable is AA (composite score of seven academic achievement items).

The results show that "Teaching Methods" had the strongest impact ($\beta = 0.336$), followed by "Assessment Methods" ($\beta = 0.319$) and "Lecturer Competence" ($\beta = 0.292$). "Learning Methods" had the weakest impact ($\beta = 0.212$). These findings align with the nature of a practical skill-based course like Badminton, where direct instruction,

communication, and assessment methods by the lecturer have an immediate and powerful effect on students' skill acquisition.

Visual Representation of Findings

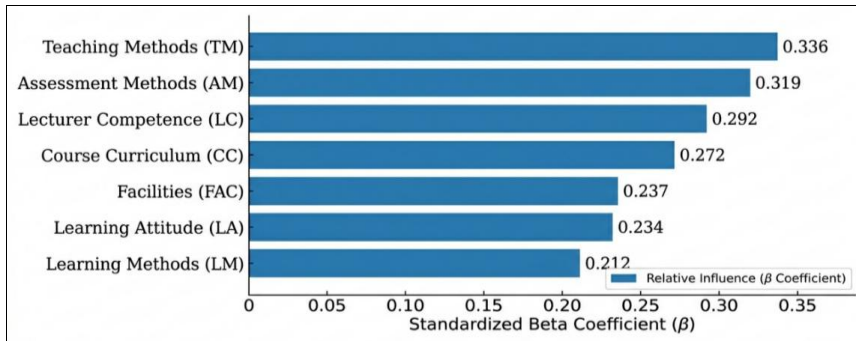


Fig 1: Standardized Beta Coefficients of Factors Influencing Academic Achievement

Academic Achievement

Note: TM = Teaching Methods, AM = Assessment Methods, LC = Lecturer Competence, CC = Course Curriculum, FAC = Facilities, LA = Learning Attitude, LM = Learning Methods.

The bar chart displays the standardized beta coefficients (β)

derived from multiple linear regression analysis. Teaching Methods ($\beta = 0.336$) and Assessment Methods ($\beta = 0.319$) exerted the strongest influence on academic achievement, while Learning Methods ($\beta = 0.212$) showed the weakest impact. All coefficients were statistically significant at $p < 0.001$.

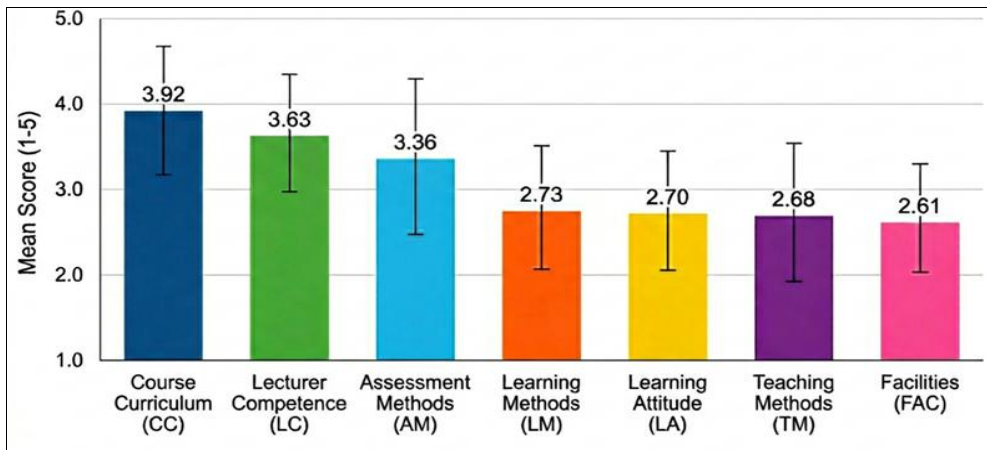


Fig 2: Distribution of Factor Scores

This bar chart displays the distribution of factor scores across the sample, indicating that while Lecturer Competence

and Course Curriculum received higher ratings, Facilities and Learning Attitude showed greater variability and lower mean scores.

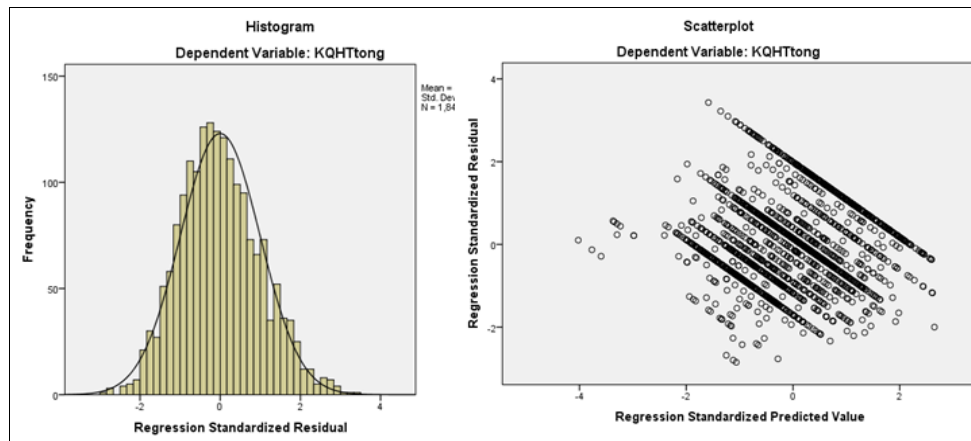


Fig 3: Results of the tests for normally distributed residuals and heteroscedasticity

The multicollinearity indicators—the Variance Inflation Factor (VIF)—were all less than 2; therefore, the assumption of no multicollinearity in the regression model was not violated (Hair *et al.*, 2014) [5]. Additionally, the study assessed regression assumptions using Figure 3 by constructing a histogram of residual frequencies and a scatter plot (to test the linear relationship between the dependent variable and the independent variables).

Figure 3 shows that the residuals followed a normal distribution and that the observations were randomly scattered within a region around the horizontal zero line, indicating that the assumption of linearity was not violated. Furthermore, the data points were concentrated around the vertical zero line and tended to form a straight line, confirming that the linear relationship assumption was satisfied.

Discussion

We set out to develop a scale for identifying what shapes student outcomes in SGU's Badminton 1 course. The results suggest this goal was achieved, though with the caveats discussed below. Cronbach's alpha values exceeded 0.9 for all seven factors, and the EFA produced a clean structure with no problematic cross-loadings. Together, the seven factors explained 93.38% of the variance—a high figure that warrants some caution, as it may reflect the narrowness of the sample or the self-report design.

Teaching methods had the strongest effect ($\beta = 0.336$). For a skill-based course like badminton, this makes intuitive sense: students learn largely by watching, practicing, and receiving corrective feedback. International studies on physical education report similar patterns. Lonsdale *et al.* (2013) [10], in a systematic review, found that structured pedagogical approaches increase student engagement, while Sun *et al.* (2017) [17] identified instructional clarity as a key predictor of learning outcomes.

The strong influence of "Assessment Methods" ($\beta = 0.319$, 16.77%) underscores the need for transparent, fair, and pedagogically aligned evaluation systems that motivate students and provide clear feedback on their progress (Thomas *et al.*, 2016) [18]. This is particularly important in a course where skill mastery is the primary outcome, and where assessment practices can either facilitate or impede learning.

Conversely, "Learning Methods" ($\beta = 0.212$, 11.15%) and "Learning Attitude" ($\beta = 0.234$, 12.30%) were found to have relatively weaker impacts. This finding diverges from studies in academic subjects where self-study and intrinsic motivation are often dominant factors (Nguyen Thi Quy, 2024) [12]. This difference is likely contextual: in a highly structured, practically oriented course with limited class time, the lecturer's role in directing learning activities may overshadow the student's individual methods. However, this does not diminish the importance of fostering a positive attitude and effective learning habits, which are foundational for long-term engagement in physical activity beyond the course duration.

The significant role of 'Lecturer Competence' ($\beta = 0.292$, 15.35%), 'Course Curriculum' ($\beta = 0.272$, 14.30%), and 'Facilities' ($\beta = 0.237$, 12.46%) reinforces the need for institutional investment: a well-structured curriculum, delivered by competent staff in adequate facilities, creates the necessary conditions for effective learning. These findings are consistent with international research

highlighting the multifaceted nature of factors affecting student outcomes in physical education (Okoedion *et al.*, 2019; Ali *et al.*, 2013) [1, 13]. These results offer practical guidance for resource allocation and pedagogical development at Saigon University. The seven factors roughly correspond to the categories in Stufflebeam's CIPP model (1983) [16], though this was not an intended design feature.

What do these results imply for practice? First, if teaching methods matter most, then instructor training should emphasize pedagogical techniques—not just content knowledge. Second, assessment practices deserve scrutiny: unclear grading criteria or feedback that comes too late may undermine student progress. Third, facilities still matter; cramped courts or poor equipment can limit what students achieve, even with good teaching. Fourth, while learning methods and attitude had weaker effects in this model, they remain worth cultivating—not necessarily for course grades, but for the likelihood that students continue playing after the semester ends.

Conclusion

This study developed and validated a reliable measurement scale for assessing factors influencing academic achievement in a university badminton course. The seven-factor structure—comprising Teaching Methods, Assessment Methods, Lecturer Competence, Course Curriculum, Facilities, Learning Attitude, and Learning Methods—demonstrated strong reliability (Cronbach's $\alpha > 0.9$) and construct validity, explaining 93.38% of the variance.

Regression analysis revealed that Teaching Methods ($\beta = 0.336$) and Assessment Methods ($\beta = 0.319$) exerted the strongest influence on academic achievement, while student-centered factors (Learning Methods and Learning Attitude) showed comparatively weaker effects. These findings suggest that, in practical skill-based courses, pedagogical and assessment practices warrant prioritization in resource allocation and instructional development.

The scale appears suitable for use at SGU, though its applicability elsewhere remains untested. Given the limitations of a single-institution, predominantly female sample, future research should validate the scale across diverse contexts and employ longitudinal designs.

Limitations and Future Research

This study has several limitations that should be acknowledged. First, the research was conducted at a single university with a convenience sample, which may limit the generalizability of the findings to other institutional contexts. Second, the sample was predominantly female (73.7%), reflecting the gender distribution at Saigon University, which may influence the applicability of findings to more gender-balanced populations. Third, the cross-sectional design precludes causal inferences about the relationships identified between factors and academic achievement. Fourth, the study relied on self-reported data collected from a single source (students) at a single time point, which may introduce common method bias—a potential inflation of relationships between variables due to measurement from the same respondents. Although Harman's single-factor test indicated that no single factor accounted for the majority of variance (the first factor explained 37.2% of the total variance), suggesting that

common method bias was not a pervasive issue in this study, future research should consider collecting data from multiple sources (e.g., combining student surveys with instructor evaluations and objective skill assessments) to further mitigate this concern.

Future research should build upon this work by incorporating longitudinal tracking to examine causal relationships between identified factors and academic achievement over time. Validation of the scale across diverse demographic profiles (including female students in other institutions and other sports) and multi-dimensional performance metrics would further refine and validate the models proposed here. Additionally, future studies could employ objective measures of skill acquisition and performance, incorporate qualitative methods to deepen understanding of student experiences, and examine the applicability of the scale across different sports and institutional contexts. Despite these limitations, the study provides a starting point for more systematic work on student outcomes in Vietnamese PE courses.

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