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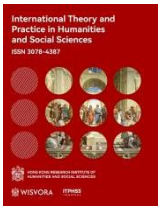

Exploring the Impact Pathways of Campus Service Quality on Student Satisfaction: An Analysis Based on Structural Equation Modeling

Yewen Lyu[1], Jiangming Qian[2]

[1]*Yangtze Delta Region Institute (Huzhou), University of Electronic Science and Technology of China*

[2]*Higher Education Research Institute, Lanzhou University*

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Corresponding Author

Yewen Lyu

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Abstract

This study uses structural equation modeling to examine how campus service quality affects student satisfaction. Based on a "student-centered" service philosophy, we built a theoretical framework with four dimensions: evidence-based approach, multi-dimensional service, holistic education, and digital transformation. We collected data through nationwide surveys in China and analyzed it using structural equation modeling. The results show that: (1) campus service quality positively influences student satisfaction; (2) students' overall perception acts as a mediator between service quality and satisfaction; (3) the level of digital transformation moderates how service quality affects both students' overall perception and satisfaction. These findings provide both theoretical foundations and practical guidance for improving campus services, contributing valuable insights to the modernization of campus service management.

1. Introduction

Campus services constitute a fundamental support system essential for the advancement of higher education institutions (Bhuian, 2016). The scope encompasses not merely basic amenities such as dining (Horacek et al., 2016) and environmental maintenance (Lukman et al., 2009), but extends to comprehensive operational support. These services play an integral role in maintaining educational infrastructure, from facility management to utility provision (Naji et al., 2023; Savanick et al., 2008), thereby facilitating seamless academic and research activities. Campus security operations, implemented through rigorous access control protocols and systematic facility inspections, ensure a secure learning environment. Furthermore, comprehensive support services extend to various administrative functions, including student orientation, departure procedures, facility maintenance, and welfare services. As a critical operational component, campus services significantly contribute to the development of educational excellence and the

establishment of world-class institutions.

In the contemporary landscape of rapidly evolving higher education, student expectations regarding campus services have undergone significant transformation. Contemporary students prioritize diverse and personalized campus experiences (Ohnishi, 2012), encompassing specialized dining options, technologically advanced residential facilities, and efficient space allocation systems. These evolving requirements necessitate enhanced service delivery mechanisms. Traditional evaluation methodologies have proven inadequate in addressing current needs, exhibiting significant limitations: survey instruments often lack analytical depth, while subjective assessments based on individual experiences fail to maintain objectivity. These methodological constraints impede comprehensive service quality assessment and informed decision-making processes.

Structural Equation Modeling (SEM) represents an advanced statistical methodology capable of analyzing complex variable relationships through integrated analytical approaches (Anderson et al., 1988; Suhr, 2006). Its application in campus service research facilitates systematic examination of the correlations between service quality metrics and student satisfaction indicators, thereby providing empirical support for service enhancement initiatives and resource optimization strategies.

This study employs questionnaire surveys for data collection and structural equation modeling for analysis. Data collection encompassed nationwide surveys across diverse institutional types, academic disciplines, and educational levels, establishing a comprehensive sample database. The analytical framework utilizes structural equation modeling to examine inter-variable relationships, elucidating the mechanisms through which various service quality dimensions influence student satisfaction. This research presents several methodological innovations: the integration of customer satisfaction theory (Yüksel & Rimmington, 1998) into campus service evaluation frameworks, the implementation of multidimensional analytical approaches for comprehensive service quality assessment, and the establishment of dynamic monitoring systems through structural equation modeling to inform evidence-based management decisions.

2. Related Work

2.1 Theoretical Interpretation of Student-Centered Campus Services

The campus service system should always prioritize enhancing student experience as its primary task, which represents the core value of modern university management. This is not only crucial for ensuring continuous service quality optimization but also serves as the fundamental basis for ensuring campus services effectively meet student needs. Through the establishment of scientific evaluation systems and continuous monitoring and improvement of student satisfaction, we can accurately measure the actual level of campus service quality and provide clear direction for future development planning. Based on the student-centered service philosophy, we reference Qian's (2023) research to conduct systematic development across the following four key dimensions.

2.1.1 Evidence-Based

Modern campus service system development should be guided by scientific theory, use quantitative analysis as its core tool, and rely on reliable data for decision-making. Looking at past development, due to limitations in data collection capabilities and insufficient information technology levels, universities often overly relied on traditional methods such as case studies or small-scale sampling when evaluating service quality, which showed clear limitations and deficiencies in scientific rigor and credibility (Hou, 2014). Therefore, we must establish a more

comprehensive data analysis system to fully understand the diverse needs of student groups through systematic needs assessment and in-depth analysis, thereby precisely creating a truly student-centered modern campus service system.

2.1.2 Multi-dimensional Services

Campus service is a highly diverse and systematic comprehensive service system, where various service dimensions need to operate in coordinated unity to serve the fundamental goal of talent cultivation. Specifically, this system includes multiple core service areas such as dining services, accommodation services, facility maintenance, environmental management, and security assurance, requiring professional teams to work together with sincere cooperation and tacit understanding. Service facilities encompass student cafeterias, student dormitories, campus landscaping, and various security equipment and other infrastructure (Semple et al., 2021). These key elements collectively constitute an important environment for students' daily study and life, having a continuous and far-reaching impact on their growth and development. Therefore, campus service work must always maintain education as its core mission, actively promote the coordinated development of various services, and strive to create a high-quality educational environment.

2.1.3 Holistic Education

In implementing the student-centered service concept, we must highly value the effective allocation of campus service resources to support students' comprehensive development in all aspects. We deeply recognize that student growth is a complex comprehensive process, influenced not only by direct classroom teaching but also by the subtle influence of the environment, including diverse extracurricular activities, daily life experiences, and unique campus culture (Stage et al., 1999). Therefore, campus services must integrate all existing resources, precisely meet students' diverse needs, and focus on building a modern service system of "education by all staff, throughout the entire process, and in all aspects."

2.1.4 Digital Transformation

With the deep advancement of the Education Informatization 2.0 strategy (Liu, 2021), smart campus construction has posed new requirements and higher standards for campus services. Digital transformation has become an important component in the modernization process of higher education and an inevitable choice for comprehensive service quality improvement. Campus service departments must fully utilize modern information technology, actively build intelligent service networks, achieve comprehensive data sharing and deep application through systematic integration, and continuously use advanced technology to provide more intelligent service experiences (Breivik & Gee, 2006), continuously pushing campus service standards to higher levels.

2.2 Student Satisfaction with Campus Services

Student satisfaction serves as a critical indicator of higher education quality (Lee et al., 2016). It reflects students' comprehensive evaluation of educational services while directly influencing universities' reputation, educational quality, and sustainable development. Research consistently demonstrates that student satisfaction strongly correlates with learning motivation (Wu et al., 2012), academic achievement (Fernando et al., 2017), adaptation to campus life (Oblitas & Jorge, 2021), and institutional loyalty (Brown & Mazzarol, 2009). Understanding and analyzing the factors affecting student satisfaction is therefore crucial for improving educational quality and optimizing talent development.

Research reveals that student satisfaction is influenced by diverse, hierarchical factors across teaching quality, learning environment, campus infrastructure, and management services (Naulanda et al., 2022). Key factors directly affecting satisfaction include faculty expertise,

teaching effectiveness, commitment to education, curriculum design, and access to learning resources. The quality of support services, campus cultural diversity, teacher-student engagement, and overall service standards also significantly impact student satisfaction.

As higher education becomes increasingly international and competitive, student satisfaction assessment has emerged as a vital component of universities' quality assurance systems. By implementing comprehensive evaluation frameworks and sophisticated analytical tools, institutions can identify areas for improvement, develop targeted solutions, and steadily enhance their educational services. This data-informed approach to quality enhancement has become essential for universities seeking to strengthen their competitive advantage (Shen et al., 2012; Wang, 2020).

2.3 Model Construction and Hypothesis Development

2.3.1 Variable Selection and Definition

This study examines how campus services influence student satisfaction by analyzing four core variables: campus service quality, degree of digitalization, students' overall perception, and student satisfaction.

Campus service quality, the key independent variable, comprises three sub-dimensions aligned with a "student-centered" philosophy (Hannafin & Land, 2000): evidence-based, multi-dimensional service, and holistic education. The evidence-based dimension evaluates how campus services implement data collection, quantitative analysis, and theory-guided practice, for example, through complete food safety information disclosure in cafeterias and detailed dormitory complaint handling records. The multi-dimensional service dimension addresses the coordination of campus services to deliver comprehensive, high-quality experiences, exemplified by diverse and nutritionally balanced dining options and efficient maintenance response times. The holistic education dimension integrates campus services into the university's educational mission, fostering students' character development through staff mentorship and environmental influences, such as dormitory activities that build community spirit and cleaning staff who model professional dedication.

The degree of digitalization acts as a moderating variable, assessing how effectively campus services utilize modern information technology. This includes the robustness of information systems, user-friendliness of online platforms, and sophistication of data integration and analysis. These factors determine whether services can meet students' evolving technological needs while supporting efficient service delivery.

Students' overall perception serves as a mediating variable, capturing their subjective assessment of campus service value. This encompasses their evaluation of service quality, convenience, and costs. Their perception both stems from campus service quality and shapes their ultimate satisfaction levels.

Student satisfaction, the dependent variable, measures students' contentment with campus services through comprehensive evaluations and specific feedback on areas like dining, accommodation, maintenance, sanitation, and security. This metric provides a thorough view of students' service experiences and serves as the primary indicator of campus service quality.

2.3.2 Research Hypothesis Development

Based on the theoretical analysis and variable definitions above, we propose four research hypotheses to explore the relationships between variables:

Campus service quality positively impacts student satisfaction. When campus services effectively implement evidence-based planning, multi-dimensional service optimization, and holistic education integration to improve service quality, these improvements manifest in students' learning and living experiences, leading to higher student satisfaction and establishing a

positive correlation.

Students' overall perception mediates the relationship between campus service quality and satisfaction. Campus service quality initially shapes students' direct perceptions, forming their preliminary judgments about service value. These subjective assessments then influence their final satisfaction ratings. Thus, students' overall perception acts as a bridge between service quality and satisfaction.

Digital transformation moderates how campus service quality affects students' overall perception. Enhanced digitalization enables campus services to deliver precise information and streamline processes through technology, making service quality improvements more apparent to students and strengthening their positive perception. Conversely, limited digitalization may obscure service quality improvements, weakening this relationship.

Digital transformation also moderates how campus service quality influences student satisfaction. High digitalization levels allow campus services to better match student needs and respond quickly to issues, effectively converting quality improvements into satisfaction. However, low digitalization levels create inefficient communication channels between campus and students, reducing the positive impact of service quality on satisfaction. Therefore, digital transformation significantly influences this relationship's strength.

In summary, this study proposes the following hypotheses:

H1: Campus service quality has a positive impact on student satisfaction.

H2: Students' overall perception mediates the relationship between campus service quality and student satisfaction.

H3: The degree of digital transformation moderates the impact of campus service quality on students' overall perception.

H4: The degree of digital transformation moderates the impact of campus service quality on student satisfaction.

2.3.3 Model Construction

Based on the theoretical foundation and research hypotheses outlined above, we carefully constructed a structural equation model. Using the three sub-dimensions of campus service quality (evidence-based, multi-dimensional service, and holistic education) as starting points, we established paths leading to students' overall perception, clearly demonstrating how campus service quality influences students' subjective cognition. The path then extends from students' overall perception to student satisfaction, highlighting the mediating variable's transmission effect. Meanwhile, direct paths were constructed from each sub-dimension of campus service quality and students' overall perception to student satisfaction, comprehensively considering the combined impact of all factors.

Additionally, we introduced the degree of digitalization as a moderating variable, establishing interactive paths with both the sub-dimensions of campus service quality and students' overall perception. This precisely captures its moderating effects across different impact pathways, creating a complete and systematic structural equation model that deeply reflects the complex relationships between variables, providing a solid framework for subsequent in-depth analysis.

The research model is shown in Figure 1.

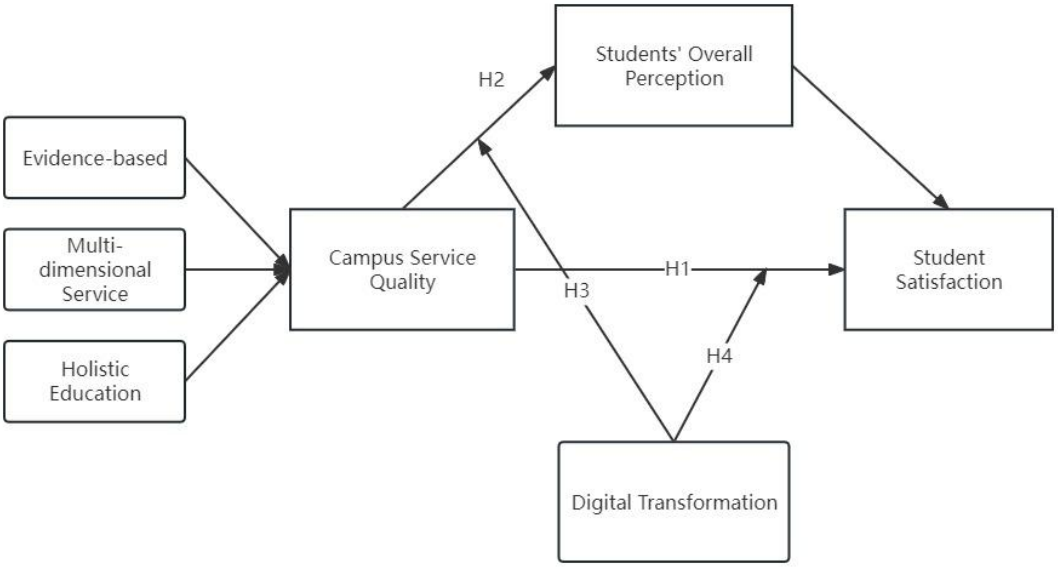


Figure 1 Theoretical Model of Research Hypotheses and Variable Relationships

3. Methodology and Procedures

3.1 Research Subject Selection

To ensure broad representation and applicability of research results, this study employed a combination of stratified and random sampling methods, selecting multiple higher education institutions from different regions, levels, and types as research subjects. The sample encompassed various institution types including comprehensive universities, science and engineering institutes, normal universities, and agricultural and forestry colleges, covering both undergraduate universities and vocational colleges. Regarding student levels, the study included undergraduates, master's students, and doctoral students, aiming to comprehensively reflect the perceptions and evaluations of campus services from students of different backgrounds. Since the questionnaire focused on higher education service quality and was forwarded by many university leaders, we received a higher than expected number of questionnaire responses. Ultimately, 5,647 students from 39 higher education institutions participated in the survey, providing an adequate sample size for subsequent in-depth analysis.

3.2 Questionnaire Design

The questionnaire was self-designed, pilot tested, and validated for reliability and validity before large-scale implementation. The questionnaire content was carefully designed around key areas of campus services, covering core sections such as dining services, dormitory services, maintenance, environmental sanitation, and order maintenance, thoroughly investigating student satisfaction across various aspects of campus services. The dining services section included questions about food quality, flavor diversity, food safety, dining environment, and staff service attitude. Dormitory services covered dormitory facilities, living comfort, response time and care from dormitory management staff, and dormitory cultural atmosphere. Maintenance services addressed repair response timeliness, maintenance quality, and fee reasonableness. Environmental sanitation focused on campus public area cleanliness, waste disposal efficiency, and restroom hygiene conditions. Order maintenance examined campus security patrol intensity, security facility adequacy, and emergency response capabilities.

The questionnaire combined multiple-choice and open-ended questions. Multiple-choice questions facilitated large-scale data collection and statistical analysis, utilizing a five-point Likert scale ranging from "very satisfied" to "very dissatisfied" to precisely quantify student

evaluations. Open-ended questions provided space for students to freely express opinions and suggestions, delving deep into students' true thoughts and obtaining rich, detailed qualitative information, making the survey results more profound and targeted, comprehensively understanding student satisfaction with campus services.

3.3 Data Collection Process

Data collection was conducted online through the Wenjuanxing platform, with questionnaires widely distributed through various channels including WeChat, official campus websites, and class groups to encourage student participation and ensure high questionnaire response and validity rates. The questionnaire was distributed in two rounds, with the first round used for exploratory factor analysis and the second round for confirmatory factor analysis and hypothesis testing.

Throughout the data collection phase, quality control was highly emphasized, with strict questionnaire review standards established to eliminate invalid questionnaires, such as those with numerous missing entries, logical inconsistencies, or obvious perfunctory responses. Real-time monitoring of collected data was implemented, with regular data cleaning and organization to promptly identify and resolve issues such as data entry errors and duplicate submissions, ensuring data accuracy, completeness, and reliability, providing a solid foundation for subsequent data analysis.

3.4 Statistical Software Description

This study used IBM SPSS Statistics 24 as the statistical software, with Process V3.4 for analyzing mediation and moderation effects in structural equation modeling. Process is a plugin for mediation and moderation analysis developed by Andrew F. Hayes, compatible with SPSS and SAS. It offers over 70 models, simplifies the analysis steps for mediation and moderation effects, and supports automated data processing, Bootstrap and Sobel tests, as well as handling multivariate models. This study employed SPSS's Process plugin to test the moderated mediation model, using Model 8, with the model concept diagram shown in Figure 2.

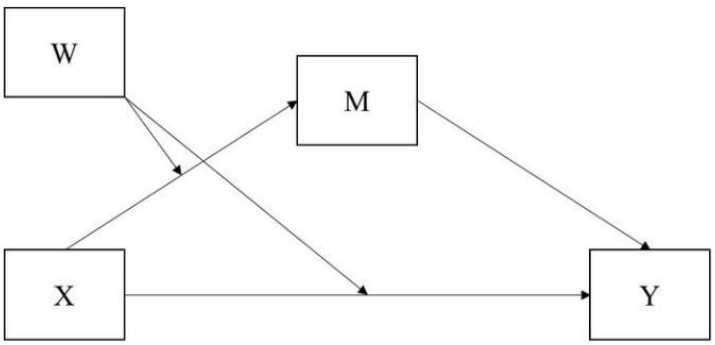


Figure 2 Conceptual Diagram of Model 8 in Process (X is the independent variable, M is the mediating variable, W is the moderating variable, and Y is the dependent variable)

4. Results

4.1 Data Quality Analysis

4.1.1 Basic Sample Characteristics

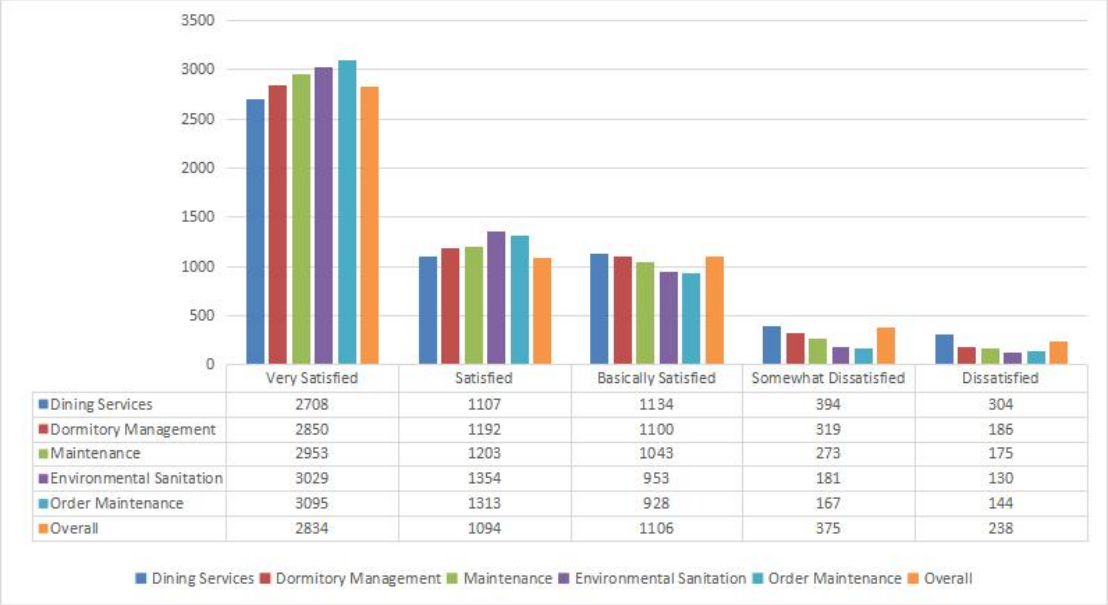
A total of 5,647 people participated in this survey. Regarding academic composition, undergraduate students made up the majority with 4,358 people (77.17%); followed by master's students with 1,081 people (19.14%); doctoral students with 81 people (1.43%); and other academic levels with 127 people (2.26%). This distribution generally aligns with the typical

student composition in higher education institutions.

Regarding gender distribution, there were slightly more female than male participants, with 3,084 females (54.61%) and 2,563 males (45.39%), yielding a male-to-female ratio of 0.83:1, demonstrating a relatively balanced gender distribution.

4.1.2 Descriptive Statistical Analysis

Descriptive statistical analysis of the collected data reveals that in terms of overall satisfaction (as shown in Figure 3), 89.14% of respondents (5,034 people) expressed basic satisfaction or above with university logistics services, with 50.18% (2,834 people) being very satisfied, 19.37% (1,094 people) satisfied, and 19.59% (1,106 people) basically satisfied. Regarding specific service satisfaction, environmental sanitation and order maintenance performed best, with 94.49% (5,336 people) of respondents expressing basic satisfaction or above, with order maintenance receiving a slightly higher percentage of "very satisfied" ratings (54.81% versus 53.64%). Engineering maintenance and dormitory management received basic satisfaction or above ratings of 92.07% and 91.06% respectively, while dining services had relatively lower satisfaction, with 87.64% expressing basic satisfaction or above.



	Very Satisfied	Satisfied	Basically Satisfied	Somewhat Dissatisfied	Dissatisfied
Dining Services	2708	1107	1134	394	304
Dormitory Management	2850	1192	1100	319	186
Maintenance	2953	1203	1043	273	175
Environmental Sanitation	3029	1354	953	181	130
Order Maintenance	3095	1313	928	167	144
Overall	2834	1094	1106	375	238

Figure 3: Detailed Presentation of Statistical Analysis of Satisfaction Levels for Various University Logistics Services and Overall Satisfaction Evaluation Results

Further analysis of variable centralization and dispersion trends shows that, taking the completeness of food safety information disclosure in cafeterias as an example, the mean value reached 3.3 (out of 5), with a standard deviation of 1.1, indicating that most students held positive evaluations of information disclosure and their evaluations were relatively concentrated; the mean value for dining menu diversity was 3.0, with a standard deviation of 1.5, reflecting relatively dispersed student evaluations for this item. Through such detailed description, the specific performance of various service quality indicators is comprehensively presented, providing a reliable data foundation for subsequent in-depth analysis.

4.1.3 Reliability and Validity Tests

Before the formal release of the questionnaire, exploratory factor analysis was conducted on the questionnaire items. The overall Cronbach's Alpha value of the questionnaire was 0.988, indicating very high internal consistency reliability. The questionnaire's Bartlett's sphericity test value was $P < 0.001$, with a KMO value of 0.950, and the results yielded 4 factors explaining 70.23% of the total variance. Factor 1 was set as campus service with three dimensions: evidence-based (6 items), multi-dimensional service (9 items), and holistic education (6 items);

Factor 2 had 4 items set as digitalization level; Factor 3 had 6 items set as student overall perception; and Factor 4 had 6 items set as student satisfaction.

Using Amos for confirmatory factor analysis of variables, results shown in Table 1 indicate that the 4-factor model had $\chi 2 = 35793.538$, df = 773, RMSEA = 0.090, RMR = 0.040, CFI = 0.881, NFI = 0.879, with indicators generally meeting statistical standards. Additionally, based on variable correlations, 5 alternative models were established, all showing poorer fit indices than the 4-factor model, indicating that the 4-factor model has good discriminant validity.

Table 1 Results of Confirmatory Factor Analysis

Model	χ^2	df	χ^2/df	RMSEA	RMR	CFI	NFI
4-factor model	35793.538	773	46.305	0.090	0.040	0.881	0.879
3-factor model 1	38852.217	776	50.067	0.093	0.043	0.871	0.868
3-factor model 2	40635.838	776	52.366	0.095	0.042	0.865	0.862
3-factor model 3	36021.331	776	46.419	0.090	0.041	0.880	0.878
2-factor model	41649.697	778	53.534	0.096	0.042	0.861	0.859
Single-factor	42396.000	779	54.424	0.097	0.042	0.859	0.856

Note: The 4-factor model consists of campus service quality, digitalization level, student overall perception, and student satisfaction. 3-factor model 1 combines campus service quality + digitalization level, student overall perception, and student satisfaction. 3-factor model 2 combines campus service quality + student overall perception, digitalization level, and student satisfaction. 3-factor model 3 combines campus service quality, digitalization level + student overall perception, and student satisfaction. The 2-factor model combines campus service quality + digitalization level + student overall perception, and student satisfaction. The single-factor model combines campus service quality + digitalization level + student overall perception + student satisfaction.

4.2 Hypothesis Testing Results

4.2.1 Direct Effect Testing

Multiple regression was used to test hypothesis H1, examining the direct impact of campus service quality on student satisfaction. Results show that the path coefficients between all subdimensions of campus service quality (evidence-based, multi-dimensional service, holistic education) and student satisfaction were significantly positive. Specifically, the standardized path coefficient from the evidence-based dimension to student satisfaction was 0.22, t-value = 15.00 ($p < 0.001$); for the multi-dimensional service dimension, the standardized path coefficient was 0.52, t-value = 32.45 ($p < 0.001$); and for the holistic education dimension, the standardized path coefficient was 0.16, t-value = 10.84 ($p < 0.001$). This fully confirms that campus service quality has a positive impact on student satisfaction. When campus services excel in data collection and utilization, multi-departmental collaborative service, and creating an educational atmosphere, students can tangibly feel the improvement in service quality and consequently give higher satisfaction ratings. Testing the direct relationship between digitalization level and students' overall perception revealed a significant path coefficient of 0.09, t-value = 13.25 ($p < 0.001$), indicating that as campus service digitalization increases, such as enhanced online service platform convenience and precise, timely information delivery, students more easily perceive campus service optimization and form more positive subjective cognitions about campus services, although the direct impact of digitalization level is notably lower than that of other campus service quality factors.

4.2.2 Mediating Effect Testing

To verify the mediating role of student overall perception in hypothesis H2, this study used the Process plugin (model 8) for analysis. As shown in Table 2, when "student overall perception" was used as the dependent variable, the model's explanatory power reached 85.54% (R = 0.9249,

R-sq = 0.8554), indicating that independent variables significantly influence student overall perception (MSE = 0.1363, F = 16694.6932, df1 = 2, df2 = 5644, p < 0.001). With "student satisfaction" as the dependent variable, the model's explanatory power further increased to 90.99% (R = 0.9539, R-sq = 0.9099), also showing significance (MSE = 0.0878, F = 18998.7831, df1 = 3, df2 = 5643, p = 0.0000).

Regarding the effects analysis, the results shown in Table 3 indicate that the total effect coefficient was 0.9610 (standard error 0.0076, t = 125.7323, p < 0.001, 95%CI = [0.9460, 0.9760]); the direct effect coefficient was 0.8816 (standard error 0.0105, t = 84.0729, p < 0.001, 95%CI = [0.8610, 0.9021]); and the indirect effect coefficient through student overall perception was 0.0794 (BootSE = 0.0101, BootLLCI = 0.0599, BootULCI = 0.0993). These data clearly show that, besides direct influence, campus service quality significantly impacts satisfaction indirectly through the mediating variable of student overall perception.

For the regression model parameters, confidence intervals obtained through the Bootstrap method did not contain zero, further verifying the significance of all effects in the model.

Table 2 Simple Mediation Model Testing

Variable	Student Overall Perception	Student Satisfaction	Student Satisfaction
Campus Service Quality	0.9249 (347.068***)	0.9541 (550.548***)	0.8820 (84.073**)
Student Overall Perception	-	-	0.079 (178.388***)
Gender	-0.049 (-14.233***)	-0.036 (-14.936***)	-0.022 (-7.412***)
Grade Level	0.011 (7.954***)	0.009 (9.409***)	0.004 (3.479***)
School Type	0.015 (10.463***)	0.010 (9.952***)	0.008 (6.099***)
R 簡	0.8554	0.9101	0.9099
F-value	16694.693***	18998.783***	33583.043***

Note: *** indicates p < 0.001, ** indicates p < 0.01, * indicates p < 0.05.

Table 3 Decomposition of Total Effects, Direct Effects, and Mediating Effects

Type	Effect Value	Standard Error	Lower Confidence Interval	Upper Confidence Interval	Effect Proportion
Direct Effect	0.8816	0.0105	0.861	0.9021	91.73%
Mediating Effect	0.0794	0.0101	0.0599	0.0993	8.27%
Total Effect	0.961	0.0076	0.946	0.976	-

4.2.3 Moderating Effect Testing

Regarding hypotheses H3 and H4, the focus was on examining the moderating effect of digitalization level. Models including interaction terms were constructed to test the moderating role of digitalization level in the influence paths from campus service quality to student overall perception and student satisfaction.

In the influence path from campus service quality to student overall perception, R = 0.9257, R-sq = 0.8569, meaning the model explained 85.69% of the variance in the "student overall perception" variable. The interaction term "campus service quality × digitalization level" showed a significant path coefficient, with a standardized path coefficient of 0.05, t-value = 7.60 (p < 0.001). When digitalization level is high, the positive influence of campus service quality on student overall perception strengthens; conversely, low digitalization level weakens this positive

influence (as shown in Figure 4). The data and syntax provided for scatter plot creation helps intuitively understand this moderating effect.

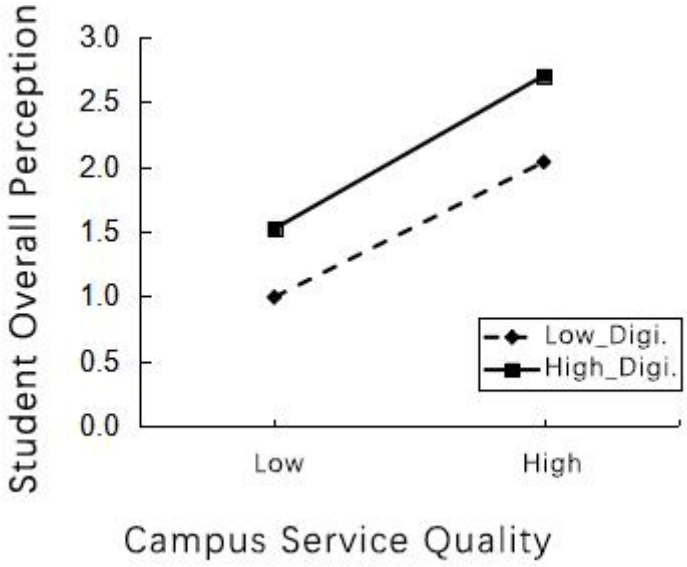


Figure 4 Moderating Effect of Digitalization Level on Campus Service Quality-Student Overall Perception

In the influence path from campus service quality to student satisfaction, R = 0.9543, R-sq = 0.9107: the model explained 91.07% of the variance in the "student satisfaction" variable. The interaction term "campus service quality × digitalization level" was also significant, with a standardized path coefficient of 0.04, t-value = 6.91 ($p < 0.001$). High digitalization helps campus services precisely meet needs, such as reducing queuing through smart ordering and quick response to online maintenance requests, efficiently converting campus service quality improvements into satisfaction increases; low digitalization hinders this conversion, making campus service efforts difficult to recognize (as shown in Figure 5).

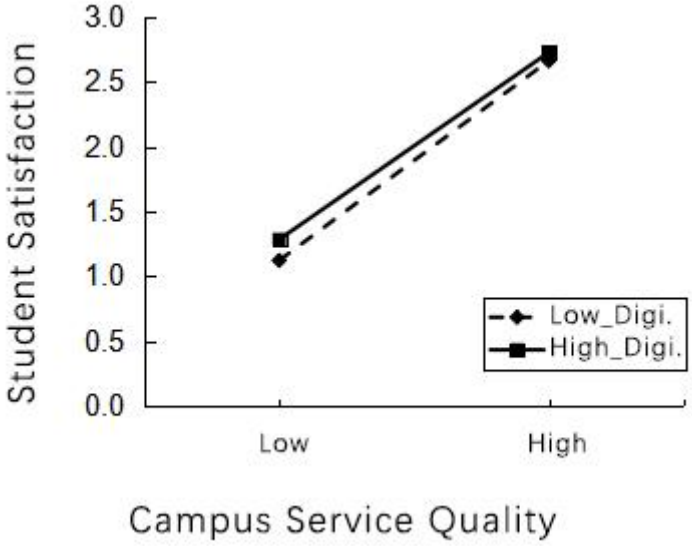


Figure 5 Moderating Effect of Digitalization Level on Campus Service Quality-Student Satisfaction

For the regression parameters of both dependent variables "student overall perception" and "student satisfaction," confidence intervals obtained through the Bootstrap method did not contain zero, further verifying the model's significance.

5. Discussion

5.1 Strengthening Student-Centered Service Philosophy

The research results clearly demonstrate that campus service philosophy and its

implementation play a crucial direct role in improving student satisfaction. This impact is reflected not only in the significant correlations of quantitative data but also in students' subjective experiences and emotional identification. To comprehensively improve service quality, we need to focus on developing in-depth and systematic work in two core areas: First, at the level of philosophy dissemination and training, we need to systematically organize diverse and content-rich regular training activities. This includes inviting senior experts and renowned scholars with rich practical experience in campus services to conduct a series of specialized lectures, explaining the deep implications, practical significance, and specific implementation requirements of the "student-centered" service philosophy in an accessible way. Training content design should fully incorporate key student needs feedback collected through questionnaires, while integrating typical successful cases and advanced management experiences from domestic and international campus service fields. Through diverse training methods such as case analysis, role-playing, and scenario simulation, we ensure maximum training effectiveness. Meanwhile, we should fully utilize comprehensive multichannel publicity platforms including campus bulletin boards, official websites of various service departments, WeChat public accounts, and TikTok short videos to extensively promote this service philosophy, especially highlighting innovative service initiatives and significant practical results that received high ratings in student satisfaction surveys, making the service philosophy more deeply rooted through vivid and specific cases.

Second, at the practical implementation level, in-depth data analysis clearly shows that service process convenience and personalization are significant factors affecting student satisfaction. This impact is reflected not only in statistical data but also in daily service experiences. Taking dormitory maintenance service as an example, which was a focus of survey feedback, efforts should be made to optimize and upgrade online maintenance platform functionality, focusing on simplifying the maintenance request process, configuring intelligent maintenance guidance systems, and achieving full-process visual tracking from request to completion. Through in-depth structural equation model analysis, it was also found that service details and humanistic care have equally important impacts, even exceeding our initial expectations. Based on this finding, it is recommended to add comfortable nursing rooms (Cummings, 2009) and quiet study areas in dining areas, and reasonably arrange shared book corners and convenient fitness equipment areas in student dormitories to create a living environment full of humanistic care. Most importantly, all service personnel must truly implement the core concept of "student-centered" in every specific service aspect, maintaining a proactive service attitude, accurately identifying and understanding student needs in a timely manner, and quickly providing necessary help and support effectively, so that every student can truly feel the warmth and quality of campus services through continuous effort.

5.2 Improving Service Quality and Expanding Service Dimensions

The campus service quality evaluation system encompasses multiple interconnected core dimensions that profoundly impact students' daily lives. Through comprehensive and systematic evaluation methods, we can deeply understand and continuously optimize various services:

First, dining service quality is the most crucial factor affecting overall student satisfaction, as it is closely tied to students' physical and mental health and quality of academic life. For this core area, we recommend implementing a comprehensive improvement strategy: deeply advance the professional training system for the culinary team by regularly inviting industry authorities such as Michelin-starred chefs to conduct in-depth culinary exchanges and practical guidance, continuously improving dish flavor quality and variety; simultaneously build a complete farm-to-table ingredient traceability management system, implementing strict quality control measures in procurement, storage, processing, and other aspects to ensure absolute food safety;

furthermore, focus on creating a humanized dining environment through scientific space planning (Ritzman et al., 1979), artistic decorative design, and ergonomic seating configuration to create a warm, comfortable, and vibrant dining atmosphere.

Second, dormitory service, as a crucial foundation of student residential life, requires establishing a more comprehensive and systematic service improvement mechanism (Budiawan et al., 2024). Specific measures include: substantially increasing investment in hardware facility updates and renovations, introducing intelligent equipment management systems, establishing dual-guarantee mechanisms for preventive maintenance and timely replacement (Sharma, 2024); comprehensively improving dormitory staff's service concepts and professional skills through systematic training programs, especially strengthening psychological counseling abilities, crisis event handling techniques, and cross-cultural communication skills (Wilcox & Holahan, 1976); building an "online + offline" integrated all-weather multi-dimensional feedback system to ensure students' various needs and suggestions receive quick response and proper resolution (Ogan et al., 2008).

Third, the intelligent upgrade of the maintenance service system plays a decisive role in improving campus life quality. We need to create a new generation of intelligent and efficient comprehensive response system: establish a centralized 24/7 maintenance service center, equipped with advanced AI smart dispatch systems to achieve precise classification and rapid matching of maintenance needs; regularly organize maintenance staff to participate in internationally certified professional skill training and practical assessments, continuously improving maintenance quality and efficiency; establish a systematic follow-up evaluation mechanism based on big data analysis to monitor service quality indicators in real-time and drive continuous improvement (Trafí-Prats, 2024).

Regarding innovative expansion of service dimensions, the research suggests focusing on advancing the following three breakthrough directions: first is creating an intelligent, integrated modern learning service ecosystem, including 24-hour self-study spaces with intelligent facilities, multifunctional academic discussion centers, and innovative laboratories among other diverse learning spaces; second is building a comprehensive campus convenience service network system, strategically introducing international brand convenience stores, intelligent parcel locker systems, professional laundry services and other high-quality life service facilities; finally, continuously optimizing sports and cultural activity venues by constructing modern facilities such as multifunctional intelligent sports venues and immersive cultural activity centers to comprehensively meet students' diverse needs in physical exercise, cultural entertainment, and social interaction.

5.3 Accelerating Campus Service Digital Transformation and Smart Service Upgrade

Digital service level shows a significant positive correlation with student satisfaction, providing important empirical support for campus service digital transformation. Structural equation analysis further reveals that precise service has a significant promoting effect on satisfaction improvement, indicating specific directions for service enhancement. Based on these research findings, we recommend comprehensively integrating existing campus service resources to create a one-stop multifunctional smart campus APP platform (Chen et al., 2024). This platform should comprehensively cover various core service functions in students' daily lives, including but not limited to dining reservations, dormitory maintenance requests, venue bookings, and parcel delivery services, while also expanding to extended functional areas such as learning resource reservations and activity registration.

Through in-depth intelligent interface design and continuous user experience optimization,

the platform should ensure students can conveniently view various service information, quickly submit personalized requests, and track service progress in real-time. Particularly in mobile application scenarios, interface design should fully consider student usage habits, adopting intuitive operation processes and clear information display methods to minimize usage barriers.

At the data application level, we recommend fully utilizing big data analysis technology to deeply mine the potential value of service data (Rico-Bautista et al., 2021). Through establishing refined student needs profiles (Panjaitan et al., 2021) and behavior pattern analysis models (Liu et al.), achieve precise matching and dynamic optimization of service provision. For example, predictively adjust service resource allocation based on service demand characteristics of different time periods and areas; identify service pain points and implement targeted improvements through analyzing student feedback data.To ensure continuous improvement of service quality, a comprehensive service quality monitoring system should be constructed. Through real-time data collection and analysis, accurately grasp the trends of various service quality indicators, establish scientific warning mechanisms, and support management in timely problem identification, service strategy adjustment, and resource allocation optimization. This monitoring system should cover the entire process from service request to completion, achieving end-to-end, traceable quality management.

In terms of technology application, besides the main APP platform, actively develop supplementary mobile access points such as WeChat mini-programs, and strongly introduce artificial intelligence technology (Kirschenbaum & Raley, 2024). For example, deploy intelligent task dispatch systems to improve task allocation efficiency, implement predictive maintenance systems to reduce equipment failure rates, and introduce intelligent customer service systems to provide 24/7 instant response services. Through the comprehensive application of these technical means, comprehensively enhance the intelligence level and convenience of campus services, ultimately achieving dual improvements in service efficiency and student satisfaction.

5.4 Strengthening Service Team Building and Professional Development

The professional competence, service attitude, and work efficiency of service personnel are core factors directly affecting student satisfaction. These elements are reflected not only in daily service interactions but also in the continuous improvement of overall service quality. To ensure the continued delivery of high-quality campus service experiences, we recommend building a comprehensive talent development and incentive system to fundamentally enhance the service team's overall capabilities:

First, develop systematic, differentiated professional training programs targeting different position characteristics and job requirements. Food service staff need to thoroughly learn nutritional knowledge, improve culinary skills, and emphasize food safety management awareness and operational standards training, while also mastering dining service detail management and quality control methods; equipment maintenance personnel need to systematically master smart equipment maintenance technology, fault diagnosis methods, and preventive maintenance concepts, while continuously updating technical knowledge to adapt to new equipment maintenance needs; dormitory management staff need to focus on strengthening psychological counseling skills, emergency response capabilities, and daily communication skills, while developing cross-cultural communication abilities to better serve international student groups. Through training methods combining theoretical learning, practical exercises, and case analysis, comprehensively improve the professional service level and work efficiency of personnel in all positions.

Second, deepen service awareness cultivation and professional quality improvement. Through systematic ideological education activities, modern service concept learning, and

professional ethics training, enable all service personnel to deeply understand and fully recognize the important value and unique role of campus service in the university's educational system. Regularly organize service experience sharing sessions and excellent case study seminars to promote experience exchange and capability enhancement, fostering service personnel's professional identity, sense of mission, and responsibility. Meanwhile, establish a mentor-mentee system to promote knowledge transfer and experience sharing between new and veteran employees (Halai, 1998). Additionally, emphasize developing service personnel's innovative thinking and problem-solving abilities, encouraging them to identify issues and propose improvements in daily work, continuously optimizing service processes and methods.

Finally, establish a scientifically sound incentive mechanism and career development path. Regularly conduct "Campus Service Education Pacesetter" selection activities, establishing service role models through a multi-dimensional evaluation system including service quality, work efficiency, innovation capability, and team collaboration. Link selection results with performance assessment, compensation, and career development, establish a professional position certification system and promotion pathway, forming a positive development mechanism to continuously motivate staff to improve service levels. Promote exemplary cases through multiple channels to create an atmosphere of healthy competition and excellence. Meanwhile, establish regular service quality follow-up and evaluation mechanisms, collect student feedback, and promptly adjust and improve service methods to ensure continuous service quality enhancement. Through these comprehensive measures, ultimately build an elite campus service team with high professional quality, excellent service awareness, and continuous innovation capability, providing solid talent support for the school's long-term development.

6. Conclusions and Future Prospects

6.1 Summary of Research Conclusions

This study conducted rigorous questionnaire surveys and advanced structural equation modeling analysis to thoroughly investigate the impact pathways of campus service quality on student satisfaction, reaching conclusions with significant practical guidance value.

Campus service quality has a significant positive effect on improving student satisfaction, with three sub-dimensions—evidence-based, multi-dimensional service, and holistic education—each playing key roles. The evidence-based dimension ensures service decisions precisely match student needs through detailed data collection and scientific analysis, such as optimizing meal offerings based on student dining consumption data to enhance service targeting. The multi-dimensional service dimension focuses on coordinated optimization across multiple areas including dining, dormitories, and maintenance, creating a comprehensive quality experience for students, such as developing dormitory areas that integrate learning, living, and social functions to meet diverse needs. The holistic education dimension deeply integrates campus services into the university's educational system, with service staff setting examples through professional dedication and humanistic care, while the campus environment nurtures students' spirits through cultural atmosphere and aesthetic design, promoting comprehensive student growth.

Students' overall perception serves as a mediating bridge between campus service quality and student satisfaction. The effectiveness of campus service quality first transforms into students' subjective evaluation of service value. When students genuinely feel the thoughtfulness and excellence of service, they form positive overall perceptions, leading to significantly improved satisfaction. This indicates that campus service work must pay high attention to students' inner feelings, transforming intangible service efforts into tangible recognition in students' minds.

The level of digitalization plays a crucial regulatory role in how campus service quality affects students' overall perception and satisfaction. High digitalization levels empower campus services to achieve precise delivery, convenient interaction, and intelligent management, allowing students to more keenly perceive the convenience and improvements brought by campus service quality, strengthening positive impacts. Conversely, low digitalization levels easily lead to poor information flow and delayed feedback, weakening service quality effectiveness. For example, through smart service apps, students can track dormitory maintenance progress in real-time and order personalized meals, enhancing their experience.

Based on these conclusions, universities aiming to improve campus service student satisfaction should strengthen the student-centered concept throughout the service process, from needs assessment and solution development to implementation and feedback, all oriented toward student needs. They should optimize service provision, expanding multiple service dimensions while ensuring basic service quality, meeting students' advanced needs in learning, living, and social interaction. They should accelerate digital transformation, integrate online resources, strengthen data applications, and create a smart service ecosystem. They should also strengthen service team building, cultivate professional talent, enhance service awareness, and inject human dynamism into high-quality campus service development. Through multi-dimensional collaborative efforts, they should build a modern campus service system that aligns with higher education development needs and student growth expectations, laying a solid foundation for university talent cultivation and internal development.

6.2 Research Limitations and Prospects

While this study has achieved certain results, limitations exist. Regarding sample selection, despite efforts to cover multiple types of universities and diverse student groups, objective conditions limited coverage of all regions and institutional levels. Some niche institutions and students from special majors were not fully included, leaving room for improvement in sample representativeness, potentially affecting the universality of conclusions. In model construction, although key factors were carefully considered, the campus service system is complex, and some potential variables and impact pathways may have been overlooked, such as the impact of regional economic differences on service investment and emergency service satisfaction during public emergencies, making the model's reflection of reality incomplete.

Future research can advance in multiple directions. Expanding sample breadth and depth, collaborating with more universities, expanding research areas, including private institutions and Chinese-foreign cooperative institutions, and analyzing student characteristics by major, grade, and family background will enable precise analysis of different group needs and improve conclusion accuracy and universality. Continuous model optimization, introducing cutting-edge theories and methods, dynamically updating variables and pathways, and exploring the integration of macro policies and campus culture factors will build models more aligned with reality and stronger in predictive power. Deepening multidisciplinary integration, drawing from management, sociology, psychology, and other disciplines will comprehensively explore campus service satisfaction driving mechanisms, injecting innovative vitality into high-quality campus service development, creating a new campus service ecosystem that meets contemporary needs and satisfies both faculty and students.

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