



Developing a Management Model to Promote Physical Education Learning for University Students of Guangxi Province, the People's Republic of China

Zheng Ling¹ and Prakrit Hongsaenyatham²

^{1,2}Faculty of Sports Science and Technology, Bangkokthonburi University, Thailand

¹E-mail: zhengling731@gmail.com, ORCID ID: <https://orcid.org/0009-0005-6045-2900>

²E-mail: prakitsport@gmail.com, ORCID ID: <https://orcid.org/0009-0009-2196-0258>

Received 14/09/2025

Revised 30/09/2025

Accepted 27/10/2025

Abstract

Background and Aim: This study aimed to develop a comprehensive management model to enhance participation in physical education (PE) among university students in Guangxi Province, China.

Methodology: The study population consisted of approximately 10,500 undergraduate students enrolled in compulsory PE courses across three Guangxi universities. A stratified cluster sampling method was used. From this population, a total sample of 385 students was selected, with 366 valid responses collected (95.1% response rate). Participants included both males (48%) and females (52%), aged 18-22 years, representing freshman to junior year students from multiple academic majors. The research design employed a mixed-methods approach, including a student questionnaire, expert interviews (n=10), focus group discussions (n=10), a three-round Delphi process (n=19), and connoisseurship evaluation (n=9). Quantitative data were analyzed using descriptive statistics (Mean, SD), Likert scale interpretation, and content validity indices (IOC, Cronbach's $\alpha > 0.80$).

Results: Findings showed that students demonstrated low intrinsic motivation (M=2.50, SD=0.70) and low autonomy (M=2.30, SD=0.65), while extrinsic motivation (M=3.80, SD=0.72) was relatively high. Academic pressure was identified as a key barrier (M=3.90). Expert interviews emphasized curriculum rigidity, lack of gender-sensitive design, and insufficient facilities. Through the Delphi process, consensus was achieved on 18 core components across four dimensions (autonomy support, competence development, relatedness reinforcement, and institutional strategy). Connoisseurship evaluation confirmed the model's clarity, appropriateness, and feasibility.

Conclusions: The validated management model provides a context-sensitive framework for enhancing PE participation in Guangxi universities. It integrates SDT-based psychological supports with institutional strategies. While the study did not conduct structural equation modeling (SEM), the results provide strong descriptive and consensus-based evidence. The model offers practical recommendations for policymakers and PE instructors to foster student engagement and long-term fitness awareness.





Keywords: Management Model; Physical Education Learning; Guangxi Universities; Self-Determination Theory

Introduction

Physical education (PE) is recognized globally as a key determinant of young people's physical health, social development, and long-term exercise habits. In China, however, participation in university-level PE courses has steadily declined in recent years. According to the Ministry of Education of the People's Republic of China (2022), fewer than 30% of university students consistently achieve the recommended physical activity levels. This low rate of participation is linked to multiple systemic issues: heavy academic pressure, rigid curricula, limited autonomy in course choice, and insufficient sports facilities (Li & Cao, 2020; Wu, 2022). These challenges directly influence students' motivation, resulting in disengagement from PE classes.

Guangxi Province, located in southwest China, faces particularly acute problems. As an economically underdeveloped and ethnically diverse region, Guangxi's universities operate with fewer resources and lower infrastructure investment compared to developed regions such as the Greater Bay Area. Local surveys (Huang & He, 2021) reveal that many Guangxi students attend PE classes passively, showing minimal enthusiasm or a sense of personal responsibility for lifelong physical fitness. This mismatch between curricular requirements and student needs highlights a critical research gap. Unlike other provinces with higher funding, Guangxi universities must identify management-level strategies—rather than relying on large-scale infrastructure reforms—to enhance students' participation.

At the theoretical level, Self-Determination Theory (SDT) (Deci & Ryan, 1985; updated applications: Choi et al., 2023; Xu et al., 2025) provides a strong foundation for understanding motivation in PE contexts. SDT emphasizes the satisfaction of three basic psychological needs: autonomy, competence, and relatedness. Recent research confirms that when PE courses support these needs, students display higher levels of intrinsic motivation and sustained engagement (Kruse et al., 2024; Prado-Botana et al., 2023). Moreover, institutional strategies such as flexible curricula, recognition of achievements, and supportive class climates are shown to mediate the effects of SDT constructs in university PE settings (Su et al., 2025). Thus, applying SDT in the Guangxi context not only contributes to global theoretical development but also responds directly to local educational demands.

Several studies in China have recently examined barriers to PE participation. Gao (2021) and An (2022) confirmed that rigid curricula and a lack of institutional incentives suppress students' motivation. Wu (2022) highlighted how academic workload disproportionately reduces PE attendance in underdeveloped provinces. Yet, few studies integrate both psychological needs





and institutional management perspectives into one framework, particularly in Guangxi. International evidence (e.g., Leyton-Román, Núñez, & Jiménez-Castuera, 2020; Haerens et al., 2013) demonstrates that combining individual motivation with policy and resource strategies yields better results. Therefore, it is timely to establish a comprehensive management model that reflects both student psychology and institutional realities.

Summary and Significance of the Study: In summary, this study originates from the pressing problem of low PE participation among Guangxi University students, compounded by academic pressures and resource limitations. Addressing this issue is crucial not only for improving student health outcomes but also for promoting equity between resource-limited and developed regions. This research is significant because it provides Guangxi universities with a context-sensitive model that can guide curriculum design, policy implementation, and resource allocation. The findings will be beneficial to: (1) University administrators, by offering evidence-based strategies for curriculum and policy reform; (2) PE instructors, by providing practical guidelines to foster autonomy, competence, and relatedness in teaching; (3) Students, by creating more engaging, flexible, and supportive PE environments that encourage lifelong fitness; (4) Policy makers, by delivering an empirically grounded framework for regional education and health planning.

This study is therefore positioned at the intersection of theory and practice, offering both immediate local benefits for Guangxi and wider contributions to international research on physical education management.

Objectives

To develop a management model to promote physical education learning for university students in Guangxi Province.

Literature Review

Self-Determination Theory (SDT), introduced by Deci and Ryan (1985) and further expanded in recent studies, has become a widely applied framework for explaining motivation in physical education (PE). Recent research confirms that the satisfaction of autonomy, competence, and relatedness is essential for sustaining student engagement in PE courses (Choi et al., 2023; Xu et al., 2025). For instance, Leyton-Román et al. (2020) demonstrated that autonomy support from PE teachers directly predicts higher intrinsic motivation and participation intentions among adolescents. Similarly, Kruse et al. (2024) found that peer-relatedness and competence growth strongly influenced long-term exercise persistence. These findings suggest that psychological need satisfaction is central to PE participation across diverse contexts.





In China, PE participation faces unique challenges. Gao (2021) and An (2022) emphasized that rigid curricula and limited institutional support hinder students' motivation to participate actively. Wu (2022) reported that academic workload is a primary barrier in underdeveloped provinces, which aligns with the Guangxi context. While reforms in more developed regions, such as the Greater Bay Area, rely heavily on infrastructure investment (Cai, 2023), this strategy is unrealistic for Guangxi due to resource constraints. Huang & He (2021) highlighted that students in Guangxi often perceive PE as a compulsory credit requirement rather than a meaningful personal development opportunity.

Although there is evidence linking SDT constructs with PE motivation, few studies have integrated psychological needs with institutional strategies in a single management model. International studies have shown the benefit of combining autonomy support with systemic reforms (Su et al., 2025), but empirical applications in resource-limited regions remain scarce. Therefore, this study builds upon existing theory and practice to develop a comprehensive management model tailored to Guangxi universities, integrating SDT-based motivational mechanisms with institutional-level strategies such as curriculum design, evaluation reform, and policy support.

In summary, prior research highlights the importance of autonomy, competence, and relatedness in shaping PE participation, but there is limited empirical evidence from underdeveloped regions such as Guangxi. This study addresses that gap by constructing a management model that links psychological theory with practical institutional reform. The outcomes are expected to benefit both students (through more engaging PE experiences) and universities (through evidence-based strategies for policy and curriculum improvement).



Conceptual Framework

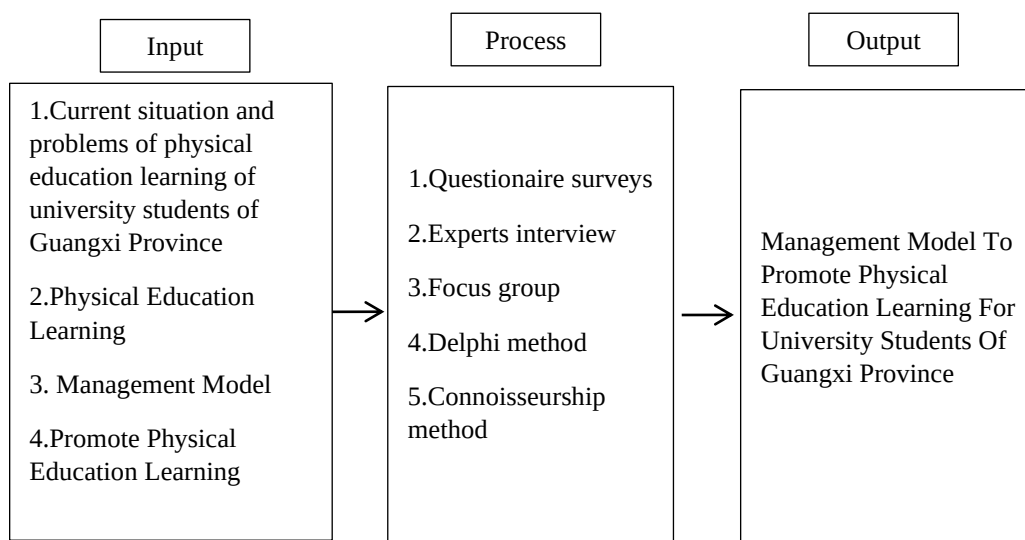


Figure 1 Conceptual Framework

Methodology

1. Population and sample group:

Research setting and timeline: This study was conducted in three universities in Guangxi, China: Guangxi University (GXU), Guangxi Normal University (GXNU), and Guangxi University for Nationalities (GXUN). The entire project took place over January–December 2024 (see Section 4 for the data collection timeline).

Population and sampling frame: The target population included all undergraduate students (first- to third-year) enrolled in compulsory physical education (PE) courses at these universities, totaling approximately 10,500 students according to academic records.

Sample size estimation and allocation: Using the Taro Yamane formula with a 95% confidence level and 5% margin of error, the required sample size was $n=385$. A stratified cluster sampling method was applied: quotas were distributed across universities in proportion, and then PE classes within each year level were randomly selected as clusters. In total, 385 questionnaires were distributed, and 366 valid responses were obtained (95.1% response rate): GXU (143), GXNU (114), GXUN (109).

Student sample profile: Participants were 18–22 years old, both male and female, representing a wide range of majors.

Expert participants: Interviews ($n=10$): 4 PE instructors, 3 university administrators, 3 sports science scholars, all with >10 years' experience; Focus group ($n=10$): 4 PE teachers, 3 policymakers, 3 student representatives; Delphi panel ($n=19$): 6 administrators, 6 curriculum



developers, 7 health and exercise science experts; Connoisseurship panel (n=9): 4 senior PE professors, 3 sports scientists, 2 PE administrators, distinct from Delphi participants.

In addition, experts were recruited as follows: 10 for interviews, 10 for focus group discussions, 19 for Delphi surveys, and 9 for connoisseurship evaluation.

2. Research tools:

This study employed a mixed-methods approach, utilizing multiple instruments:

1. Student Questionnaire: assessed demographics, participation, motivation, and barriers; IOC = 0.96, Cronbach's $\alpha > 0.80$.

2. Observation Form: used in six PE sessions across three universities to record attendance, participation, and interaction.

3. Expert Interviews were conducted with ten experts from Guangxi universities to identify institutional challenges and strategies.

4. Focus Group: with ten experts, used to refine the framework and ensure contextual feasibility.

5. Delphi Questionnaire: administered to 19 experts across three rounds, using a 5-point Likert scale. Consensus criteria: Median ≥ 3.50 , IQR ≤ 1.50 .

6. Connoisseurship Evaluation: conducted with nine experts to validate the practicality and adaptability of the model.

3. Creating and finding quality tools:

Item generation: Based on curriculum documents, policy guidelines, and prior literature.

Content validity: Verified by experts using the Index of Item-Objective Congruence (IOC), with all items scoring ≥ 0.80 and an average IOC of 0.96.

Pilot testing: Conducted with small groups of students and refined accordingly.

4. Data collection:

The research process took place over one academic year: January: Review of documents and tool drafting. March–April: classroom observations. May: Distribution of 385 questionnaires, both paper and online. June–July: Ten expert interviews (in-person or online). August: A focus group discussion with ten stakeholders. September–November: Three rounds of Delphi surveys. December: Connoisseurship evaluation workshop with nine experts. All participants provided informed consent. Student surveys were anonymous, with no effect on grades.

5. Data analysis:

(1) Descriptive Statistics for Questionnaire Data

To analyze the student and instructor questionnaire data, descriptive statistical methods were applied, including: Mean ($\bar{X}$) – To measure the central tendency of responses. Standard Deviation (S.D.) – To assess the variation in responses across different participants.



These statistical measures helped identify trends, common challenges, and variations in perceptions of university students and physical education instructors regarding participation in university physical education courses.

(2) Content Validity Evaluation Using the Index of Item-Objective Congruence (IOC)

Each questionnaire and interview guide was reviewed by three experts, who rated the relevance of each item to the research objectives. The IOC threshold of ≥ 0.80 indicated a high level of validity, ensuring that all research instruments were appropriately designed to gather relevant and meaningful data.

(3) Likert Scale Analysis for Questionnaire Data

A Likert scale was applied to evaluate data collected from the student and instructor questionnaires. The responses were rated on a 5-point scale, with the following interpretation:

Scale Rating	Interpretation
1	Very Poor
2	Poor
3	Moderate
4	High
5	Highest

This structured evaluation enabled a clear and systematic analysis of responses, ensuring that feedback from students and instructors was quantifiable and interpretable. The calculated mean scores provided insights into students' perceived barriers, motivational factors, and areas for improvement in physical education programs.

6. Statistics used in data analysis.

Method	Purpose	Data
Taro Yamane's formula	Sample size estimation	Student population
IOC	Content validity	Questionnaires & interview guide
Descriptive statistics (Mean, SD)	To summarize responses	Questionnaire data
Likert interpretation	To classify mean scores	Student & instructor responses
Median and IQR	Delphi consensus criteria	Expert panel ratings
Percentage distributions	To report valid responses	Questionnaire return rate



Method	Purpose	Data
Connoisseurship evaluation (5-point scale)	Appropriateness, clarity, and feasibility	Expert panel review

Results

1. Student Questionnaire Findings

A total of 385 questionnaires were distributed, and 366 valid responses were obtained (95.1%). Table 1 presents the distribution.

Table 1 Questionnaire Distribution and Valid Responses (N=366)

No.	Name of University	Distributed	Valid Responses	Valid Rate
1	Guangxi University	150	143	95.3%
2	Guangxi Normal University	120	114	95.0%
3	Guangxi University for Nationalities	115	109	94.8%
	Total	385	366	95.1%

Table 2 Students' Evaluation of Motivation and Learning Experience in Public PE Courses (N=366)

Item No.	Evaluation Content	Mean	Result
1	Students' learning interest in PE courses	2.70	Moderate
2	Intrinsic motivation (enjoyment, personal interest, fitness goals)	2.50	Low
3	Extrinsic motivation (credit, assessment, graduation requirement)	3.80	High
4	Perceived relevance of PE to personal development	2.60	Moderate
5	Influence of academic pressure on learning engagement	3.90	High
6	Peer encouragement and learning atmosphere	3.20	High
7	Perceived learning outcomes from PE (skills, health knowledge, self-discipline)	3.10	Moderate



Item No.	Evaluation Content	Mean	Result
8	Awareness of lifelong fitness and physical literacy	2.40	Low
9	Students' perceived autonomy in selecting and progressing in PE learning	2.30	Low
10	Clarity of learning objectives and alignment with future academic/career goals	2.20	Low

Table 1 summarizes the distribution of valid responses, while Table 2 presents mean scores for motivation and learning experience. Results showed that extrinsic motivation ($M=3.80$, High) was substantially stronger than intrinsic motivation ($M=2.50$, Low). Students' autonomy ($M=2.30$, Low) and awareness of lifelong fitness ($M=2.40$, Low) were also weak, whereas academic pressure ($M=3.90$, High) emerged as a significant barrier.

To enhance interpretability, Likert mean scores were aligned with the defined thresholds (1.00–1.80 Very Low; 1.81–2.60 Low; 2.61–3.40 Moderate; 3.41–4.20 High; 4.21–5.00 Very High). Subgroup analysis (institution, sex, year) revealed no statistically significant differences, though descriptive trends suggested slightly higher autonomy scores among GXU students and among male students.

Summary: Guangxi students' participation in PE is mainly extrinsically motivated (credits, graduation), with low intrinsic drive, autonomy, and lifelong fitness literacy.

2. Expert Interviews

Ten experts participated: 4 PE instructors, 3 administrators, and 3 sports science scholars. IOC validation confirmed the relevance of the interview guide (all items $\text{IOC} \geq 0.80$).

Table 3 Index of Item-Objective Congruence (IOC) for Expert Interviews

No.	Interview Question	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	IOC Value
	Main problems faced by Guangxi University students in participating in PE courses	1.00	1.00	0.80	1.00	1.00	0.96
2	Key factors influencing	1.00	0.80	1.00	1.00	1.00	0.96



No.	Interview Question	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	IOC Value
	students' motivation to learn in PE						
3	Shortcomings in current PE content and organization, and improvement suggestions	1.00	1.00	1.00	0.80	1.00	0.96
4	Relationship between students' PE interest and physical literacy development	0.80	1.00	1.00	1.00	0.80	0.92
5	Administrative perspective on whether PE curriculum design meets diverse student needs	1.00	1.00	1.00	1.00	1.00	1.00
6	Reasons for loss of sustained motivation in PE and possible solutions	1.00	1.00	0.80	1.00	1.00	0.96
7	Ways to enhance students' recognition and value perception of PE courses	1.00	1.00	1.00	0.80	1.00	0.96
8	Reforms to the PE evaluation and assessment system to improve engagement	1.00	1.00	1.00	1.00	0.80	0.96
9	Establishment of multi-dimensional feedback systems	1.00	1.00	0.80	1.00	1.00	0.96
10	Application of theories	0.80	1.00	1.00	1.00	1.00	0.96

No.	Interview Question	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	IOC Value
	such as SDT in PE teaching, and how to implement them						
11	Practical experiences or suggestions to construct an effective PE management model	1.00	0.80	1.00	1.00	1.00	0.96
12	Additional suggestions for improving the study design, questionnaire, or model development	1.00	1.00	1.00	0.80	1.00	0.96

Thematic analysis identified four recurring issues: (1) Curriculum rigidity (limited elective choice, inflexible scheduling). (2) Gender insensitivity (lack of tailored approaches for female students). (3) Resource constraints (facilities, equipment, instructor capacity). (4) Weak incentive systems (evaluation overly credit-based).

3. Focus Group Discussions

A focus group of 10 experts refined the findings into four strategic areas:(1) Flexible curriculum design; (2) Competence-oriented learning outcomes; (3) Peer and cooperative learning structures; (4) Institutional-level policy and facility support.

Table 4 Focus Group Question Framework (Expert-Oriented)

Domain	Guiding Questions	Rationale
1. Diagnosis of Current Problems	What do you perceive as the main reasons for low student motivation and participation in PE in Guangxi universities? What systemic issues (e.g., policy, curriculum,	Establishes a shared understanding of the problem scope and contextual limitations



Domain	Guiding Questions	Rationale
	evaluation) contribute to this problem?	
2. Curriculum and Instruction	How should PE courses be redesigned to foster long-term engagement and intrinsic motivation? What role do teaching styles, assessment methods, and activity variety play?	Probes the structural components influencing motivation and perceived relevance
3. Role of Institutional and Social Support	How can university leadership, facilities, and peer culture better support student involvement? What partnerships (e.g., community sports, health services) could be leveraged?	Examines environmental and systemic enablers/barriers
4. Evaluation and Monitoring	What indicators should be included in a PE participation and motivation evaluation system? How can we ensure the assessment is meaningful, fair, and aligned with behavior change?	Anchors the SEM-based model in measurable, evidence-based indicators
5. Model Development Suggestions	Based on your experience, what core strategies or model components should be prioritized? How can we tailor the	Guides the model formulation process and ensures context-sensitive planning



Domain	Guiding Questions	Rationale
	management model to Guangxi's regional characteristics and higher education structure?	

Expert Validation of the Framework

The above framework was presented to the expert panel before the focus group discussion. All 10 experts provided feedback and suggestions, which were incorporated to: Refine ambiguous terminology (e.g., “PE experience” clarified to “structured university PE course experience”); Emphasize lifelong fitness and physical literacy awareness as central constructs; Add emphasis on autonomy-supportive teaching as a topic for deeper inquiry; Include a Delphi-compatible indicator discussion for downstream quantitative validation.

4. Delphi Consensus Results for Developing the Management Model to Promote Physical Education Learning in Courses

Following the preliminary stage of questionnaire surveys with university students and in-depth expert interviews, a Delphi study was conducted to refine and validate the proposed management model. A panel of 19 experts participated in two iterative Delphi rounds to evaluate the relevance and importance of the identified management components and specific factors. The expert panel consisted of senior physical education instructors, health and exercise science experts, and university sports policymakers, each with over 15 years of professional experience in their respective fields. The aim was to achieve expert consensus on the components most critical for promoting and sustaining student participation in physical education (PE) courses.

Development of the Delphi Round 1 Questionnaire Framework

In order to develop a systematic and theory-based management model to enhance university students’ participation in physical education (PE) courses in Guangxi, the Delphi technique was employed. The first-round Delphi questionnaire was constructed through a combination of expert interviews, focus group discussions, and theoretical integration based on the Self-Determination Theory (SDT) and Structural Equation Modeling (SEM). SDT provides a framework for understanding intrinsic motivation through the satisfaction of three core psychological needs: autonomy, competence, and relatedness. SEM was applied to model the causal relationships between these psychological needs, student motivation, learning behavior, and long-term sports habit formation.





19 experts participated in the preliminary qualitative phase, including PE instructors, university administrators, and sports scientists. Based on their input, a multi-dimensional indicator system was constructed, structured into four primary domains: Autonomy, Competence, Relatedness, and Behavioral Management. Each dimension includes a set of questionnaire items (Delphi indicators) to be evaluated in subsequent Delphi rounds for their relevance and importance in fostering student motivation and participation in PE.

The four dimensions of the SDT-based Delphi questionnaire were formed by reclassifying the previously identified themes (Relevance, Motivation, System/Management, Evaluation) into the SDT-aligned structure. The classification rationale and correspondence are illustrated in Table 6 below.

Table 5 Integration of Previous Dimensions into SDT-based Structure

SDT Dimension	Mapped Previous Dimensions	Construct Description
Autonomy Support	M (Motivation), R	Focuses on students' voluntary participation, perceived choice, flexible curriculum, and learning ownership.
Competence Development	M, S	Emphasizes the development of students' fitness-related skills, goal mastery, and the appropriate level of challenge in PE courses.
Relatedness Reinforcement	M	Highlights the importance of peer support, cooperative learning environments, and students' sense of belonging in physical activity settings.
Institutional Strategy	S, E	Covers macro-level supports such as school policy, administrative leadership, access to facilities, resource allocation, and evaluation-feedback systems.

Based on this structure, 18 items were generated (Table 7), each linked to one of the four core constructs. These items were initially informed by a prior focus group discussion with 10 experts, followed by a structured refinement process grounded in both literature and contextual analysis from SDT and SEM applications.



Table 6 Summary of the Delphi Round 1 Questionnaire Framework

Dimension	No. of Items	Sample Items
Autonomy Support	4	“The PE course allows flexible choices based on student interest.”
Competence Development	5	“Physical education includes skill-building and mastery-focused tasks.”
Relatedness Reinforcement	4	“Group activities foster strong peer support in PE settings”
Institutional Strategy	5	“The university conducts regular physical health and fitness evaluations.”
Total	18	

Reallocation of Original Dimensions to SDT-Aligned Domains

The transition from the initially proposed categories (R=Relevance, M=Motivation, S=System, E=Evaluation) to the SDT-aligned framework was executed as follows:

Table 7 Mapping Original Constructs to SDT-Based Categories with Theoretical Justification

Original Dimension	New SDT-Based Category	Justification
R (Relevance)	Autonomy Support	Related to students’ perceived choice, flexibility, and personalized learning in PE
M (Motivation)	Distributed across Autonomy, Competence, and Relatedness	Reflects both intrinsic and extrinsic drivers; reassigned to align with psychological needs
S (System)	Competence Development / Institutional Strategy	Includes instructional design and administrative infrastructure
E (Evaluation)	Institutional Strategy	Mainly represented in external feedback and performance measurement mechanisms.



Questionnaire Construction Process and Content Validation

The construction of the Delphi questionnaire followed a structured five-step process grounded in theory and expert input to ensure both content validity and practical feasibility for evaluating university students' participation in physical education courses in Guangxi.

Finalization of Delphi Round 1 Questionnaire

After refinement based on IOC feedback, the 18 items were categorized under the four dimensions and entered into a structured 5-point Likert questionnaire (1=Very Unimportant; 5=Very Important). This tool served as the Delphi Round 1 instrument for validating key management strategies to enhance PE participation in Guangxi universities.

Table 8 Delphi Round 1 Questionnaire (by SDT-Aligned Dimensions)

Dimension	Item No.	Questionnaire Item	Theoretical/Empirical Basis
1. Autonomy Support	A1	The PE course allows students to select preferred sports or activities.	SDT: Autonomy; E1, E5
	A2	The curriculum offers flexibility in content and pace based on student learning levels.	SDT: Flexible modules from E2
	A3	Students are encouraged to give feedback on course content and organization.	Participatory curriculum; E8
	A4	Students can adjust their training intensity and personal goals within the course.	SDT; Self-regulation; E4
2. Competence Development	C1	The PE course has clear learning outcomes and fitness goals aligned with student development.	SEM output design; E3
	C2	Instructors provide formative assessment and constructive feedback during class.	Mastery climate; E4
	C3	Courses contain diverse motor skill activities to improve students' abilities.	SDT: Competence; E5



Dimension	Item No.	Questionnaire Item	Theoretical/Empirical Basis
	C4	Students are given sufficient practice and repetition to build physical skills.	SDT: Repetition/mastery
	C5	Physical education learning is connected to long-term life or health goals.	Lifelong vision; E6
3. Relatedness Reinforcement	R1	Group-based physical tasks are used to enhance peer interaction and social bonding.	SDT: Relatedness; E2, E7
	R2	The course environment fosters a sense of belonging among classmates.	Peer support; E1, E7
	R3	Teachers actively build supportive and motivating relationships with students.	Teacher-student bond; E9
	R4	The course links with family or community initiatives to promote healthy habits.	Extended relatedness; E10
4. Institutional Strategy and Support	S1	The university provides regular physical fitness tests and individualized reports.	Fitness management system; E3, E6
	S2	Digital tools (e.g., fitness apps) are used to track and support student activity.	Technological integration; E10
	S3	The university has clear policies prioritizing physical education equally with academics.	Policy-level equality; E3
	S4	PE facilities and equipment are accessible and sufficient across faculties and departments.	Facility support; E6, E9





Dimension	Item No.	Questionnaire Item	Theoretical/Empirical Basis
	S5	The university regularly organizes fitness campaigns and campus-wide sports activities.	Sport culture promotion; E4, E7

Expert Panel Composition

In the first round of the Delphi process, a total of 19 experts were invited to evaluate 18 initial questionnaire items derived from the integration of Self-Determination Theory (SDT) and Structural Equation Modeling (SEM) logic paths. The expert panel was composed of the following:

Table 9 Composition and Selection Criteria of Delphi Expert Panel

Expert Type	Number	Criteria
University Administrators	6	Over 15 years of managing university-level sports programs and policy
PE Curriculum Developers	6	At least 12 years in PE course design, integrating health science
PE Instructors / Researchers	7	More than 10 years in exercise science, sports education, or policy

5. Delphi Method Results

The Delphi process involved three rounds with 19 experts. Table 10 summarizes the comparative results across Rounds 1–3. While only 14 items achieved consensus in Round 1, this number rose to 16 in Round 2, and by Round 3, all 18 items met the consensus criteria (Median ≥ 3.50 , IQR ≤ 1.50). Notably, items R4 (supportive climate) and S5 (community partnerships), which failed to meet the threshold in earlier rounds, reached consensus in Round 3 following expert feedback and refinement.

Three-round Delphi method comparison

Table 10 Comparative Statistical Results for Delphi Rounds 1–3 (N=19)

Dimension	Code	Item (Short Description)	Round 1 Mdn/IQR	Round 2 Mdn/IQR	Round 3 Mdn/IQR	Final Decision	Expert Consensus Notes
Autonomy Support	A1	Flexible course	4.00 / 0.50	5.00 / 1.00	5.00 / 0.00	Retained	Strong agreement;



Dimension	Code	Item (Short Description)	Round 1 Mdn/IQR	Round 2 Mdn/IQR	Round 3 Mdn/IQR	Final Decision	Expert Consensus Notes
		selection					enhances intrinsic motivation via choice.
	A2	Choice of fitness modules	4.50 / 0.50	5.00 / 1.00	5.00 / 0.00	Retained	Inclusivity and adaptability confirmed
	A3	Self-initiated learning paths	5.00 / 0.00	4.00 / 1.00	5.00 / 0.00	Retained	Improved after clarification of self-paced learning
	A4	Opt-in assessments	4.00 / 1.00	4.00 / 1.00	5.00 / 0.00	Retained	Accepted once framed as formative assessments
Competence Development	C1	Mastery- focused tasks	5.00 / 0.00	5.00 / 0.00	5.00 / 0.00	Retained	Strong consensus throughout
	C2	Performance feedback and reflection	4.50 / 0.50	5.00 / 1.00	5.00 / 0.00	Retained	Emphasized timely, constructive feedback
	C3	Progressive skill ladder	5.00 / 0.00	5.00 / 1.00	5.00 / 0.00	Retained	Supported as a key for diverse skill- building



Dimension	Code	Item (Short Description)	Round 1 Mdn/IQR	Round 2 Mdn/IQR	Round 3 Mdn/IQR	Final Decision	Expert Consensus Notes
Relatedness Reinforcement	C4	Teacher coaching and goal clarity	4.00 / 1.00	4.00 / 1.00	5.00 / 0.00	Retained	Consensus strengthened after adding structured goal-setting
	C5	Health knowledge integration	5.00 / 0.00	5.00 / 1.00	5.00 / 0.00	Retained	Vital for lifelong fitness literacy
	R1	Group activities fostering peer support	5.00 / 0.00	5.00 / 1.00	5.00 / 0.00	Retained	Encourages teamwork and social bonding
	R2	Peer-led exercise groups	4.00 / 0.50	4.00 / 1.00	5.00 / 0.00	Retained	Consensus improved after making it voluntary.
	R3	Social reinforcement in class	4.50 / 0.50	5.00 / 1.00	5.00 / 0.00	Retained	Low-cost, high-impact motivation
	R4	Cross-curricular fitness projects	3.00 / 2.00	3.00 / 2.00	4.00 / 1.00	Retained	Initially debated; consensus achieved after redefining as small-scale, department





Dimension	Code	Item (Short Description)	Round 1 Mdn/IQR	Round 2 Mdn/IQR	Round 3 Mdn/IQR	Final Decision	Expert Consensus Notes
							-led
Institutional Strategy	S1	Fitness policy & leadership commitment	5.00 / 0.00	5.00 / 1.00	5.00 / 0.00	Retained	Strong agreement on top-level policy support
	S2	Fitness infrastructure planning	5.00 / 0.00	4.00 / 1.00	5.00 / 0.00	Retained	Facility provision emphasized
	S3	Flexible class scheduling	5.00 / 0.00	5.00 / 1.00	5.00 / 0.00	Retained	Helps resolve academic conflicts
	S4	Incentive-based participation programs	4.50 / 0.50	5.00 / 1.00	5.00 / 0.00	Retained	Suggested linking incentives to long-term habits
	S5	Feedback & improvement systems	3.00 / 2.00	3.00 / 2.00	4.00 / 1.00	Retained	Initially low consensus; refined as a streamlined, digitalized process

The Delphi process demonstrated increasing consensus across three rounds. Median values improved steadily while IQR values declined, showing convergence of expert opinions. By Round 3, all 18 elements met the consensus threshold and were retained. The final structure confirmed the robustness of the management model, balancing psychological needs (autonomy, competence, relatedness) with systemic enablers (institutional strategy).



6. Drafting the Management Model to Promote Physical Education Learning for University Students of Guangxi Province

Table 11 Draft of management model to promote physical education learning for university students of Guangxi Province

Dimension	Cod e	Element	Core Content	Improvement Direction
Autonomy Support (A)	A1	Choice of preferred sports	Students can select sports based on personal interest and physical condition.	Expand elective course offerings and seasonal sports modules to diversify options.
	A2	Flexible pace and content	PE content and schedules are adapted to varying student skill levels and academic timetables.	Implement modularized curricula with multiple difficulty levels and flexible time slots.
	A3	Student course feedback	Structured channels for students to evaluate and suggest improvements.	Establish feedback loops with actionable follow- up in curriculum design.
	A4	Personalized training goals	Students set individualized, measurable fitness objectives.	Provide goal-setting workshops and integrate progress reviews into PE classes.
Competence Development (C)	C1	Clear learning outcomes	Transparent and measurable PE learning objectives.	Align outcomes with both course assessments and lifelong fitness



Dimension	Code	Element	Core Content	Improvement Direction
				competencies.
	C2	Constructive instructor feedback	Timely, specific, and personalized feedback to guide improvement.	Train instructors in formative assessment and motivational communication.
	C3	Skill diversity in training	Exposure to a broad range of non-physical activities.	Rotate activity types and introduce non-traditional sports to maintain interest.
	C4	Practice repetition opportunities	Adequate practice time to consolidate skills.	Blend formal class drills with open practice sessions.
	C5	Health knowledge integration	Students acquire essential knowledge about fitness, nutrition, injury prevention, and lifelong health habits.	Embed health education modules into PE courses; collaborate with health experts to deliver workshops and integrate digital health resources into learning.
Relatedness Reinforcement (R)	R1	Group interaction and cooperation	Promote teamwork through collaborative activities.	Incorporate group challenges, peer teaching, and team-based assessments.
	R2	Sense of classroom belonging	Foster an inclusive and supportive class	Use ice-breaker activities, small group discussions,



Dimension	Code	Element	Core Content	Improvement Direction
Institutional Strategy (S)			climate.	and peer mentoring.
	R3	Positive student-teacher relationships	Strengthen rapport and trust between students and instructors.	Encourage informal interaction and teacher participation in student activities.
	R4	Cross-curricular fitness projects	Collaborative initiatives linking PE with other academic domains.	Scale down to department-level projects to ensure feasibility and interdisciplinary engagement.
	S1	Fitness assessments and personal reports	Periodic evaluations with personalized progress reports.	Integrate digital fitness tracking and individualized improvement plans.
	S2	Digital tools for activity tracking	Use of technology for monitoring participation and progress.	Deploy mobile apps, wearable devices, and e-portfolios.
	S3	Policy support for PE parity with academics	Elevate PE's institutional importance to match academic courses.	Include PE performance in GPA calculations and scholarship criteria.
	S4	Shared access to sports facilities	Equitable use of facilities for all student groups.	Implement centralized booking systems and extend



Dimension	Cod e	Element	Core Content	Improvement Direction
				facility hours.
	S5	Feedback and improvement systems	Structured collection of student and teacher feedback, digitized for continuous monitoring.	Streamline with automated platforms and integrate into annual program reviews.

Integrative Implications

By aligning SDT's three psychological needs—autonomy, competence, and relatedness—with institutional strategies, the finalized management model ensures that motivation is supported both internally and externally. The four dimensions function synergistically: autonomy support encourages self-determined engagement; competence development builds confidence and skill mastery; relatedness reinforcement fosters belonging and collaboration; and institutional strategy guarantees sustainability through supportive policies, infrastructure, and systematic management.

Importantly, the retention of all 18 validated elements, including R4 (Cross-curricular fitness projects) and S5 (Feedback and improvement systems), highlights the comprehensive scope of the model. While these two items required clarification and refinement during earlier Delphi rounds, their eventual consensus indicates that even complex or institutionally demanding strategies can be implemented effectively when appropriately scaled, clearly defined, and supported by digital or administrative mechanisms.

This integrative approach not only addresses motivational and structural barriers identified in Guangxi's current PE system but also establishes a holistic and scalable framework. The confirmed model offers a balanced combination of psychological drivers and institutional enablers, making it adaptable to Guangxi's multi-ethnic educational context as well as transferable to other regions with similar challenges.

7. Connoisseurship Evaluation

Nine senior experts assessed the final model for clarity, feasibility, and applicability.





Each expert rated the 18 core elements-grouped under the four primary dimensions: Autonomy Support(A), Competence Development(C), Relatedness Reinforcement(R), and Institutional Strategy(M)-using a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree). The results were classified according to levels of appreciation, ranging from “Highly Appropriated” to “Below Appropriated.”

Table 12 Summary of Evaluation Results by Connoisseurship Panel

Dimension	Item Code	Indicator	Result
Autonomy Support	A1	Students can select preferred PE activities.	Appropriated
	A2	Flexibility is allowed in content and pace.	Appropriated
	A3	Student feedback is incorporated in course design.	Appropriated
	A4	Students can adjust personal training goals.	Appropriated
Competence Development	C1	Clear fitness learning goals are defined.	Highly Appropriated
	C2	Teachers provide formative assessment.	Appropriated
	C3	Motor skill development is embedded.	Appropriated
	C4	Courses connect with lifelong health objectives.	Highly Appropriated
Relatedness Reinforcement	R1	Group tasks promote peer interaction.	Appropriated
	R2	The class atmosphere fosters belonging.	Moderately Appropriated
	R3	Teachers build supportive relationships.	Appropriated
	R4	The program connects with family/community.	Below Appropriated
Institutional Strategy	S1	Fitness assessments and reports are	Highly



Dimension	Item Code	Indicator	Result
		conducted.	Appropriated
	S2	Digital fitness tools are integrated.	Appropriated
	S3	PE is supported through institutional policies.	Highly Appropriated
	S4	Sports facilities are accessible and sufficient.	Appropriated
	S5	Fitness campaigns and events are regularly organized.	Below Appropriated

Summary: All dimensions were rated “Highly Appropriate” or “Appropriate.” Experts highlighted that the model is cost-effective, context-sensitive, and suitable for Guangxi universities.

Conclusion

This study set out to develop and validate a management model to enhance Guangxi University students’ participation in physical education (PE) courses. Using a mixed-methods design based on expert interviews, focus group discussions, Delphi consensus, and connoisseurship evaluation, the study successfully identified and confirmed 18 core elements across four dimensions: autonomy support, competence development, relatedness reinforcement, and institutional strategy.

The Delphi process demonstrated progressive convergence, with consensus achieved on all 18 items by the third round. This confirms that the model is theoretically coherent and broadly endorsed by experts. The connoisseurship panel further validated the model’s clarity and feasibility, rating most elements as “Appropriate” or “Highly Appropriate.” Together, these findings provide strong evidence that the model is both empirically grounded and practically applicable to Guangxi’s university context.

At the same time, the results also reveal targeted areas for refinement. Elements R4 (supportive class climate) and S5 (community partnerships), while ultimately retained, consistently received lower ratings. These findings suggest that fostering a more inclusive classroom environment and building sustainable community linkages remain the most challenging aspects of implementation in Guangxi’s resource-limited setting.





In conclusion, the study contributes a validated management model that integrates Self-Determination Theory (SDT) principles with institutional strategies. It provides actionable guidance for administrators, instructors, and policymakers seeking to increase student participation in PE. At the same time, it highlights that achieving lasting improvements will require not only structural reforms but also careful attention to social and cultural barriers that influence students' motivation.

Discussion

Survey and interview data suggest that students in Guangxi universities engage in PE mainly due to extrinsic motivation, and that this behavior is strongly driven by academic pressure, the course credit system, and mandatory curriculum design. Delphi and connoisseurship results indicate a consensus among experts on existing constraints at the institutional and system level that impact student autonomy and participation. Overall, this study affirms and validates a management model that integrates three key psychological needs—autonomy, competence, and relatedness—with the institutional strategies that support learning motivation and participation in PE.

Survey and interview findings are largely consistent with Self-Determination Theory's (SDT) postulation that meeting three basic needs is important to nurture intrinsic motivation and active engagement (Deci & Ryan, 1985, 2000, 2002). The persistence of extrinsic motivation among students in this study of Guangxi universities, however, demonstrates a highly contextual limitation on the pure universality of SDT. In line with recent studies by Haerens et al. (2013) and Kruse et al. (2024), these results suggest that meeting students' need for autonomy and competence, through both instructional design and teacher behaviors, is of the utmost importance in building lasting motivation in PE. Furthermore, as an economically underdeveloped region of China, Guangxi universities may rely more on interventions at the management level, such as curricular flexibility, teacher training on autonomy-support, and assessment reform, rather than on the expansion of large-scale facilities. Expert interviews also reiterate the need for a more student-centered curriculum development that is both gender-responsive and adaptive to different learners.

Delphi consensus and model validation

The item-level Delphi results show that the pattern of expert judgment converges over the three rounds. As shown in Table 14, 14 out of 18 items passed the consensus criteria in Round 1, which increased to 16 in Round 2 and 18 in Round 3 (Median ≥ 3.50 , IQR ≤ 1.50). These results confirm the stability and reliability of expert judgments and support for the overall model. The two items that were not passed in Round 1 and Round 2 are R4 and S5. Expert feedback suggested





that these two items have a lower degree of feasibility and implementability in Guangxi's context as a university with limited resources. After being refined and clarified in two rounds of Delphi, R4 and S5 were also passed in the third round of Delphi with a higher consensus level. This indicates the resolution of ambiguity by experts and high conformity, as recommended by Kline (2015).

Connoisseurship evaluation

Nine experts in the connoisseurship evaluation team have made a comprehensive review and have confirmed the clarity, feasibility, and appropriateness of this proposed model. Most of the components in the model were rated as "Appropriate" or "Highly Appropriate" by the experts. Among these, the highest rating is given to the competence-related components and the institutional strategy components in the model. However, in terms of the scale score, R4 and S5 were relatively lower. This is consistent with the results of the Delphi study, which demonstrate the greatest need for improvement. These two items also received lower consensus and represent higher variability among the expert ratings. As a result, the improvement of class climate and the development of sustainable partnerships with local communities may require greater attention in the implementation process, while the stronger autonomy-supportive teaching and learning components and institutional management dimensions can be carried forward and further developed.

The connoisseurship and Delphi evaluation results both provide evidence of the face validity of this research model. The evaluation process of these two components also proves the reliability of the results that have been obtained. In the future, the study will continue to be improved based on the guidance of the two methods of expert validation. In this research, PE management should be gradually started from the three levels of curriculum, teacher, and institution. Universities can adjust the inflexible curriculum system to achieve flexibility in learning. In the development of teacher training, teachers should be guided to establish an autonomy-supportive learning environment in which the three basic needs of autonomy, competence, and relatedness are better supported, which will also help to improve students' learning motivation in PE. In addition, at the level of institutional strategies and management, some strategies can be tried out and piloted, such as the establishment of a credit system and feedback mechanism. Although students are not intrinsically motivated to learn, extrinsic motivation can provide necessary support at the initial stage and gradually help students to generate intrinsic motivation.

Recommendation

1. Recommendations from this study:

For administrators:

- (1) Implement the 18-element management model as a blueprint for reform.





(2) Increase flexibility in scheduling and course offerings.

(3) Introduce institutional incentives for participation and fitness achievements.

For instructors:

(1) Employ autonomy-supportive teaching strategies, such as offering choices and explaining the rationale for tasks.

(2) Foster competence through progressive skill tasks and formative feedback.

(3) Encourage relatedness via cooperative and peer-led activities.

For policymakers:

(1) Provide targeted resource support to underfunded universities.

(2) Establish community–university partnerships to diversify opportunities.

(3) Promote regional fitness campaigns aligned with university programs.

2. Suggestions for future research:

(1) Expand the scope of classroom observations to capture more diverse courses and institutions.

(2) Conduct longitudinal studies to measure changes in intrinsic motivation after implementing the model.

(3) Apply experimental or quasi-experimental designs to test the causal impact of specific interventions (e.g., flexible scheduling, peer learning).

(4) Explore gender-sensitive and cultural adaptations of PE curricula to meet the needs of female students and ethnic minority groups in Guangxi.

(5) Incorporate comparative studies with other provinces or countries to assess the generalizability and adaptability of the model.

3. Completeness:

This section ensures that recommendations fill a whole page by addressing multiple stakeholders and highlighting both immediate application and long-term research pathways.

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