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Article

The Influence of Campus Cultural and Sports Activities in Colleges and Universities on College Students' Satisfaction with Campus Life

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Abstract

This study explores the impact of campus cultural and sports activities on college students' satisfaction with campus life. A questionnaire survey was conducted among students in private colleges and universities in Guangdong Province, and the analysis was carried out using PLS-SEM. The study found that expectations of campus cultural and sports activities did not have a significant direct impact on students' satisfaction with campus life, but had a significant indirect impact through perceived quality and perceived equity. At the same time, engagement has a significant positive impact on satisfaction, while personality types play a moderating role between expectations and engagement. The study provides theoretical models and empirical evidence for private colleges to enhance students' satisfaction with campus life, suggesting strengthening fairness in activity design, optimizing activity quality and content, and increasing the depth of participation, etc.

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1. Introduction

1.1. Research Background

In recent years, private higher education in China has developed rapidly. As of 2023, there are 789 private colleges and universities across the country, accounting for 25.66% of the total number of colleges and universities, with nearly 10 million students enrolled [1]. Private colleges have played a significant role in expanding the supply of educational resources and promoting educational diversity. However, due to their high reliance on tuition fees for operation, they are generally under financial strain and competitive pressure, and many schools tend to expand in scale while neglecting internal development [2]. With the decline in the birth rate and the intensification of competition in higher education, the brand reputation and enrollment situation of private colleges and universities have become increasingly severe.

Against this backdrop, student satisfaction, as the core object of educational services, has become a key factor affecting the survival and development of private colleges [3]. According to a 2023 survey covering secondary and higher vocational colleges in 31 provinces and municipalities across the country, although students' overall satisfaction was high, their scores were low in "extracurricular education" and "service and management", especially in Guangdong Province [4]. This serves as a wake-up call for private colleges to improve the quality of their services.

At present, the phenomenon of "lying flat" and "giving up" among college students is becoming increasingly common, and the pressure of study and employment is intensifying. Improving their life satisfaction has become an important issue. Existing studies have explored the factors influencing satisfaction from multiple perspectives such as demographic variables, social support, and educational investment, and found that campus cultural and sports activities are an important part, but the specific mechanism of their action is still unclear. Therefore, based on customer satisfaction theory, attitude theory, etc., this study constructs a theoretical model of the impact of campus cultural and sports activities on college students' satisfaction, attempting to reveal the internal pathways and key factors, and provide a basis for optimizing activity design in private colleges.

1.2. Significance of the Study

The existing research on college students' satisfaction with campus life has the following shortcomings: First, it mostly focuses on public colleges and universities, ignoring the particularity of the student group in private colleges and universities; Second, the relationship between campus cultural and sports activities and satisfaction mostly remains at the level of correlation analysis, lacking empirical tests of mediating and moderating mechanisms; Third, the impact of individual differences (such as personality types) on activity outcomes is not fully considered.

The significance of this study lies in: First, constructing a mechanism model of "activity expectation - perceived quality/fairness/participation - satisfaction" to deepen the understanding of the formation path of student satisfaction in private colleges and universities; Second, introducing personality types (such as extroversion/introversion) as moderating variables to expand the application of personalized education theory; Third, focus on private colleges and universities to provide empirical evidence for improving service quality and enhancing student satisfaction.

1.3. Scope of the Study

This study aims to explore the mechanism by which campus cultural and sports activities affect college students' satisfaction with campus life, with core variables including: Campus cultural and sports activity expectations (students' prior expectations of the effect of the activity), perceived quality (actual evaluation of the organization, content and facilities of the activity), perceived fairness (subjective judgment of the fairness of resource allocation and opportunity), participation (degree of behavioral and emotional engagement), and campus life satisfaction (degree of satisfaction with the campus experience of cultural and sports activities). By clarifying the relationships among these variables, reveal their intrinsic pathways of influence.

The subjects of the study were college students in private undergraduate colleges in Guangdong Province. The group was chosen for the following reasons: First, private colleges have a service-oriented nature, and most students come from families with better economic conditions and have higher expectations for services; Secondly, existing research has mostly focused on public colleges and universities, while studies on student satisfaction in private colleges and universities are relatively scarce; Third, Guangdong Province has a large number of private colleges, diverse types, and obvious shortcomings in satisfaction, and the research is representative and urgent.

The study collected data using questionnaires and conducted stratified sampling in dimensions such as gender, major, and grade to ensure the representativeness of the sample and the scientific nature of the results.

2. Literature Review

2.1. Research Design

This study adopts a cross-sectional quantitative research design to examine how private university students' expectations of campus cultural and sports activities influence their satisfaction with campus life. The research model integrates key constructs from Customer Satisfaction Theory [5,6] and the Expectancy-Disconfirmation Paradigm, with Equity Theory [7] introduced as a core cognitive mechanism. The model further incorporates Behavioral Engagement [8] as a direct antecedent and Personality (Extraversion/Introversion) [9] as a moderator.

Specifically, the model posits that students'expectations do not directly affect satisfaction but exert influence indirectly through two key cognitive mediators: perceived quality (subjective evaluation of activity content, organization, and facilities) and perceived equity (judgment of fairness in resource allocation and opportunity access). Engagement is hypothesized to directly predict satisfaction but not mediate the expectation-satisfaction link. Furthermore, personality type is theorized to moderate the relationship between expectations and engagement. This integrated design aims to address the research gaps concerning multiple parallel mediating mechanisms and the role of individual differences in the private higher education context.

2.2. Sampling and Data Collection

The target population for this study was full-time undergraduate students from private universities in Guangdong Province, China. A multi-stage sampling strategy was employed. First, three private universities in the Pearl River Delta region were purposively selected based on their scale and diversity of activity offerings.

Within these universities, a combination of stratified and convenience sampling was used to recruit student participants. The sample was stratified by academic year (freshman to senior) and major category (e.g., humanities, sciences, engineering, business). Questionnaires were distributed primarily through the online platform Wenjuanxing during July 1-7, 2025. Survey links were disseminated via official class groups and student activity communities with the assistance of university staff. A small lottery incentive was offered to improve the response rate.

A total of 415 questionnaires were collected. After removing invalid responses (e.g., excessively short completion time, patterned answering), 313 valid responses were retained for analysis, yielding an effective response rate of 76.90%. The demographic profile of the final sample is presented in Section 4.1.

2.3. Measurement Instruments

All constructs were measured using established scales adapted to the campus activity context. Responses were captured on a 7-point Likert scale (1 = "Strongly Disagree", 7 = "Strongly Agree").

Expectations (EXP): A 5-item scale adapted from Oliver (1980) [5] and Parasuraman et al. (1988) [10]. Sample item: "I expected the campus cultural and sports activities to offer novel and interesting content."

Perceived Quality (PQ): A 5-item scale adapted from the SERVQUAL model [10] and Sample item [11]: "The activity was executed efficiently without delays."

Perceived Equity (PF): A 5-item scale adapted from Colquitt's (2001) [12] organizational justice scale and Tang & Tang (2020) [13]. Sample item: "All students had equal opportunities to participate in the activities."

Engagement (PL): A 4-item scale adapted from Astin's (1984) [8] student engagement theory and Sample item [14]: "I often proactively signed up for campus cultural and sports activities."

Campus Life Satisfaction (CLS): A 5-item scale adapted from Baker & Siryk (1984) [15] and Elliott & Healy (2001) [16]. Sample item: "Overall, I am satisfied with the campus life provided by the university."

Personality Type (PT): A 5-item scale measuring the Extraversion/Introversion dimension, adapted from Goldberg's (1992) [9] Big Five Inventory. Sample item: "I enjoy taking the initiative to communicate with others at social gatherings."

Control Variables: Gender, Academic Year, and Major were included as control variables.

Marker Variable (ATCB): A 7-item "Attitude Toward the Color Blue" scale [17] was embedded to assess potential common method bias.

The questionnaire was structured in four parts: (1) Introduction and consent; (2) Screening questions to confirm participation in campus activities; (3) The main scale items; (4) Demographic information. All English scale items underwent a back-translation procedure to ensure conceptual equivalence.

2.4. Data Analysis (PLS-SEM)

Data analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0 software. PLS-SEM was chosen for its suitability for predictive research, complex models with mediating/moderating effects, and less stringent data distribution requirements.

The analysis followed a two-stage approach:

Assessment of the Measurement Model: We evaluated internal consistency reliability (Cronbach's α and Composite Reliability > 0.7), convergent validity (Average Variance Extracted > 0.5, outer loadings > 0.7), and discriminant validity using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio (< 0.85).

Assessment of the Structural Model: We evaluated the model's explanatory power (R^2 values) and predictive relevance. Path coefficients (β) and their significance (p-values) were calculated using a bootstrap procedure with 5000 resamples. The sizes of direct effects were assessed using f^2. Mediating effects (H5, H6, H7) were tested by examining the significance of specific indirect paths via bootstrapped confidence intervals. Moderating effects (H8) were tested by including an interaction term (Expectations × Personality) in the model, following the two-stage product-indicator approach.

2.5. Ethical Considerations

This study adhered to standard ethical research practices:

The research protocol was reviewed and approved by the Guangdong University of Science and Technology Research Ethics Committee.

Participation was voluntary and anonymous. A detailed information sheet at the beginning of the online questionnaire explained the study's purpose, data usage, confidentiality, and the right to withdraw. Submission of the completed questionnaire was taken as implied consent.

All data were collected and stored anonymously, with no personally identifiable information gathered. Data were used solely for aggregate statistical analysis and are stored on password-protected devices.

2.6. Hypothetical Summary and Theoretical Model Construction

Based on the customer satisfaction theory and expectation theory, this study proposes the research hypothesis that campus cultural and sports activities affect college students' campus life satisfaction through multiple pathways: campus cultural and sports activity expectations negatively affect satisfaction (H1), while perceived quality (H2), perceived equity (H3), and participation (H4) all have positive effects; Perceived quality (H5), perceived equity (H6), and participation (H7) play a positive mediating role between

expectations and satisfaction; Personality type moderates the impact of expectations on engagement, with e-type positively moderating (H8a) and I-type negatively moderating (H8b).

Based on the description of the relationships among the concepts, the research hypotheses are summarized in Table 1, and based on this, a theoretical framework for the impact of campus cultural and sports activities on college students' campus life satisfaction is constructed, as shown in Figure 1.

Table 1. Summary of Research Hypotheses

Hypothesis Numbers	Research Hypotheses
H1	Expectations of campus sports and cultural activities negatively affect college students' satisfaction with campus life
H2	Perceived quality positively affects college students' satisfaction with campus life
H3	Perceived equity positively affects college students' satisfaction with campus life
H4	Engagement positively affects college students' satisfaction with campus life
H5	Perceived quality plays a positive mediating role between expectations of campus cultural and sports activities and college students' satisfaction with campus life
H6	Perceived equity plays a positive mediating role between expectations of campus cultural and sports activities and satisfaction with college students' campus life
H7	Participation plays a positive mediating role between expectations of campus cultural and sports activities and satisfaction with college students' campus life
H8	Personality types (E-type/I-type personality) play a moderating role between expectations of campus cultural and sports activities and participation

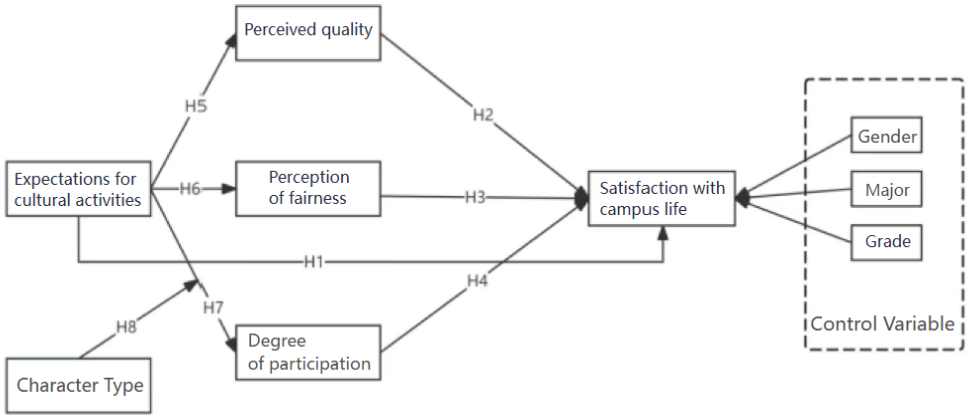

Figure 1. Theory of the impact of campus sports activities on college students' satisfaction with campus life

3. Materials and Methods

3.1. Research Design

Quantitative research methods are empirical research paradigms that test theories, reveal patterns, validate hypotheses, and predict trends by collecting and analyzing numerical data. The results of quantitative research are highly objective and reproducible [20]. Quantitative methods are important, necessary and unique in the study of education [21]. Therefore, the reason for choosing quantitative research in this study is that it can provide more accurate, reliable, objective and reproducible analytical results, thereby providing stronger support and evidence for the research question

This study employed a combination of judgment sampling and convenience sampling in non-probability sampling. The selection of this method system is mainly based on: First, the particularity of the private college group requires researchers to select typical samples through professional judgment; Second, there are obvious self-selection characteristics in participation in campus cultural activities, and strict probability sampling is difficult to implement; Third, constrained by research resources, feasibility needs to be taken into account while ensuring scientific rigor [22]. This study investigates the impact of campus cultural activities on the satisfaction of college students' campus life. The sampling process can be divided into two steps: sampling of the universities to be surveyed, followed by sampling of the student samples of the selected universities.

3.2. Sampling and Data Collection

This study took college students from private universities as the research subjects. Due to factors such as research costs, the typical sampling method was adopted and Guangdong Province was selected as the main research area for the following reasons:

First, private higher education in Guangdong Province is representative in the country. The number of private colleges and universities in the province accounts for one-third of the total number of colleges and universities, and 92% are concentrated in the Pearl River Delta region [23]. The highly concentrated distribution provides convenience for research. Secondly, Guangdong Province has a typical paradox of "high economic level - low satisfaction". The Annual report on the quality of Vocational education in China (2023) shows that the overall satisfaction rate of college students in Guangdong Province (80.55%) is the lowest in the country. Among them, the score of the "extracurricular education" dimension (83.93%) is significantly lower than that of other dimensions. This phenomenon provides an ideal sample for exploring the relationship between campus cultural and sports activities and satisfaction. Finally, the researchers are based in universities in the region, which facilitates in-depth observation of the activity implementation process and obtaining first-hand information. At the same time, the geographical agglomeration of universities in the Pearl River Delta region reduces the cost of cross-school research and ensures sample diversity and representativeness with limited resources.

After the universities have been selected, student samples are selected using a combination of judgment sampling and convenience sampling:

Judgment sampling: Based on the influencing factors of participation and satisfaction in campus cultural and sports activities, representative groups are selected. Including active participants (deep experience), low-participation students (analyze the reasons for alienation), student leaders (global perspective), general students (general perspective), and those with clear opinions on the activity (targeted feedback).

Convenient sampling: Distribute questionnaires in areas with high student traffic such as cafeterias and libraries, and push questionnaire links through counselors in online channels such as class groups and activity groups to expand coverage and improve recovery efficiency.

3.3. Measurement Methods

According to the recommendations of Hair at al. (2022) [18] and Xiao (2020) [19], the sample size required for PLS-SEM analysis should meet the following conditions: at least 200 cases for complex models, or 10 times the number of items in the scale. There are 35 items in the scale for this study, so the minimum effective sample size is set at 300. Considering the exclusion of invalid questionnaires, it is planned to collect 400 to 450 questionnaires.

The data was mainly collected through the Wenjuanxing platform, supplemented by lottery incentives. The process includes:

Trial survey: Distribute 50-80 questionnaires to test the reasonableness and feasibility of the items;

Formal research: Large-scale distribution through online channels after adjustment;

Data cleaning: Eliminate invalid questionnaires with too short filling times and duplicate options;

Ethical safeguards: All questionnaires were filled out anonymously, the purpose of the study was informed and informed consent was obtained before the survey, and the privacy of participants was strictly protected.

3.4. Measurement Methods

This study questionnaire consists of four parts:

Part 1: Introduction to the Questionnaire. The purpose of the study, privacy protection measures and variable definitions are explained to reduce misinterpretation and data bias. Part 2 of 2: Screening items. Set two questions, "Have you participated in campus sports activities?" and "Most Recent participation time", to screen out the target samples that have participated in activities and ensure the validity of the data. Part 3 of 3: Scale Items. A total of 35 items, using the Likert five-level scale (1= very inconsistent, 5= very consistent), including:

Dependent variable: Campus life satisfaction [15]

Independent variable: Expectations of campus cultural and sports activities (based on Oliver, 1980 [5])

Mediating variables: Perceived quality (reference: SERVQUAL scale), perceived equity [12], engagement [8].

Moderating variable: Personality type

Label variable: Attitude towards blue (ATCB) for detecting Common Method Bias (CMV) The English scale uses backtranslation to ensure translation accuracy. The labeled variable ATCB has no theoretical association with the core variable and can effectively capture methodological bias, which is subsequently tested and corrected by PLS-SEM analysis.

Part 4: Basic information of the respondents. Include demographic variables such as gender, grade, and major at the end of the questionnaire to reduce response bias caused by privacy concerns.

The reason for this design is to understand the differences in usage among different respondents themselves, but this part of the questions may cause respondents to be averse to giving up answering or cause bias when answering the scale items because it involves personal privacy. Therefore, this study referred to the recommendations of Shepherd & Vincent (1991) [24] and designed this section at the end of the questionnaire.

Table 2. Variables and measurement items

Variable Names	Code	Measurement items	Reference
Expectations of Campus Sports activities (EXP)	EXP1	I expect that campus cultural and sports activities can offer novel and interesting content	Oliver (1980) expected Inconsistency theory
	EXP2	I expect the event organization process to be efficient and well-arranged	
	EXP3	I expect to gain practical skills (such as communication/leadership) through the event.	
	EXP4	I expect the event facilities to meet professional needs	
	EXP5	I expect the event to create opportunities for deep social interaction	
Perceived quality (PQ)	PQ1	The actual content of the campaign is consistent with the previous promotional description	Parasuraman et al. (1988) SERVQUAL scale
	PQ2	The activity flow is executed efficiently without delay	
	PQ3	The venue is well-equipped and meets the requirements of the event	
	PQ4	Staff can respond promptly to the needs of participants	
	PQ5	The event design reflects an emphasis on the participants' experience	
Perceived Equity (PF)	PF1	Activity resources (funding/venue) are allocated fairly and reasonably	Colquitt's (2001) organizational justice scale
	PF2	The criteria for selecting awards are open and transparent	
	PF3	All students have equal opportunities to participate	
	PF4	Organizers can handle participants' feedback fairly	
	PF5	People with special needs, such as students with disabilities, receive proper care	
Engagement (PL)	PL1	I often sign up for campus sports and cultural activities on my own initiative	Astin (1984) Student Engagement Theory
	PL2	When participating, one is fully engaged in the activity session	
	PL3	Keep an eye on the results or feedback after the event	
	PL4	I am willing to take on the organization work during the event	
	PL5	The event has influenced my planning for campus life	
Campus Life satisfaction (CLS)	CLS1	You think campus cultural activities have enriched your college life	Baker & Bohdan Siryk (1984)
	CLS2	Participating in campus cultural activities enhances your sense of belonging to the school	
	CLS3	Campus cultural activities help you relieve academic stress	

Variable Names	Code	Measurement items	Reference
	CLS4	You are generally satisfied with the campus cultural activities provided by the school	
	CLS5	Campus cultural activities have facilitated communication and cooperation between you and your classmates	
Personality Type (extraversion/introversion personality) (PT)	PT1	I enjoy taking the initiative to communicate with others at social gatherings	Goldberg (1992) Big Five Personality Scale - Extraversion Dimension
	PT2	I prefer group activities to being alone	
	PT3	It's easy for me to make new friends in social situations	
	PT4	I feel energetic after big social events	
	PT5	I prefer face-to-face communication to text communication with people	
Control variables (CV)	CV1	Gender	
	CV2	Grade	
	CV3	Major	
Labeled Variables (ATCB)	ATCB1	Blue is a beautiful color	
	ATCB2	Blue is a lovely color	
	ATCB3	Blue is a delightful color	
	ATCB4	Blue is a wonderful color	
	ATCB5	Blue is a nice color	
	ATCB6	I think blue is a nice color	
	ATCB7	I like blue	

Collect data and pretest based on the chart framework. From the results of the pretest, it was found that the overall reliability and most of the validity indicators of the scale performed well, but the analysis revealed serious problems with items PL5 and PQ3: the PL5 loading was 1.000 and the model Settings were inconsistent, distorting the estimation of the latent variable PL, so PL5 was deleted; Secondly, PQ3's cross-load on its latent variable PQ was too low (0.344) and there was a fundamental contradiction in the model setting. Therefore, PQ3 was deleted. Due to space limitations, the chart is not presented here.

PLS-SEM has lower requirements for sample size and data distribution assumptions [25], is suitable for research scenarios with more complex models, and can output latent variable scores for subsequent analysis [26]. Due to the limited sample size and the inclusion of mediating variables in the study model, the structural equation model based on partial least squares (PLS-SEM) was chosen, and SmartPLS 4.0 software was used for statistical modeling and analysis.

4. Results

4.1. Descriptive Statistical Analysis

After the pretest and questionnaire adjustment, the research officially began. The questionnaire was distributed through social media platforms from July 1 to 7, 2025, and a total of 415 copies were retrieved. As all questions were set as required, there were no missing values. After screening, 94 invalid questionnaires with too short filling times

or highly consistent answers were excluded, and 313 valid questionnaires were obtained, with an effective recovery rate of 76.90%.

The demographic characteristics of the sample were as follows: The gender distribution was relatively balanced, with 47.6% male and 52.4% female; In terms of grade distribution, juniors were the most (31.6%) and freshmen the least (20.1%); In terms of subjects, liberal arts students accounted for 46.3%.

4.2. Measurement Model analysis

Reliability and validity tests are required to ensure the stability and accuracy of the research results. Internal Consistency Reliability is one of the commonly used metrics for measuring reliability, and the commonly used metrics for measuring internal consistency are Cronbach's α and the Composite reliability of latent variables (CR). Scale validity can be tested in terms of content validity, Construct validity, Discriminant validity, convergent validity, etc. Metrics commonly used to measure scale validity include Average variance extracted (AVE), Fornell-Larcker criteria, Outer loadings, Cross-Loadings, etc. [27].

Table 3 describes the Cronbach's Alpha coefficient, CR value, AVE, and Factor loadings for each latent variable. It can first be seen that the Cronbach's Alpha coefficients for each latent variable are all greater than 0.70, indicating high reliability of the scale [26]. Secondly, the CR values of each latent variable were all greater than 0.70, indicating good composite reliability of the scale [26]. Again, AVE values were all greater than 0.50, indicating good convergent validity of the scale [26]. Then, as shown in Table 3, Factor loadings were measured to confirm the reliability of each measure, and the results showed that all loadings exceeded 0.708 and were statistically significant at the significance level of 0.05 [26], indicating good convergent validity of the scale. In addition, cross-loading was tested in this study, as shown in Table 4, indicating that the loading of each metric on its own construct was higher than that on other constructs [28], suggesting good discriminant validity of the scale.

Table 3. Construct Reliability, Validity and Factor loadings

Latent variables	Cronbach's alpha	CR	AVE	Item	Factor Loading
CLS	0.91	0.93	0.74	CLS1	0.87
				CLS2	0.88
				CLS3	0.87
				CLS4	0.84
				CLS5	0.83
EXP	0.89	0.92	0.70	EXP1	0.84
				EXP2	0.81
				EXP3	0.84
				EXP4	0.85
				EXP5	0.85
PF	0.90	0.92	0.71	PF1	0.83
				PF2	0.84
				PF3	0.87
				PF4	0.87

Latent variables	Cronbach's alpha	CR	AVE	Item	Factor Loading
				PF5	0.80
PL	0.88	0.92	0.73	PL1	0.84
				PL2	0.85
				PL3	0.86
				PL4	0.88
PQ	0.91	0.93	0.78	PQ1	0.90
				PQ2	0.88
				PQ3	0.89
				PQ4	0.87
PT	0.91	0.93	0.74	PT1	0.85
				PT2	0.86
				PT3	0.86
				PT4	0.88
				PT5	0.85

Note: PT= Personality type, EXP= Expectations of campus sports activities, PL= Participation, CLS= Satisfaction with college students' campus life, PQ= Perceived quality, PF= Perceived equity.

Table 4. Cross-loads

Item	CLS	EXP	PF	PL	PQ	PT
EXP1	0.21	**0.84**	0.23	0.17	0.17	0.12
EXP2	0.18	**0.81**	0.18	0.19	0.13	0.20
EXP3	0.22	**0.84**	0.20	0.21	0.14	0.16
EXP4	0.17	**0.85**	0.27	0.22	0.12	0.21
EXP5	0.18	**0.85**	0.22	0.19	0.19	0.20
PQ1	0.40	0.17	0.39	0.40	**0.90**	0.41
PQ2	0.37	0.15	0.30	0.36	**0.88**	0.33
PQ3	0.37	0.13	0.31	0.38	**0.89**	0.39
PQ4	0.39	0.17	0.38	0.34	**0.87**	0.37
PF1	0.41	0.26	**0.83**	0.42	0.33	0.41
PF2	0.41	0.27	**0.84**	0.44	0.32	0.51
PF3	0.44	0.23	**0.87**	0.46	0.35	0.49
PF4	0.45	0.16	**0.87**	0.47	0.36	0.47
PF5	0.40	0.19	**0.80**	0.47	0.31	0.36
PL1	0.48	0.21	0.47	**0.84**	0.36	0.45
PL2	0.53	0.15	0.43	**0.85**	0.43	0.50
PL3	0.45	0.26	0.49	**0.86**	0.27	0.46
PL4	0.53	0.19	0.45	**0.88**	0.36	0.59
CLS1	**0.87**	0.21	0.51	0.56	0.33	0.49

Item	CLS	EXP	PF	PL	PQ	PT
CLS2	**0.88**	0.18	0.41	0.53	0.41	0.49
CLS3	**0.87**	0.18	0.45	0.52	0.32	0.50
CLS4	**0.84**	0.19	0.36	0.45	0.42	0.42
CLS5	**0.83**	0.23	0.40	0.42	0.39	0.40
PT1	0.47	0.17	0.47	0.52	0.43	**0.85**
PT2	0.43	0.24	0.45	0.49	0.33	**0.86**
PT3	0.46	0.20	0.45	0.51	0.39	**0.86**
PT4	0.47	0.24	0.50	0.50	0.33	**0.88**
PT5	0.47	0.07	0.43	0.52	0.35	**0.85**

Note: PT= Personality type, EXP= Expectations of campus sports activities, PL= Participation, CLS= Satisfaction with college students' campus life, PQ= Perceived quality, PF= Perceived equity.

As shown in Table 5, the bold diagonals represent the square roots of AVE. It can be seen that the square root of AVE for each latent variable is greater than the correlation coefficients of the other latent variables, indicating good discriminant validity [29]. In addition, Fornell & Larcker (1981) [30] proposed a method based on the multitrait - multi-method matrix (HTMT) for testing Discriminant validity. This method can consider the correlations between different metrics and different methods under the same latent variable at the same time. Compared with previous metrics, HTMT can assess the Discriminant validity between latent variables more accurately and avoid the problems that may arise when using AVE and correlation coefficients. Therefore, in this study, using HTMT as the metric for evaluating Discriminant validity can improve the accuracy and reliability of the model. As shown in Table 6, the HTMT values among the latent variables were all less than 0.85, once again demonstrating good discriminant validity of the scale [31].

Table 5. the Fornell-Larcker (1981) criterion

Latent variables	CLS	EXP	PF	PL	PQ	PT
CLS	0.86					
EXP	0.23	0.84				
PF	0.50	0.26	0.84			
PL	0.58	0.24	0.54	0.86		
PQ	0.43	0.18	0.39	0.42	0.88	
PT	0.54	0.21	0.53	0.59	0.43	0.86

Note: PT= Personality type, EXP= Expectations of campus sports activities, PL= Participation, CLS= Satisfaction with college students' campus life, PQ= Perceived quality, PF= Perceived equity.

Table 6. HTMT-Matrix

Latent variables	CLS	EXP	PF	PL	PQ	PT
CLS						
EXP	0.26					
PF	0.55	0.29				
PL	0.64	0.27	0.61			
PQ	0.48	0.20	0.43	0.47		
PT	0.58	0.24	0.59	0.65	0.47	

Note: PT= Personality type, EXP= Expectations of campus sports activities, PL= Participation, CLS= Satisfaction with college students' campus life, PQ= Perceived quality, PF= Perceived equity.

4.3. Common Method Bias Test

The Common Method Bias (CMB) problem [32] is likely to arise because the study collected data through questionnaires, with all items filled out by the same person. CMB can seriously lead to the validity of the research results. As a result, CMB has received extensive attention in disciplines such as Management and sociology, and papers in journals such as MIS Quarterly and Management Science have emphasized the importance of assessing the impact of CMB on statistical analysis results. Currently, the methods commonly used to assess the presence of CMB include Harman's Single-Factor Test and the Partial Correlation Technique.

Among the partial correlation techniques, the main ones are MTMM and Marker-variable Technique [33].

In this study, based on the recommendations of Lindell & Whitney (2001) [34], the CMB was examined using the labeled variable technique. First, introduce a variable that is theoretically irrelevant to this study as a marker variable in the formal questionnaire: Attitude Toward the Color Blue (ATCB), the Marker Variable is derived from the study by Miller & Simmering (2022) [35]. Second, calculate the correlation between the Marker variable and the endogenous variable in the structural model. Kline (2016) [36] pointed out that when judging the common method bias, a correlation coefficient of 0.70 to 0.85 can be used as the alert interval, but emphasized that high correlation requires further comprehensive judgment in combination with VIF and model metrics. Finally, the presence of common method bias is determined by comparing whether the addition of exogenous variables significantly changes the R^2 of endogenous variables [37].

From Table 7, it can be seen that the path coefficients between the labeled variables and the latent variables are all less than 0.70, not significant, indicating that the scale is less affected by the common method bias. It can be seen from Table 8 that the R^2 values of most variables changed slightly before and after the introduction of the labeled variables. In particular, CLS (customer satisfaction) only increased from 0.420 to 0.429 (with a change of 0.009), and the adjusted R^2 only increased from 0.407 to 0.414, with little change. In addition, the increase in R^2 for constructs such as PQ, PF, and PL was also relatively small, although the increase was slightly higher in PF and PQ (possibly due to more mediating effects in the structural path), but the overall change was still within an acceptable range.

Table 7. Correlations between latent variables and labeled variables

Paths	Path coefficients	T value
MARK -> CLS	0.12	2.474
MARK -> EXP	0.179	2.96
MARK -> PF	0.474	9.361
MARK -> PL	0.319	5.799
MARK -> PQ	0.37	6.712
MARK -> PT	0.515	10.581

Note: PT= Personality type, EXP= expectations of campus sports activities, PL= Engagement, CLS= satisfaction with college students' campus life, PQ= perceived quality, PF= perceived equity, MARK= labeled variable.

Table 8. R^2 of the model before and after adding the labeled variable

Latent variables	Add R^2 before the marker variable	After adding the marker variable, R^2
CLS	0.42	0.429
PF	0.069	0.286
PL	0.377	0.448
PQ	0.032	0.164

Note: PT= Personality type, PL= Engagement, CLS= satisfaction with college life, PQ= Perceived quality, PF= Perceived equity.

4.4. Multicollinearity (VIF) test

Multicollinearity problems arise when there is a high correlation between the variables in the measurement model. In such cases, a change in one dependent variable may be interpreted by other variables, resulting in an inaccurate or insignificant estimation of the correlation coefficient of that dependent variable. This study uses VIF as a statistic for detecting multicollinearity problems, and if the VIF value is greater than 3, it indicates the presence of multicollinearity problems [26]. As shown in Table 9, VIF values (1.93 to 1.524) for all variables were within an acceptable range. Therefore, it indicates that multicollinearity is not a serious problem for this study.

Table 9. Collinearity Statistics (VIF)

Paths	VIF
EXP -> CLS	1.092
EXP -> PF	1
EXP -> PL	1.134
EXP -> PQ	1
PF -> CLS	1.51
PL -> CLS	1.524

Paths	VIF
PQ -> CLS	1.277
PT -> PL	1.051
PT x EXP -> PL	1.083

Note: PT= Personality type, EXP= Expectations of campus sports activities, PL= Participation, CLS= satisfaction with college students' campus life, PQ= perceived quality, PF= perceived equity, PT= Personality type.

4.5. Structural Model Analysis

Structural model analysis is the test of the correlations among the variables in a model, that is, hypothesis testing. Commonly used metrics include R-squared (R^2), Cohen's f-squared (f^2), path coefficient, and significance level values, etc. These metrics can be used to measure the fit and explanatory power of the model. In PLS-SEM, R^2 and f^2 are used to assess the explanatory power and effect size of the structural model. R^2 serves as the primary criterion for evaluating the predictive accuracy of the model, while f^2 measures the impact of each exogenous construct on an endogenous construct [27]. According to Chin (1998) [38], R^2 values of 0.67, 0.33, and 0.19 indicate substantial, moderate, and weak explanatory power, respectively. Moreover, f^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large effect sizes [27].

4.5.1. Results of path analysis

The path analysis results are shown in Table 10. The significance of several hypothetical paths was verified in the study as follows:

In the other paths of H1, both "EXP → PF" (β=0.263, P<0.001, f^2=0.074) and "EXP → PQ" (β=0.178, P=0.002, f^2=0.033) reached significant levels, indicating that expectations can indirectly affect satisfaction by influencing perceived equity and perceived quality. The "EXP → PL" path was not significant (P=0.143).

Furthermore, H2, H3 and H4 were all supported: the PF → CLS path coefficient was 0.214 (P<0.001, f^2=0.052), indicating that perceived fairness has a positive impact on satisfaction; The "PL → CLS" path coefficient was 0.378 (P<0.001, f^2=0.161), with a moderate effect intensity; The PQ → CLS path coefficient was 0.180 (P<0.001, f^2=0.044).

Figure 2 shows the analysis results of PLS, describing each path coefficient and significance level. The results show that the variance explanation for college students' campus life satisfaction in the model is 42%; The proportion of interpreted variance for perceived quality was 3.2%; The proportion of interpreted variance for perceived fairness was 6.9%; Engagement was 37.7 percent of the explained variance.

Table 10. Hypothesis Testing Results

Hypotheses	Path	Path coefficient	F square	T value	P value	Test results
H1	EXP -> CLS	0.055	0.005	1.557	0.12	Not supported
H2	PQ -> CLS	0.18	0.044	4.01	0	Support
H3	PF -> CLS	0.214	0.052	4.24	0	Support
H4	PL -> CLS	0.378	0.161	7.104	0	Support
H8	PT x EXP -> PL	0.13	0.027	2.635	0.008	Support

Note: PT= Personality type, EXP= Expectations of campus sports activities, PL= Engagement, CLS= Satisfaction with campus life, PQ= Perceived quality, PF= Perceived equity.

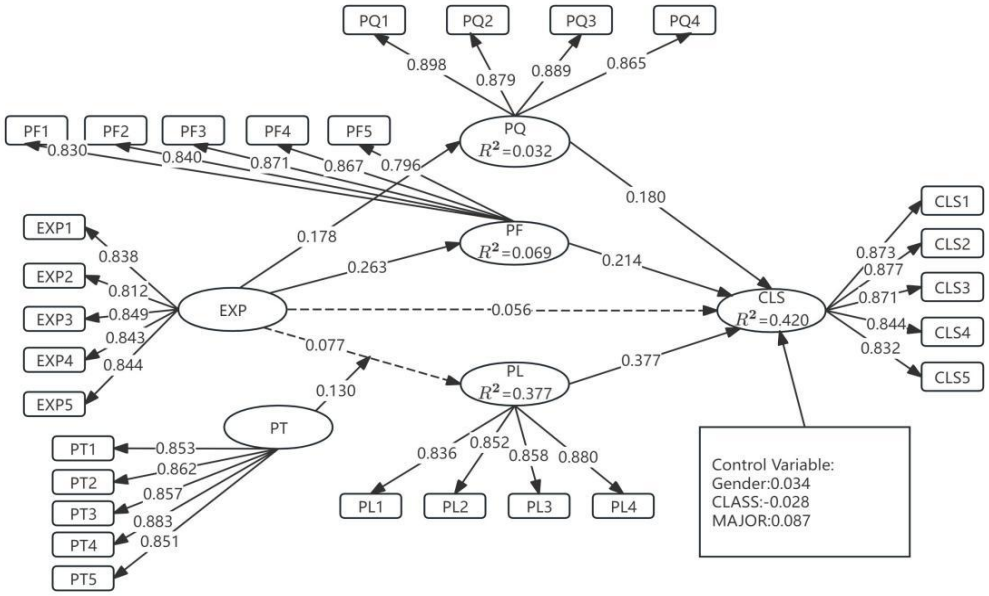

Figure 2. Analysis Results of the structural equation model

In order to explore the mediating mechanisms among the variables in the theoretical model in depth, this study systematically tested the mediating effects based on the standardized process proposed by Zhou and Fan (2021) [39]. Specifically, 5,000 Bootstrapping sessions were used to assess the significance of the mediating effect. In short, the analytical framework mainly determines the presence and type of mediating effects through tests of total effects, direct effects, and indirect effects.

The basic condition for a mediating effect to be significant is that the total effect and the indirect effect must be statistically significant. On this basis, if the direct effect is not significant, it indicates that the mediating variables play a full mediation role; If the direct effect is also significant, it constitutes partial mediation. Further, if both the indirect and direct effects are significant and in the same direction, it is a complementary mediation; Conversely, if the directions are opposite, it can be classified as a competitive mediation [40].

Table 11. Analysis of PLS-SEM mediating effects

Paths	Influence	Estimate	Bootstrap			95% confidence interval		Conclusion
			S.E.	T value	P value	Low	Upper	
EXP -> PQ -> CLS	Direct effect	0.055	0.036	1.557	0.12	-0.015	0.123	Complete mediating effect
	Indirect effects	0.032	0.014	2.349	0.019	0.009	0.063	
	Total effect	0.172	0.054	3.182	0.001	0.067	0.281	
EXP -> PF -> CLS	Direct effects	0.055	0.036	1.557	0.12	-0.015	0.123	
	Indirect effects	0.056	0.021	2.698	0.007	0.023	0.104	

Paths	Influence	Estimate	Bootstrap			95% confidence interval		Conclusion
			S.E.	T value	P value	Low	Upper	
	Total effect	0.172	0.054	3.182	0.001	0.067	0.281	Complete mediating effect
EXP -> PL -> CLS	Direct effects	0.055	0.036	1.557	0.12	-0.015	0.123	No mediating effect
	Indirect effects	0.029	0.022	1.353	0.176	-0.009	0.076	
	Overall effect	0.172	0.054	3.182	0.001	0.067	0.281	

Note: PT= Personality type, EXP= expectations of campus sports activities, PL= Engagement, CLS= satisfaction with campus life, PQ= perceived quality, PF= perceived equity.

Firstly, "EXP → PQ → CLS" represents a complete mediating effect, and H5 holds true. As shown in Table 11, the indirect effect of the path is estimated at 0.032, with a T value of 2.349 and a P value of 0.019, and the confidence interval [0.009, 0.063] does not contain 0, indicating that the path is significant. Since the direct effect (EXP → CLS) of the path is not significant, it can be determined that perceived quality plays a fully mediating role between expectation and satisfaction. This suggests that students' expectations of campus cultural and sports activities do not directly increase their life satisfaction, but rather play a role through their perception of the quality of activities. That is to say, expectations will eventually translate into satisfaction only when the actual experience aligns with expectations and students consider the quality of the activity to be high. This is in line with the "expectation - perception - satisfaction" logic in SERVQUAL theory, indicating that perceived quality is the key bridge between expectation fulfillment and satisfaction.

Secondly, "EXP → PF → CLS" is also a complete mediating effect, and H6 holds. As shown in Table 11, the indirect effect of this path is 0.056, with a T value of 2.698, a P value of 0.007, and a confidence interval of [0.023, 0.104], indicating significance. Since the direct effect of this path (EXP → CLS) is not significant, it can be determined that perceived fairness plays a complete mediating role between expectation and satisfaction. This suggests that students' expectations are more likely to translate into satisfaction if they consider the process to be fair and reasonable during their participation in campus cultural and sports activities. The sense of fairness includes fair distribution of resources, fair organization processes and fair interaction (such as activity opportunities, scheduling, fair scoring, etc.). This aligns with the Equity Theory: when individuals assess their satisfaction, they do not only look at how much they gain, but also at whether the gains are fair and reasonable. Therefore, even if expectations are high, satisfaction does not increase if there is a lack of a sense of fairness (such as unequal participation opportunities, some students being given preferential treatment). This further reinforces the importance of "perceived equity" as a mediating variable.

Again, "EXP → PL → CLS" has no mediating effect, and H7 does not hold. As shown in Table 11, the indirect effect of this path is 0.029, the T value is 1.353, the P value is 0.176, and the confidence interval [-0.009, 0.076] crosses 0, indicating that this path is not significant and does not constitute a mediating effect. In other words, the degree of student engagement does not constitute a significant mediating mechanism between expectations and satisfaction. Even if students have higher expectations and higher levels of engagement, this does not directly lead to an increase in satisfaction.

Finally, as shown in Table 11, the overall effect: estimated at 0.172, T at 3.182, P at 0.001, significant. Direct effect (EXP → CLS): not significant (P=0.120). It indicates that

although the direct effect of expectation on satisfaction is not significant, it still shows a significant influence on satisfaction through the two mediating variables of perceived quality and perceived equity.

Therefore, this study identified a "multipath complete mediating" mechanism, that is, students' expectations must affect their satisfaction through the two perceived dimensions of "quality" and "fairness".

As shown in Table 12, the moderating effect is significant (PT × EXP → PL, β=0.13, P=0.008, f ²=0.027), and H8 holds, that is, personality type moderates the influence of expectation on engagement.

Table 12. Analysis of the moderating effects of PLS-SEM

Paths	Influence	Estimate	Bootstrap			95% confidence interval		Conclusion
			S.E.	T value	P value	Low	Upper	
PT x EXP -> PL	Moderating effects	0.13	0.049	2.635	0.008	0.034	0.227	Significant

Note: PT= Personality type, EXP= expectations of campus sports activities, PL= participation.

In addition, by testing the control variables as shown in Table 13, the impact of the control variables on college students' campus life satisfaction in this study was not significant.

Table 13. Test Results of Control Variables

Path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P value
SEX -> CLS	0.034	0.035	0.089	0.381	0.703
CLASS -> CLS	-0.028	-0.027	0.042	0.658	0.511
MAJOR-> CLS	0.087	0.085	0.09	0.961	0.337

Note: SEX= gender, CLASS= grade, MAJOR= major, CLS= student satisfaction with campus life.

4.6. Model fit analysis

PLS -SEM model fit reflects the degree of match between the theoretical model and the observed data. In this study, indicators such as SRMR, d_ULS, d_G, chi-square value and NFI were used for evaluation. The results showed an SRMR value of 0.049, below the strict standard of 0.08, indicating that the model residuals were well controlled; The d_ULS value was 0.960 and the d_G value was 0.473, both at low levels, indicating that the model had small errors and a high degree of structural matching; The chi-square value was 873.867, which was within the acceptable range; The NFI was 0.863, slightly below the ideal value of 0.90, but still indicated strong adaptability of the model. Taking all the indicators into account, the model fits well and can effectively interpret the data.

5. Discussion

5.1. Interpretation of key findings

Firstly, although H1 predicted a direct negative effect of expectations on satisfaction, the path was not statistically significant ($\beta = 0.055$, $p = 0.120$, $f^2 = 0.005$). This finding, however, aligns with prior studies suggesting that expectations alone do not determine satisfaction unless they are confirmed or disconfirmed through actual experiences [5,41]. In the context of campus activities, students may form idealized expectations before participation, but their post-event satisfaction is contingent upon perceived quality and fairness, not the initial expectation level. This supports the expectancy-disconfirmation paradigm, where expectations operate indirectly through mediators rather than directly affecting satisfaction [5]. Thus, the non-significant direct effect of expectations does not undermine the theoretical model; rather, it reinforces the importance of mediating mechanisms in satisfaction formation.

Non-significant Mediation, Contrary to H7, the indirect effect of expectations on satisfaction via engagement was not significant ($\beta = 0.029$, 95% CI [–0.009, 0.076]). This null finding aligns with Astin's (1984) [8] contention that engagement is more strongly predicted by personality and social support than by cognitive expectations. It also echoes the Theory of Planned Behavior, which posits that behavioral involvement requires intention + perceived control, not merely positive expectations [42]. Consequently, expectations may influence cognitive appraisals (quality, equity) more readily than behavioral involvement, especially among students with high academic workload or introverted dispositions. Theoretically, this highlights the need to differentiate cognitive mediators (quality, fairness) from behavioral mediators (engagement) in future satisfaction models. Practically, universities should decouple recruitment strategies from engagement targets: rather than assuming that higher expectations automatically boost participation, they could offer multiple engagement pathways tailored to diverse personality profiles.

Although the moderation effect of personality (H8) was statistically significant ($\beta = 0.13$, $p = 0.008$), its effect size was small ($f^2 = 0.027$). While this value falls below [43] threshold for a medium effect, it remains theoretically meaningful for two reasons. First, personality traits are stable dispositions rather than transient states; even small interaction effects can accumulate across repeated activities and ultimately shape long-term engagement patterns [44]. Second, meta-analyses of personality × situation interactions consistently report small effect sizes ($\rho \approx 0.02$–0.04; [45]), indicating that our finding is consistent with the broader literature. Practically, the result implies that extraverted students are slightly more likely to translate expectations into actual participation, whereas introverted students may require alternative pathways (e.g., virtual roles, small-group tasks) to bridge the expectation–engagement gap. Thus, although the immediate impact of personality is modest, its cumulative influence on activity involvement and subsequent satisfaction should not be overlooked.

5.2. Theoretical and Practical Contributions

5.2.1. Theoretical implications

1. This study is among the first to integrate expectancy-disconfirmation theory, equity theory, and student-engagement research into a single model explaining campus-life satisfaction in private universities—a context rarely examined in the literature.

2. By demonstrating that perceived quality and perceived equity fully mediate the expectation – satisfaction link while engagement does not, we clarify the boundary conditions of each mediator and extend the applicability of the SERVQUAL and organizational-justice frameworks to non-academic services.

3. We introduce extraversion/introversion as a moderator of the expectation – engagement pathway, responding to recent calls for persona-based university experience design [46].

5.2.2 Practical implications

1. Quality-first design: Universities should prioritize professionalism (content, logistics, feedback) over sheer quantity.

2. Fairness transparency: Publicly display selection criteria and resource-allocation rules to boost institutional trust.

3. Parallel participation tracks: Offer high-interaction roles for extraverts and low-stimulus, task-based roles (e.g., backstage, virtual curation) for introverts.

4. Feedback loop: Embed real-time satisfaction dashboards after each activity to dynamically adjust future designs.

6. Conclusions

This study empirically examines the mechanism through which campus cultural and sports activities influence student satisfaction in Chinese private universities. Utilizing PLS-SEM analysis of data from Guangdong Province, four core findings emerge. Indirect Effect via Cognitive Appraisals: Students' expectations of activities do not directly affect campus life satisfaction. Instead, their influence is fully mediated by two cognitive evaluations: perceived quality (of content, organization, and facilities) and perceived equity (in resource allocation and opportunity). Direct Role of Behavioral Engagement: While engagement directly and positively predicts satisfaction, it does not serve as a mediator between expectations and satisfaction, indicating distinct motivational pathways. Moderating Effect of Personality: The relationship between expectations and engagement is significantly moderated by personality type (Extraversion/Introversion). Extraverted students show a stronger link between high expectations and subsequent participation.

Theoretical Contributions: This research makes three key contributions: (1) It integrates expectancy-disconfirmation theory, equity theory, and engagement literature into a unified framework, specifically applied to the under-researched context of private higher education. (2) It delineates and confirms the distinct roles of cognitive mediators (quality, equity) versus a behavioral antecedent (engagement) in the satisfaction formation process. (3) It validates personality as a critical boundary condition, advancing personalized models of student experience. Practical Contributions: The findings offer actionable guidance for university administrators: (1) Shift from Expectation Management to Experience Delivery: Prioritize investment in the actual quality and procedural fairness of activities over promotional hype. (2) Design for Diverse Participation Drivers: Recognize that engagement stems from varied motives; provide both social, high-energy options and low-pressure, task-based or virtual roles to cater to different personalities, especially

introverted students. (3) Implement Transparency and Feedback Loops: Establish clear, fair rules for resource allocation and use post-activity feedback to iteratively improve design.

For practice, private universities are advised to institutionalize quality and fairness standards in activity planning and to adopt a student persona-based approach to diversify participation channels. For researchers, future studies should: (1) test this model in diverse institutional (e.g., public universities) and cultural contexts to enhance generalizability; (2) employ longitudinal designs to strengthen causal claims and explore temporal dynamics; (3) incorporate additional contextual variables (e.g., social support, organizational trust) to extend the model's explanatory power; and (4) investigate the effects of emerging digital activity formats on the proposed mechanisms.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy and ethical restrictions, as they contain potentially identifiable information about students within specific private universities.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. The online questionnaire began with a detailed information sheet explaining the study's purpose, anonymity, voluntary nature, and right to withdraw. Submission of the completed questionnaire was taken as implied consent.

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Abbreviations

The following abbreviations are used in this manuscript:

PLS-SEM	Partial Least Squares Structural Equation Modeling
MTMM	Multitrait-Multimethods
CR	Composite reliability
AVE	Average variance extracted
EXP	Expectations of Campus Sports activities
PQ	Perceived quality
PF	Perceived Equity
PL	Engagement
CLS	Campus Life sat-isfaction
PT	Personality Type
CV	Control variables
ATCB	Labeled Variables
CMB	Common Method Bias

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