

An Analysis of Foundation Students' Satisfaction with the Service Quality at Centre for Pre-University Studies

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This paper investigates satisfaction levels among foundation-year students regarding the quality of services at the Centre for Pre-University Studies (CPUS), University Malaysia Sarawak (UNIMAS). Beginning with a review of the literature on service quality and student satisfaction in higher education, the study addresses its research question through four dimensions: teaching and learning, academic support, campus facilities, and campus life. A quantitative research design was employed, with data collected through a structured questionnaire administered to 1 001 foundation students. Exploratory factor analysis supported a three-factor solution — student experience, teaching quality, and campus facilities — with excellent sampling adequacy (Kaiser-Meyer-Olkin value = 0.983) and a significant Bartlett's test of sphericity ($\chi^2 = 30\,111.73$, $p < 0.001$). The estimated reliability of all factors was high (Cronbach's α between 0.802 and 0.966). Regression analysis indicated that student experience and teaching quality together explained 92.2% of the variance in overall satisfaction ($R^2 = 0.922$). Nonetheless, student experience was the strongest predictor. Another regression model demonstrated that these factors were also significantly associated with retention intention ($R^2 = 0.743$). Random forest classifiers were then employed as a complementary machine learning approach. The items related to campus life, aggregated under the student experience factor and the composite scores, emerged as the most significant predictors of retention and the degree of satisfaction. The machine learning models predicted satisfaction levels with 76.2% accuracy and retention with 88.1% accuracy. Overall, the findings underscore the significance of a holistic student experience such as a sense of belonging, well-being, and willingness to remain at the institution in predicting satisfaction and retention metrics at the CPUS stage, alongside instructional quality. The study therefore has practical implications for the CPUS, which seeks to enhance student experience through the intelligent application of aggregate statistical and machine learning findings.

Keywords: *SERVQUAL; student satisfaction; pre-university; retention; machine learning.*

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1. Introduction

Foundation courses play an important role in facilitating a firm transition between secondary and undergraduate education. Their purpose is not only to equip students with knowledge but also to familiarize them with university culture and expectations. With preparatory programs becoming more competitive and student-focused, the quality of their services has emerged as a key factor in determining the institution's reputation, student performance, and subsequent degree enrollment [1, 2].

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Student satisfaction is generally regarded as a primary indicator of higher education service quality and institutional effectiveness. It is commonly characterized as the extent to which students' needs, expectations, and experiences are met by the educational environment [2,3]. Empirical studies across diverse contexts consistently demonstrate that higher perceived academic service quality positively influences student satisfaction, which in turn enhances outcomes such as academic engagement, loyalty, and retention [4–6].

Recent research trends indicate a growing interest in integrating traditional statistical approaches with machine learning techniques to understand and predict student satisfaction and behavior. For instance, Arfah et al. [7] applied K-Nearest Neighbors (KNN) and Naive Bayes to categorize student satisfaction, while Lopez-Cuevas et al. [8] compared decision trees and logistic regression as predictive tools in higher education. Other researchers have employed machine learning to analyze satisfaction with online education or ICT services [9–12].

Nonetheless, empirical studies focusing on foundation students in pre-university settings remain limited, particularly in Malaysia. As these students transition into a new academic system, with unfamiliar requirements and campus environments, they may be especially vulnerable. It is therefore important for university policymakers and administrators to understand how they view service quality and how these perceptions influence satisfaction and intentions to continue.

This study was conducted at the Centre for Pre-University Studies (CPUS) in a Malaysian public university. It addresses this gap by examining the relationships among service-quality dimensions, student satisfaction, and retention. The study employs SPSS-based factor analysis and regression analysis, alongside machine learning (ML) models. The study assesses foundation students' perceptions of service quality across four domains: teaching and learning, academic support, campus facilities, and campus life. It further examines how these dimensions relate to student satisfaction and influence students' intentions to continue at the pre-university level. Finally, the study compares traditional regression analysis and ML models in predicting satisfaction and retention and in identifying the most influential factors.

2. Background Study

2.1. Student Satisfaction with Higher Education and Service Quality

Higher education service quality is typically conceptualized as a multidimensional construct, encompassing both academic and non-academic components of institutional performance. Several frameworks have been developed to capture this complexity, including generic service-quality models such as SERVQUAL and university-specific models such as HEdPERF and HEISQUAL [13,14]. Recent empirical studies consistently confirm that academic service quality is a strong predictor of student satisfaction. Sihombing et al. [4] reported a significant positive relationship between academic service quality and satisfaction, while studies among business students in India and Nepal similarly found service quality to be a key determinant of satisfaction. Osman et al. (2024) identified three determinants, including the quality of teaching, administrative services, and the contribution of academic support, as the most powerful predictors of student satisfaction. Research by Rifa'i and Triana [15] affirmed that the quality of online learning services significantly influenced satisfaction, emphasizing the roles of responsiveness, clarity, and support. Raharjo et al. [6] used the American Customer Satisfaction Index in higher education and found that perceived quality and value strongly affected student satisfaction and loyalty in higher education.

Wahyuni et al. [14] emphasized that the assessments of higher education service quality should be performed with consideration of both academic processes and infrastructure. The latter was again demonstrated by Seitova et al. [2], who affirmed that the perceived quality of services in these areas was the key indicator of satisfaction in an array of higher education settings.

Table 1. Service Quality Dimensions in Pre-University Education.

Dimension	Description
Teaching and learning	Quality of lectures, tutorials, and practical classes; clarity of explanations; expertise and professionalism of lecturers; and reliability of academic processes
Academic support	Supportiveness of administrative staff and academic advisers; access to counseling and support services; and responsiveness to schedule or venue changes
Campus facilities	Suitability and maintenance of campus facilities, including classrooms, laboratories, and information technology facilities; availability and quality of learning resources, such as computers, internet access, and e-learning platforms; and overall outlook of the campus
Campus life and student experience	Sense of belonging; awareness of student voice; concern for student well-being; participation in co-curricular activities; and willingness to recommend and remain in the institution

2.2. Student Engagement and Retention Toward Student Satisfaction

Academic engagement, persistence, and institutional loyalty have a positive correlation with student satisfaction [5, 6]. When students perceive that the services provided meet their expectations and result in satisfaction, they are more likely to remain at the institution and progress academically. At the foundation level, retention is particularly important, as it may be terminated because of poor fit, subpar experiences, or lack of perceived support. López-Cueva et al. [8] showed that decision trees and logistic regressions were effective in predicting the levels of satisfaction, whereas Arfah et al. [7] demonstrated that ML models, such as KNN, Naive Bayes, and hybrid machine learning models, could be employed to more effectively predict the levels of satisfaction in hybrid and online learning settings. These methods can not only provide predictive capabilities but also rank the relative significance of diverse features, which provides useful information about which service-quality characteristics have the greatest impact.

Building on this, the current research integrates both conventional regression and ML techniques in its analysis of the relationship between service-quality dimensions and student satisfaction and retention.

3. Methodology

3.1. Research Design

The proposed study followed a cross-sectional survey design that is quantitative. The data were collected using an online questionnaire administered to foundation students at the CPUS, UNIMAS.

3.2. Participants

A total of 1 001 valid responses were obtained. The respondents were enrolled in different foundation programs (Foundation in Life Sciences, Foundation in Computing, Foundation in Physical Sciences, and International Foundation in Science), resided in various residential colleges (Kolej Seroja, and Kolej Kenanga), and came from urban and rural regions. Listwise deletion in SPSS was utilized to exclude cases with missing values on important items ($N = 1\,001$ valid cases for all analyses).

Table 2. Summary of Data Set According to Gender and Course.

Variable	Category	n	%
Gender	Male	432	43%
	Female	569	57%
Course	Foundation in Life Science	414	41%
	Foundation in Physical Science	359	36%
	Foundation in Computing	213	21%
	International Foundation in Science	15	2%

3.3. Instrument and Variables

The questionnaire comprised several sections, and all attitudinal items were measured using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 3. Measurement Items by Dimension.

Dimension	Item	#
Tangibles	Classrooms and laboratories are clean, well-maintained, and conducive to learning.	1
	Learning resources (computers, internet, library, and e-learning platforms) are accessible and up-to-date.	2
	Campus facilities (study areas, lecture halls, and IT labs) are adequate to support my academic needs.	3
	The appearance of the campus and facilities creates a positive learning environment.	4
	Staff and lecturers present themselves professionally.	5
Reliability	Lectures, tutorials, and practical classes are conducted as scheduled.	6
	Academic staff deliver lessons and guidance consistently and on time.	7
	University announcements and information are accurate and reliable.	8
	Course materials and references are provided in a timely manner.	9
	Administrative and academic processes are conducted as promised.	10
Responsiveness	Administrative staff respond quickly and effectively to student inquiries.	11
	Lecturers are accessible and willing to provide academic support outside class.	12
	Students are informed promptly about changes in schedules or venues.	13
	Support services (helpdesk, counseling, and IT support) respond quickly to student concerns.	14
	Staff at the CPUS are approachable and helpful.	15
Assurance	Lecturers demonstrate strong knowledge and expertise in their subject areas.	16
	Staff and lecturers treat students respectfully and courteously.	17
	I feel safe and confident using the services and facilities at the Centre.	18
	University staff are competent in resolving student issues or concerns.	19
	Lecturers communicate clearly and instill confidence in students' learning.	20
Empathy	Lecturers understand students' academic difficulties and provide guidance.	21
	Academic counseling and advisory services are available and supportive.	22
	The Centre demonstrates concern for students' personal well-being and welfare.	23
	Lecturers are patient and willing to explain topics more than once when necessary.	24
	Administrative staff treat students with care and consideration.	25
Student experience	I feel a strong sense of belonging at the Centre for Pre-University Studies.	26
	My opinions and feedback as a student are valued and considered.	27
	The Centre supports my overall well-being.	28
	The Centre offers sufficient support for my personal and academic development.	29
	The learning environment encourages student engagement and participation.	30
Overall satisfaction	I am satisfied with the overall quality of services provided at the Centre.	31
	The services provided meet my expectations.	32
	I would recommend this pre-university program to others.	33
	I feel valued and supported as a student.	34
	My satisfaction motivates me to stay engaged in my academic journey.	35
	I am likely to continue my studies at UNIMAS after completing the foundation program.	36

3.4. Data Preparation and SPSS Composite Scores

The SPSS syntax used to compute composite scores was as follows:

$$\text{Composite Score} = \frac{1}{n} \sum_{i=1}^n X_i.$$

3.5. Factor Analysis

An exploratory factor analysis was conducted on 36 items using Principal Axis Factoring with Promax rotation to examine the latent structure of the service quality measures. The Kaiser-Meyer-Olkin measure was 0.983, indicating excellent sampling adequacy. Bartlett's test of sphericity was significant ($\chi^2 = 30\,111.73$, $df = 630$, $p < 0.001$), confirming suitability for factor analysis. Three factors with eigenvalues greater than 1 explained 63.81% of the total variance.

The rotated solution supported a three-factor structure. Factor 1, labeled student experience, comprised 14 items associated with well-being, sense of belonging, willingness to recommend the institution, expectations being met, feeling valued, motivation, and perceived administrative care (eigenvalue = 20.02; 55.61% of the initial variance; Cronbach's $\alpha = 0.966$). Factor 2, labeled teaching quality, included 15 items reflecting teaching processes, lecturers' expertise, clarity, responsiveness, reliability, and academic support (eigenvalue = 1.63; 4.54% variance; Cronbach's $\alpha = 0.948$). Factor 3, labeled campus facilities, comprised four items covering physical and technological facilities (eigenvalue = 1.32; 3.66% variance; Cronbach's $\alpha = 0.802$).

The communalities were between 0.409 and 0.775, which demonstrates sufficient representation of items. The factor correlation matrix displayed moderate and strong relationships among factors ($r = 0.623 - 0.788$) and which justifies the application of oblique rotation.

3.6. Reliability Analysis

Reliability analysis showed strong internal consistency for all three factors. Student experience (Factor 1) demonstrated excellent reliability (Cronbach's $\alpha = 0.966$; 14 items), with corrected item-total correlations ranging from 0.653 to 0.864 and alpha-if-item-deleted values between 0.962 and 0.966. Teaching quality (Factor 2) also displayed excellent reliability (Cronbach's $\alpha = 0.948$; 15 items), with corrected item-total correlations from 0.674 to 0.792 and alpha-if-item-deleted remaining at or above 0.943. Campus facilities (Factor 3) showed good reliability for a short scale (Cronbach's $\alpha = 0.802$; 4 items). These findings validate that the three latent constructs are internally consistent and suitable for further analysis.

3.7. Descriptive Statistics

Table 4 presents the descriptive statistics for the composite variables. Overall, students reported high satisfaction levels across all dimensions, with both teaching and learning and campus life having mean scores above 4.1 on a 5-point scale.

Table 4. Descriptive Statistics of Composite Variables.

Variable	Min	Max	Mean	Std. dev
Teaching_Learning	1.10	5.00	4.4014	0.5610
Academic_Support	1.00	5.00	4.2442	0.6475
Campus_Facilities	1.80	5.00	4.1309	0.6344
Campus_Life	1.20	5.00	4.3118	0.6347
Overall_Satisfaction	1.00	5.00	4.2156	0.7093
Retention	1.00	5.00	4.2258	0.7596

4. Regression Analysis

4.1. Predicting Overall Satisfaction (H1–H4)

Hypotheses H1–H4 were tested using multiple regression analysis, with overall satisfaction as the dependent variable and the factor scores for student experience, teaching quality, and campus facilities as the independent variables. The SPSS output indicated a strong model fit ($R = 0.960$; $R^2 = 0.922$; Adjusted $R^2 = 0.922$), and the overall regression model was statistically significant, $F(3\,997) = 3\,914.44$, $p < 0.001$.

Table 5. Regression Coefficients Predicting Overall Satisfaction.

Predictor	B	SE	Beta	t	p
Constant	4.216	0.006	–	671.167	0.000
StudentExperience_Factor	0.723	0.013	1.003	57.086	0.000
TeachingQuality_Factor	–0.028	0.012	–0.038	–2.358	0.019
CampusFacilities_Factor	–0.012	0.011	–0.015	–1.115	0.265

The model explained 92.2% of the variance in overall satisfaction. Student experience emerged as the dominant predictor, exhibiting a very high positive standardized coefficient. Teaching quality displayed a small negative beta, likely due to multicollinearity with student experience, as these constructs are highly correlated. Campus facilities did not make a statistically significant contribution.

With respect to the hypotheses, H1 and H2 are strongly supported at the bivariate level, reflecting the close association between teaching and academic support. However, in the multivariate factor model, the student experience factor predominates and already incorporates the items that reflect satisfaction. H3 and H4 are not as supported in the multivariate model, demonstrating that facilities and campus life do have an effect, but they are part of the greater student experience dimension and not independent predictors.

4.2. Testing Hypothesis H5: Predicting Retention Intention

For H5, a second multiple regression analysis was conducted with Retention as the dependent variable and the three factor scores as predictors. The SPSS results indicated a strong model fit ($R = 0.862$; $R^2 = 0.743$; Adjusted $R^2 = 0.743$), and the overall model was statistically significant, $F(3,997) = 958.80$, $p < 0.001$.

Table 6. Regression Coefficients Predicting Retention.

Predictor	B	SE	Beta	t	p
Constant	4.226	0.012	–	346.410	0.000
StudentExperience_Factor	0.653	0.025	0.845	26.524	0.000
TeachingQuality_Factor	–0.130	0.023	–0.167	–5.697	0.000
CampusFacilities_Factor	0.158	0.021	0.191	7.632	0.000

The regression model accounted for 74.3% of the variance in students' intention to remain enrolled. Student experience emerged as the strongest positive predictor, whereas teaching quality exhibited a negative coefficient in the multiple regression model, and suggesting that the two predictors may capture similar underlying constructs. Campus facilities also showed a positive and significant impact. Taken together, these results support H5, indicating that increased satisfaction with service quality and student experience is strongly associated with an increased likelihood of students remaining at the institution and continuing their studies.

5. Machine Learning Analysis

ML models were developed and integrated with the traditional regression methods using a Python-based framework. The sample comprised 1001 records, including composite scores, and item-level measures.

5.1. Regression-Based Prediction of Overall Satisfaction

The predictive model treated overall satisfaction as the dependent variable and employed four composite predictors: teaching and learning, academic support, campus facilities, and campus life. After a standard train-test split, a random forest regressor was evaluated on the hold-out set and achieved an R^2 of 0.7619 and an RMSE of 0.3346, compared with a baseline mean prediction of approximately 4.2156.

Table 7. Feature Importance for Satisfaction Prediction.

Feature	Importance Score
Campus_Life	0.8557
Teaching_Learning	0.0524
Campus_Facilities	0.0470
Academic_Support	0.0449

Regulation of importance of features showed that Campus Life, which is quite close to the Student Experience factor, was the most significant predictor (importance 0.8557), further supporting the SPSS regression results.

5.2. Predicting Retention (Classification)

There were three ordinal classes of retention scores (low, medium, and high). The overall accuracy of the random forest classifier was 0.8806, which is better than the baseline accuracy of 0.8358, based on the most prevalent class. The feature importance for predicting retention is summarized in Table 8.

The classification metrics showed high performance for the high-retention class, while classification performance for the low and medium classes was relatively limited due to class imbalance, as reflected in warnings regarding undefined precision and recall. Nonetheless, the results consistently identified campus life (Student Experience) as the most significant predictor of retention, followed by teaching quality.

Table 8. Feature Importance for Retention Prediction.

Feature	Importance Score
Campus_Life	0.4620
Teaching_Learning	0.2654
Campus_Facilities	0.1454
Academic_Support	0.1272

6. Discussion

This study provides strong empirical evidence that student experience and teaching quality are key indices of satisfaction and retention in a pre-university environment. Factor analytic revealed three consistent latent constructs — student experience, teaching quality, and campus facilities — all exhibiting strong internal consistency. Descriptive statistics indicated a high level of satisfaction, implying a generally positive perception of the Centre by students.

Regression and ML analyses converged in their results. Student experience, operationalized through items related to belonging, well-being, perceived care, unmet expectations, recommendation, and retention intention, emerged as the most significant determinant of overall satisfaction and retention intention. This finding aligns with existing literature, highlighting student-focused quality and psychological involvement as essential drivers of satisfaction and loyalty [1, 5, 6].

Although teaching quality and academic support exhibited strong bivariate relationships with satisfaction, their effects in factor-level regression models were attenuated by shared variance with student experience. The ML findings, however, indicate that teaching and learning remain significant predictors of both retention and satisfaction, underscoring the importance of high-quality instruction and consistent academic support. [4, 15].

Campus facilities, while not the strongest factor, exerted a substantial effect on retention in the regression models and demonstrated non-negligible significance in the ML analyses. This suggests that a favorable physical and technological design enhances the choice of students to remain in the program, aligning with the results of Wahyuni et al. [14] and Seitova et al. [2] regarding the contribution of tangible infrastructure to their assessment of service quality.

The application of multiple regression in SPSS, implemented alongside ML algorithms, proves the applicability of a hybrid analysis approach. Conventional inferential approaches explain significant statistical relationships and explain effect sizes and magnitudes, but ML models have greater predictive power and offer more intuitive rankings of feature importance [7–10].

7. Conclusion

This paper analyzes the correlation between service quality, student satisfaction, and retention among 1001 foundation students at the CPUS using SPSS-based factor and regression analyses coupled with ML models. Results indicate that student experience, in terms of a sense of belonging, well-being, perceived support, and loyalty, is the strongest predictor of retention and satisfaction, followed by teaching quality and campus facilities.

By integrating statistical and ML approaches, this work highlights the importance of holistic service-quality management within the CPUS program. The findings provide actionable insights for institutional leaders to design targeted interventions that enhance student experience, teaching, and support, ultimately improving satisfaction and enrollment in degree programs.

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Аналіз задоволеності студентів підготовчого відділення якістю послуг у Центрі довузівської підготовки

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У цій статті досліджується рівень задоволеності студентів підготовчого відділення якістю послуг у Центрі довузівської підготовки (CPUS) Університету Малайзії в Сараваку (UNIMAS). Розпочинаючись із огляду літератури щодо якості послуг та задоволеності студентів у вищій освіті, дослідження розглядає поставлене наукове питання через чотири виміри: викладання та навчання, академічна підтримка, інфраструктура кампусу та життя в кампусі. Було застосовано кількісний дизайн дослідження, а дані збиралися за допомогою структурованого анкетування, проведеного серед 1 001 студента підготовчого відділення. Експлораторний факторний аналіз підтвердив трифакторне рішення (студентський досвід, якість викладання та інфраструктура кампусу) з відмінною адекватністю вибірки (коефіцієнт Кайзера-Мейєра-Олкіна становить 0.983) та значущим критерієм сферичності Бартлетта ($\chi^2 = 30\,111.73$, $p < 0.001$). Розрахункова надійність усіх факторів була високою (α Кронбаха від 0.802 до 0.966). Регресійний аналіз показав, що студентський досвід та якість викладання разом зумовлюють 92.2% дисперсії загальної задоволеності ($R^2 = 0.922$). Водночас, студентський досвід виявився найсильнішим предиктором. Інша регресійна модель продемонструвала, що ці фактори також суттєво пов'язані з наміром продовжити навчання ($R^2 = 0.743$). Після цього, як додатковий алгоритм машинного навчання для аналізу даних, було застосовано класифікатори "випадкового лісу". Показники, пов'язані з життям у кампусі, які були об'єднані у фактор студентського досвіду, а також композитні оцінки, виявилися найбільш значущими предикторами продовження студентами навчання в закладі та рівня їхньої задоволеності. Моделі машинного навчання спрогнозували рівень задоволеності з точністю 76.2%, а намір продовжити навчання – з точністю 88.1%. Загалом, отримані результати підкреслюють важливість цілісного студентського досвіду (такого як відчуття приналежності, благополуччя та прихильності до закладу) поряд із якістю навчання для прогнозування показників задоволеності та утримання закладом студентів на етапі довузівської підготовки. Отже, дослідження має практичне значення для CPUS, який прагне покращити студентський досвід шляхом інтелектуального застосування сукупних статистичних результатів та результатів машинного навчання.

Ключові слова: *SERVQUAL; задоволеність студентів; довузівська підготовка; утримання студентів; машинне навчання.*