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Determinants of badminton learning outcomes in higher education: Empirical evidence from Saigon University, Vietnam

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Abstract
Compulsory Physical Education (PE) courses in Vietnamese universities aim to build motor competence, physical fitness, and regular exercise habits among undergraduates. Few domestic studies, however, have tested instructional, institutional, and learner predictors within a single model while checking whether student self-ratings match official university course grades. Drawing on Biggs' constructive alignment theory, Bandura's social cognitive theory, and Kirkpatrick's training evaluation framework, this study examined what drives student achievement in Badminton 1 at Saigon University (SGU) and tested whether outcomes differed across student subgroups. A two-phase sequential mixed-methods design was used. Thirty PE lecturers and domain experts first reviewed the questionnaire items for content clarity and relevance. Survey responses were then collected from 1,846 undergraduates completing Badminton 1 across 14 faculties, four study years, and two class sessions, and linked to official final course grades in IBM SPSS Statistics. Principal Component Analysis with Varimax rotation extracted seven independent constructs across 34 items (KMO = 0.892, Bartlett's χ^2 = 119,330.515, df = 561, $p < 0.001$, explaining 93.375% of variance) and a single learning outcome factor across 7 items (KMO = 0.876, Bartlett's χ^2 = 14,542.392, df = 21, $p < 0.001$, loadings from 0.795 to 0.947). Multiple regression explained 45.3% of the variance in learning outcomes ($R = 0.673$, $R^2 = 0.453$, Adjusted $R^2 = 0.451$, $F(7, 1838) = 217.226$, $p < 0.001$). Teaching Methods (TM, $\beta = 0.336$) and Assessment Methods (AM, $\beta = 0.319$) had the strongest effects, followed by Lecturer Competency (LC, $\beta = 0.292$), Course Curriculum (CC, $\beta = 0.272$), Facilities and Equipment (FE, $\beta = 0.237$), Student Learning Attitude (SLA, $\beta = 0.234$), and Learning Methods (LM, $\beta = 0.212$) (all $p < 0.001$). Rescaled self-reported scores (M = 7.84, SD = 1.461) correlated closely with official final grades (M = 7.63, SD = 1.805, $r = 0.643$, $p < 0.001$). Group tests showed no significant differences by gender, study year, class session, or faculty (all $p > 0.05$). How instructors organize court practice and evaluate student progress matters more for badminton achievement than physical facilities alone.

Keywords: Physical education, badminton, learning outcomes, exploratory factor analysis, multiple linear regression, constructive alignment, higher education, Vietnam

Introduction

Under Circular No. 25/2015/TT-BGDĐT issued by Vietnam's Ministry of Education and Training (MOET, 2015) [10], Physical Education (PE) is a mandatory part of undergraduate training, designed to improve student fitness, basic motor skills, and regular physical activity habits. Evidence from university health and sport pedagogy indicates that structured physical activity during college years helps offset prolonged sitting and supports students' physical and mental well-being (Bailey *et al*., 2009; Sallis *et al*., 2012) [1, 11]. Unlike secondary school classes, however, university PE brings together large cohorts from very different academic majors, with wide gaps in coordination, prior sport experience, and weekly study schedules (Lonsdale *et al*., 2013) [9].

At Vietnamese public universities, running practical sport courses often involves tight court capacity, limited gear, and uniform drills that can discourage beginners (Huynh *et al*., 2014; Le, 2017) [5]. Saigon University (SGU), a large multidisciplinary public university in Ho Chi Minh City, offers Badminton 1 as a core practical PE course across 14 academic faculties, four undergraduate cohorts, and morning or afternoon class sessions. The syllabus pairs 2 periods of classroom theory with 28 periods of court practice across 10 weeks (one session per week), concluding with practical skill and match-play grading.

Although PE reform has received growing administrative attention in Vietnam, existing domestic studies leave two issues unresolved. Many focus on single factors—such as court satisfaction or general motivation—rather than testing teaching delivery, curriculum design, grading transparency, lecturer skill, campus facilities, and student study habits together. Most also rely only on student opinion questionnaires without verifying whether self-reported gains match official grades recorded by the university.

To address both issues, this study applies Biggs' (1996) [3] constructive alignment theory, Bandura's (1986) [2] social cognitive theory, and Kirkpatrick's (1994) [7] evaluation model to Badminton 1 at SGU. We examine three questions: (1) How strongly do teaching methods, assessment methods, lecturer competency, course curriculum, facilities and equipment, student learning attitude, and learning methods predict learning outcomes in Badminton 1? (2) How closely do students' self-reported learning outcomes match their official final course grades? (3) Do learning outcomes vary across student gender, academic year, class session, and academic faculty?

Theoretical Framework and Hypotheses

Explaining student achievement in university sport courses requires looking at classroom instruction, institutional resources, and learner effort together. Biggs' (1996) [3]

constructive alignment theory holds that students learn more effectively when course goals, practice activities, and grading tasks reinforce one another. Bandura's (1986) [2] social cognitive theory adds that skill acquisition reflects an ongoing interaction between personal motivation or study habits and environmental support such as instructor modeling and court access. Kirkpatrick's (1994) [7] training evaluation framework further stresses checking learner self-assessments against objective performance records.

1. Instructional Alignment: Teaching, Assessment, and Curriculum

In beginner racquet courses, Teaching Methods (TM) directly affect how fast students pick up basic strokes and footwork. Clear visual demonstrations, step-by-step drills, varied grouping (individual, pair, small-group, and team work), and game-based exercises help novices get past early coordination hurdles and stay engaged (Lonsdale *et al*., 2013; Sierra-Díaz *et al*., 2019) [9, 12]. Assessment Methods (AM) guide where students put their effort. When grading criteria are clear, fair, and backed by timely instructor feedback rather than relying solely on a single end-of-term test, students show stronger technical mastery (Biggs, 1996; Kirkpatrick, 1994) [3, 7]. Course Curriculum (CC) sets the structural frame: logical drill progression, clear theory notes, a workable split between theory (2 periods) and practice (28 periods), and realistic 10-week pacing keep course expectations aligned with student capacity.

2. Campus Environment, Lecturer Role, and Student Agency

Under Bandura's (1986) [2] social cognitive view, Lecturer Competency (LC)—technical command of badminton, clear explanations, approachable court manner, flexible pedagogy, and punctuality—provides a social model that builds student confidence. Facilities and Equipment (FE), including playable courts, safe racquets and shuttlecocks, ventilated theory rooms, and clean restrooms, govern how much active practice time each student actually gets per session. Student effort enters through two channels: Student Learning Attitude (SLA), which reflects attentiveness, discipline, persistence, and enthusiasm, and Learning Methods (LM), which captures self-directed habits such as organizing practice time, training outside class, applying skills in games, and reviewing instructional videos.

Based on these relationships, seven hypotheses were tested regarding student Learning Outcomes (LO) in Badminton 1:

H1: Teaching Methods (TM) positively predict student Learning Outcomes (LO).

H2: Assessment Methods (AM) positively predict student Learning Outcomes (LO).

H3: Lecturer Competency (LC) positively predicts student Learning Outcomes (LO).

H4: Course Curriculum (CC) positively predicts student Learning Outcomes (LO).

H5: Facilities and Equipment (FE) positively predict student Learning Outcomes (LO).

H6: Student Learning Attitude (SLA) positively predicts student Learning Outcomes (LO).

H7: Learning Methods (LM) positively predict student Learning Outcomes (LO).

Methods and Materials

1. Study Design and Ethical Approval

We used a two-phase sequential mixed-methods design (Johnson & Onwuegbuzie, 2004; Hair *et al*., 2010) [4, 6]. In Phase 1, domain experts reviewed the draft questionnaire to verify content validity and item wording. In Phase 2, undergraduate students completing Badminton 1 at SGU completed the survey, and their responses were matched with official final grades from the Office of Academic Affairs. The study protocol was approved by the Faculty of National Defense, Department of Security & Physical Education at Saigon University. Participation was voluntary, students gave informed consent before completing the form, and all student IDs were anonymized before statistical analysis.

2. Participants and Sampling

Phase 1 involved 30 PE lecturers and academic specialists from Saigon University, Ho Chi Minh City University of Physical Education and Sport, Ho Chi Minh City University of Education, University of Science (VNU-HCM), and Ho Chi Minh City University of Technology.

Phase 2 surveyed undergraduates enrolled in Badminton 1 at SGU, yielding 1,846 valid, complete records paired with official course grades on a 10-point scale. Because responses were screened for completeness prior to coding, there were no missing values in the analytical dataset (n = 1,846). By study year, the sample included Year 1 (n = 1,111, 60.2%), Year 2 (n = 197, 10.7%), Year 3 (n = 419, 22.7%), and Year 4 (n = 119, 6.4%). Classes were split between morning sessions (Session 1: n = 992, 53.7%) and afternoon sessions (Session 2: n = 854, 46.3%) across 14 academic faculties: Information Technology (n = 89), Education (n = 33), Political Education (n = 9), Early Childhood Education (n = 18), Primary Education (n = 27), Social Sciences and Humanities (n = 80), Engineering and Technology (n = 211), Law (n = 226), Foreign Languages (n = 112), Business Administration (n = 772), Natural Science Education (n = 5), Finance and Accounting (n = 147), Applied Mathematics (n = 49), and Culture and Tourism (n = 68).

3. Survey Instrument and Score Scaling

During expert review, initial item pools for Student Learning Attitude (6 draft items), Lecturer Competency (6 draft items), and Teaching Methods (5 draft items) were trimmed to remove overlapping wording, leaving 41 validated items rated on a 5-point Likert scale (1 = Strongly Disagree / Very Dissatisfied to 5 = Strongly Agree / Very Satisfied). Thirty-four items measured seven independent constructs: Student Learning Attitude (SLA1–SLA5; 5 items), Lecturer Competency (LC1–LC5; 5 items), Teaching Methods (TM1–TM4; 4 items), Course Curriculum (CC1–CC5; 5 items), Learning Methods (LM1–LM5; 5 items), Facilities and Equipment (FE1–FE5; 5 items), and Assessment Methods (AM1–AM5; 5 items). Seven items measured the dependent construct, Learning Outcomes (LO1–LO7), covering perceived gains in disciplined study attitude, practice efficiency, instructional clarity, curriculum grasp, competency satisfaction, grading transparency, and facility adequacy. To compare perceived outcomes directly against official university grades (0–10 scale), each student's composite LO mean score (1–5 scale) was linearly rescaled to a 10-point metric by multiplying the mean by 2.

4. Statistical Analysis

Data were analyzed in IBM SPSS Statistics in five steps. First, item and construct means and standard deviations were computed. Second, Exploratory Factor Analysis (EFA) was run via Principal Component Analysis (PCA) with Varimax rotation and Kaiser normalization (KMO ≥ 0.50, Bartlett's test $p < 0.05$, eigenvalues > 1.0, factor loadings ≥ 0.50). Third, multiple linear regression tested H1–H7 simultaneously, checking R^2, Adjusted R^2, F-test, standardized β weights, Variance Inflation Factors (VIF < 2.0), and the Durbin-Watson statistic. Fourth, rescaled self-reported LO scores were checked against official final grades using Pearson correlation (r), a paired-samples t-test, and simple linear regression. Fifth, subgroup differences were tested using an Independent Samples t-test for gender and One-Way ANOVA (with Levene's variance homogeneity test and Bonferroni post-hoc checks) for academic year, class session, and the 14 faculties.

Results

1. Factor Structure and Descriptive Statistics

For the 34 independent items (n = 1,846), the Kaiser-Meyer-Olkin (KMO) index was 0.892 and Bartlett's test of sphericity was significant ($\chi^2 = 119{,}330.515$, df = 561, $p < 0.001$), supporting factor analysis. PCA with Varimax rotation (converging in 5 iterations) extracted seven components with eigenvalues above 1.0 (from 3.175 to 5.259), accounting for 93.375% of cumulative rotated variance. Every item loaded strongly on its intended factor (0.897 to 0.994) with no cross-loadings. These high within-factor loadings and cumulative variance reflect tight item-level coherence within each single-course sub-scale when students evaluate a specific, standardized 10-week module.

A separate PCA on the 7 dependent items (LO1–LO7) produced a KMO of 0.876 and a significant Bartlett's test ($\chi^2 = 14{,}542.392$, df = 21, $p < 0.001$), extracting one unidimensional factor with loadings from 0.795 to 0.947 (LO1 = 0.947, LO6 = 0.939, LO2 = 0.885, LO4 = 0.858, LO7 = 0.816, LO3 = 0.809, LO5 = 0.795). On the 5-point scale (Table 1), students gave the highest mean ratings to Course Curriculum (M = 3.9428, SD = 1.09919), Learning Outcomes (M = 3.9225, SD = 0.73060), and Lecturer Competency (M = 3.6328, SD = 1.18759), followed by Assessment Methods (M = 3.3654, SD = 1.47024), Learning Methods (M = 2.7321, SD = 1.46236), Student Learning Attitude (M = 2.7051, SD = 1.44297), Teaching Methods (M = 2.6834, SD = 1.46510), and Facilities and Equipment (M = 2.6122, SD = 1.31265).

Table 1: Construct Summary, EFA Eigenvalues, Variance Explained, and Descriptive Statistics (n = 1,846)

Construct / Variable	Code	Items	Initial Eigenvalue	Rotated Variance (%)	Mean (M)	Std. Dev. (SD)
Facilities and Equipment	FE	5	5.259	14.087	2.6122	1.31265
Lecturer Competency	LC	5	5.166	13.995	3.6328	1.18759
Assessment Methods	AM	5	4.899	13.900	3.3654	1.47024
Learning Methods	LM	5	4.673	13.817	2.7321	1.46236
Student Learning Attitude	SLA	5	4.457	13.229	2.7051	1.44297
Course Curriculum	CC	5	4.119	12.820	3.9428	1.09919
Teaching Methods	TM	4	3.175	11.527	2.6834	1.46510
Learning Outcomes (Dependent)*	LO	7	Unidimensional	Loadings: .795–.947	3.9225	0.73060

Note: Independent variables KMO = 0.892, Bartlett's $\chi^2 = 119{,}330.515$ (df = 561, $p < 0.001$), cumulative rotated variance = 93.375%. Dependent variable LO extracted as a single unidimensional component (KMO = 0.876, Bartlett's $\chi^2 = 14{,}542.392$, df = 21, $p < 0.001$; unrotated component matrix loadings from 0.795 to 0.947).

2. Multiple Linear Regression (Hypotheses H1–H7)

Multiple linear regression tested the simultaneous impact of the seven independent constructs on composite Learning Outcomes (LO). As shown in Table 2, the model was statistically significant ($F(7, 1838) = 217.226$, $p < 0.001$) and accounted for 45.3% of the variance in LO ($R = 0.673$, $R^2 = 0.453$, Adjusted $R^2 = 0.451$, Standard Error of the Estimate = 0.54150). Tolerance values (0.965 to 0.994) and Variance Inflation Factors (VIF: 1.006 to 1.037) ruled out multicollinearity, and the Durbin-Watson value of 1.930 indicated independent residuals.

All seven predictors had positive, statistically significant effects at $p < 0.001$, supporting H1 through H7. Standardized regression weights (β) showed that Teaching Methods (TM: $\beta = 0.336$, $t = 19.276$, $p < 0.001$) and Assessment Methods (AM: $\beta = 0.319$, $t = 18.289$, $p < 0.001$) were the strongest predictors, followed by Lecturer Competency (LC: $\beta = 0.292$, $t = 16.853$, $p < 0.001$), Course Curriculum (CC: $\beta = 0.272$, $t = 15.717$, $p < 0.001$), Facilities and Equipment (FE: $\beta = 0.237$, $t = 13.587$, $p < 0.001$), Student Learning Attitude (SLA: $\beta = 0.234$, $t = 13.294$, $p < 0.001$), and Learning Methods (LM: $\beta = 0.212$, $t = 12.076$, $p < 0.001$).

Table 2: Multiple Linear Regression Results Predicting Badminton Learning Outcomes (n = 1,846)

Predictor Variable	Code	Unstd. B	Std. Error	Std. β	t-value	p-value	VIF	Rank
(Constant)	—	0.619	0.088	—	7.073	< 0.001	—	—
Teaching Methods (H1)	TM	0.167	0.009	0.336	19.276	< 0.001	1.019	1
Assessment Methods (H2)	AM	0.159	0.009	0.319	18.289	< 0.001	1.024	2
Lecturer Competency (H3)	LC	0.179	0.011	0.292	16.853	< 0.001	1.006	3
Course Curriculum (H4)	CC	0.181	0.012	0.272	15.717	< 0.001	1.009	4
Facilities and Equipment (H5)	FE	0.132	0.010	0.237	13.587	< 0.001	1.025	5
Student Learning Attitude (H6)	SLA	0.118	0.009	0.234	13.294	< 0.001	1.037	6
Learning Methods (H7)	LM	0.106	0.009	0.212	12.076	< 0.001	1.034	7

Note: Dependent variable = LO (composite Learning Outcomes). Model summary: $R = 0.673$, $R^2 = 0.453$, Adjusted $R^2 = 0.451$, $F(7, 1838) = 217.226$ ($p < 0.001$), Durbin-Watson = 1.930.

3. Criterion Check: Self-Reported Outcomes vs. Official Course Grades

To verify whether student perceptions matched actual academic records, rescaled self-reported learning outcomes on the 10-point scale (M = 7.84, SD = 1.461, Median = 8.00, Min = 4.00, Max = 10.00) were tested against official Badminton 1 final grades retrieved from university records (M = 7.63, SD = 1.805, Median = 7.40, Min = 3.00, Max = 10.00). Pearson correlation showed a strong positive association between self-reported scores and actual course grades ($r = 0.643$, $p < 0.001$, $n = 1,846$).

In a simple linear regression predicting official grades from rescaled self-reported scores, perceived outcomes explained 41.4% of the variance in final grades ($R = 0.643$, $R^2 = 0.414$, Adjusted $R^2 = 0.413$, Standard Error of the Estimate = 0.616; B = 0.354, SE = 0.010, Constant = 4.855, $F(1, 1844) = 1301.315$, $t = 36.074$, $p < 0.001$). A paired-samples t-test showed a small mean difference of -0.210 points between official grades and self-reported scores (SD = 1.127, SE = 0.026, $t = -8.007$, $df = 1,845$, $p < 0.001$). Students rated their perceived learning slightly above their formal grades, yet their self-evaluations tracked actual course performance closely.

4. Subgroup Comparisons Across Student Characteristics

Independent Samples t-tests and One-Way ANOVA tested whether Learning Outcomes (LO) differed across demographic and academic subgroups (Table 3). Levene's tests confirmed equal variances across all four grouping variables (all $p > 0.05$). Mean LO scores did not differ significantly by gender (Levene's $F = 0.774$, $p = 0.379$; Male [Code 1, n = 486]: M = 3.9477, SD = 0.72341 vs. Female [Code 2, n = 1,360]: M = 3.9136, SD = 0.73321; $t = 0.884$, $df = 1,844$, $p = 0.377$), academic year (Levene's $F = 1.484$, $p = 0.217$; ANOVA $F(3, 1842) = 0.927$, $p = 0.427$), class session (Levene's $F = 0.784$, $p = 0.376$; Session 1: M = 3.9003, SD = 0.73596, n = 992 vs. Session 2: M = 3.9483, SD = 0.72390, n = 854; ANOVA $F(1, 1844) = 1.979$, $p = 0.160$), or across the 14 academic faculties (Levene's $F = 1.583$, $p = 0.083$; ANOVA $F(13, 1832) = 0.899$, $p = 0.553$).

Table 3: Subgroup Comparisons of Badminton Learning Outcomes across Student Characteristics (n = 1,846)

Grouping Variable	Subgroup Descriptive Statistics (M ± SD)	Levene's Sig.	Test Statistic	p-value	Result
Gender	Male (n = 486): 3.9477 ± 0.72341 Female (n = 1,360): 3.9136 ± 0.73321	0.379	t = 0.884	0.377	Not significant
Academic Year	Year 1 (n = 1,111): 3.9374 ± 0.73833 Year 2 (n = 197): 3.8651 ± 0.67504 Year 3 (n = 419): 3.8960 ± 0.74319 Year 4 (n = 119): 3.9724 ± 0.70140	0.217	F = 0.927	0.427	Not significant
Class Session	Session 1 (n = 992): 3.9003 ± 0.73596 Session 2 (n = 854): 3.9483 ± 0.72390	0.376	F = 1.979	0.160	Not significant
Academic Faculty	14 Faculties (Range: Natural Sci. Ed. 3.6857 ± 0.69547 to Info. Tech. 4.0931 ± 0.67492)	0.083	F = 0.899	0.553	Not significant

Discussion and Practical Implications

Our regression results point to a clear priority for university PE instruction: how lecturers teach on court (TM; β = 0.336) and how student progress is assessed (AM; β = 0.319) carry greater weight in predicting learning outcomes than physical facilities (FE; β = 0.237) or learner study habits alone. Previous studies in Vietnamese universities often emphasized court crowding and gear shortages as the main obstacles to PE quality (Huynh *et al*., 2014; Le, 2017) [5]. The present findings support Biggs' (1996) [3] constructive alignment argument: once basic court space is available, student achievement turns mainly on well-structured practice activities and clear, fair evaluation standards.

Lecturer Competency (LC; β = 0.292) and Course Curriculum (CC; β = 0.272) also showed strong positive effects, consistent with Bandura's (1986) [2] social cognitive framework. Accurate stroke demonstrations, approachable coaching, and a balanced 10-week syllabus (2 theory periods and 28 practice periods) help beginners build confidence with unfamiliar racquet skills. Student Learning Attitude (SLA; β = 0.234) and Learning Methods (LM; β = 0.212) contributed significantly as well, showing that personal persistence, out-of-class practice, and use of instructional videos reinforce classroom sessions. Comparing descriptive scores against regression weights also reveals a practical gap: while Course Curriculum received high student ratings (M = 3.9428), Teaching Methods (M = 2.6834) and Facilities and Equipment (M = 2.6122) scored much lower despite their strong impact on outcomes, marking clear areas for instructional improvement.

Checking survey scores against official university grades ($r = 0.643$, $p < 0.001$; $R^2 = 0.414$) addresses a frequent weakness in PE survey studies by showing that students' self-assessed gains align closely with formal grading standards. In addition, the absence of significant score differences across gender, study year, morning or afternoon sessions, and all 14 academic faculties (all $p > 0.05$) suggests that the Badminton 1 curriculum provides consistent learning opportunities across SGU's diverse student body.

For PE departments, these findings suggest four practical priorities: (1) organize active, level-appropriate court sessions that build basic stroke confidence early and keep beginners moving through rotating drills and small-sided games; (2) use transparent, multi-criteria grading rubrics paired with formative feedback so students understand how technical progress is scored; (3) support lecturer pedagogical workshops and share short instructional videos to guide extracurricular practice; and (4) streamline court scheduling and routine equipment checks so scheduled periods translate into active hitting time.

Limitations and Future Research

Three limitations bound these conclusions. First, the data come from a single compulsory course (Badminton 1) at one public university in Ho Chi Minh City; replicating the model across other PE modules and across both public and private universities would test broader generalizability. Second, while survey scores were verified against official course grades, the cross-sectional design cannot show whether students keep playing badminton or exercising regularly in later semesters; longitudinal follow-up is needed. Third, future studies can extend this analysis with Confirmatory Factor Analysis (CFA), Structural Equation Modeling (SEM), and objective fitness or wearable activity measures.

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