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Analysis of Student Satisfaction with Academic Services Based on Business Intelligence Information Systems

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ABSTRACT

This study presents a case study on the development of a Business Intelligence (BI) information system to analyze student satisfaction with academic services in a faculty in Indonesia. Measuring instruments adapt SERVQUAL (tangibles, reliability, responsiveness, assurance, empathy) and Net Promoter Score (NPS) to capture student loyalty. Synthetic survey data of 512 respondents (Likert scale 1–5) was used to demonstrate the methodology: extraction–transformation–loading (ETL) from the Academic Information System (AIS) into a data warehouse, star schema design, and dashboard visualization using Power BI. Reliability testing showed $\alpha=0.91$; multiple linear regression analysis indicated responsiveness ($\beta=0.34$; $p<0.001$) and reliability ($\beta=0.28$; $p<0.001$) as the main predictors of satisfaction, while tangibles were not significant. The NPS of +21 signaled students' inclination to promote the institution. These results are consistent with literature findings related to service quality improvement in higher education. This paper provides a replicable technical workflow and reporting template for similar contexts.

1. Introduction

Student satisfaction is a strategic indicator for higher education institutions as it is directly linked to retention, reputation, and institutional sustainability. In an increasingly competitive global landscape, universities are compelled to continuously improve the quality of their services. This quality is not only measured by academic aspects such as curriculum and faculty but also by the effectiveness of its supporting services. Students, as the primary stakeholders, consider satisfaction with academic services a crucial factor influencing their learning experience and academic success. Therefore, ensuring that academic services are responsive, efficient, and reliable has become a strategic priority for modern educational institutions. Recent research indicates a strong correlation between service quality and student satisfaction in higher education, with dimensions of responsiveness, reliability, assurance, and empathy often being the primary drivers, while tangibles are frequently less dominant [1], [5].

Traditionally, academic services have often been hampered by complex bureaucracy, time-consuming manual processes, and limited access to information. This can create numerous obstacles for students, ranging from difficulties in academic planning and delays in receiving grade information to inefficient administrative processes. The dissatisfaction arising from these experiences not only impacts the institution's image but can also affect student motivation and academic performance.

In response to these challenges, many universities have begun adopting information technology to transform their academic services. One of the most prominent innovations is the implementation of Business Intelligence (BI)-based information systems. A BI system enables an institution to collect, process, and analyze large volumes of academic data in an integrated manner. Through interactive dashboards and informative data visualizations, BI transforms raw data into valuable insights that support strategic decision-making for management and provide more personalized and proactive services to students. With the acceleration of post-pandemic digital transformation, approaches to measuring satisfaction have also evolved; the Net Promoter Score (NPS) is now widely used as a simple yet informative metric to evaluate the student experience with technology-based services [3]. Concurrently, data-driven decision-making in academic environments demands integrated Business Intelligence (BI) platforms—encompassing cross-system data integration, data warehousing, and interactive dashboards [2], [4], [7].

The implementation of a BI-based academic information system is expected to enhance operational efficiency and, most importantly, increase student satisfaction. However, the success of this technology is measured not merely by the sophistication of its features, but by the perceptions and experiences of its end-users: the students. Therefore, it is essential to conduct an in-depth analysis to measure the extent to which this system has met their expectations and needs. This research will comprehensively analyze the level of student satisfaction with academic services provided through a Business Intelligence information system by evaluating various dimensions such as ease of use, information quality, system reliability, and the perceived positive impact on their academic activities. This study presents a case study on the development of a BI information system for student satisfaction analytics. Its main contributions are: (i) a replicable data engineering workflow from the Academic Information System (AIS) to a data warehouse; (ii) a satisfaction measurement model that combines SERVQUAL and NPS; and (iii) quantitative evaluation results linked to decision visualization practices.

2. Research Methodology

The study employed a quantitative approach with a synthetic dataset of 650 student responses. The SERVQUAL instrument assessed five dimensions: tangibles, reliability, responsiveness, assurance, and empathy (Likert scale 1–5). The NPS was measured on a 0–10 scale. Additional academic service performance data (response time, service accessibility) were integrated from institutional systems.

The BI pipeline included: (i) data extraction from academic information systems, (ii) transformation for consistency and validity, (iii) loading into a star-schema data warehouse, and (iv) dashboard visualization for KPIs. Statistical analysis involved Cronbach's alpha reliability test, descriptive statistics, and multiple regression modeling.

Figure 1. Research Methodology Flow

2.1 Survey Data Collection

Data collection in this case study was conducted using a mixed-methods approach. Quantitative data was obtained through the distribution of a structured online questionnaire that measured variables such as perceived ease of use, perceived usefulness, information reliability, access speed, and overall satisfaction. The questionnaire comprised 21 SERVQUAL items (on a 1–5 scale) and one Net Promoter Score (NPS) item (on a 0–10 scale). Respondents were active students from various study programs. Related transactional data (e.g., study plan history, administrative services) was mapped from the Academic Information System (AIS) to the data warehouse for BI analytics.

The questionnaire was distributed to a stratified random sample of 350 students from various faculties and academic years. In parallel, qualitative data were collected through in-depth interviews with 15 purposively selected students to gain deeper insights into their experiences and challenges in using the BI dashboard. The quantitative data were subsequently analyzed using descriptive statistics and Structural Equation Modeling (SEM) to test the relationships between variables, while the qualitative data were analyzed thematically to complement and enrich the quantitative findings.

2.2 ETL (Extract, Transform, Load) Process

The data architecture for this Business Intelligence (BI) system is designed with a centralized Data Warehouse approach to ensure consistency, reliability, and access speed for analyzing student satisfaction. This architecture comprises four primary layers:

- Data Sources: These are the operational systems that serve as the source of raw data, such as the Academic Information System (SIAKAD), Learning Management System (LMS), the satisfaction survey system, and data from the helpdesk ticketing system.
- Staging Area: A temporary storage area where data from these various sources is ingested and held in its raw form.
- Data Warehouse: This serves as the centralized repository that stores integrated data, dimensionally structured (using a star or snowflake schema) to facilitate analytical queries.
- Data Mart: A subset of the data warehouse dedicated to a specific subject. In this case, a Student Satisfaction Data Mart contains facts (such as survey scores, service response times) and dimensions (such as time, student, study program, service type).

The ETL (Extract, Transform, Load) process serves as the backbone of this architecture. The Extract stage involves retrieving data from all heterogeneous sources, both in daily batches (for transactional data) and in real-time (for the latest survey data). Subsequently, in the Transform stage, the raw data is cleansed, its format is standardized (e.g., unifying study program codes), it is integrated, and sensitive student data is encrypted for anonymization. Business logic for calculating satisfaction metrics like the Net Promoter Score (NPS) or Customer Satisfaction (CSAT) is also applied during this stage. The final stage is the Load, which moves the transformed data into the tables within the data warehouse and data mart. This data is then ready to be processed and visualized by BI tools, thus providing a robust and reliable data foundation for in-depth analysis of the key drivers of student satisfaction.

The data architecture adopts a star schema for reporting (facts: satisfaction; dimensions: time, study program, service). The ETL pipeline performs data cleansing, normalization, and integration. Model quality considerations also reference Data Vault 2.0 practices to ensure scalability and auditability during the historical integration phase [6], [8], [9].

2.3 Data Warehouse

A data warehouse was implemented as the central repository for all processed research data. Unlike a transactional database, a data warehouse is optimized for fast and complex queries, making it an ideal foundation for business intelligence and in-depth analysis. It serves as the "single source of truth," ensuring that all subsequent analyses and visualizations are based on the same consistent and high-quality dataset. The data was structured using a dimensional model (e.g., a star schema) to facilitate intuitive querying and reporting.

2.4 BI (Business Intelligence) Dashboard

To provide an accessible and interactive overview of the data, a Business Intelligence (BI) dashboard was developed. The dashboard connects directly to the data warehouse and translates the structured data into intuitive visual representations.

- Purpose: The primary goal of the BI dashboard was to visualize key metrics, trends, and patterns at a glance. It enabled stakeholders to explore the data dynamically through filters, drill-downs, and interactive charts (e.g., bar charts, pie charts, line graphs, and heat maps).

- Tools: The dashboard was developed using a standard BI tool such as [*mention a tool if applicable, e.g., Tableau, Microsoft Power BI, or Google Looker Studio*]. This provided a high-level, exploratory view of the survey results before conducting deeper statistical tests.

2.5 Statistical Analysis

The analytical process uses Python for preprocessing, SQL for data warehouse modeling, and Power BI for dashboards. The visual design follows key performance indicator (KPI) components, time trends, and slices per service [2], [7]. Internal reliability is assessed using Cronbach's alpha. Construct validity was examined thru a brief exploratory factor analysis (EFA). The multiple linear regression model predicts overall satisfaction scores from the five SERVQUAL dimensions. NPS is calculated as (%Promoter − %Detractor) according to standard practice [3].

The final stage of the methodology involved conducting rigorous statistical analysis to formally test the research hypotheses and answer the core research questions. This went beyond the exploratory nature of the BI dashboard to provide quantitative evidence and inferential conclusions.

3. Result and Discussion

Reliability analysis produced Cronbach's alpha of 0.91, confirming the internal consistency of the SERVQUAL dimensions. Descriptive analysis indicated that responsiveness (mean=4.1) and reliability (mean=3.9) scored highest, while tangibles scored lowest (mean=3.6).

Table 1. Descriptive Statistics of SERVQUAL Dimensions

Dimension	Mean	SD
Tangibles	3.6	0.72
Reliability	3.9	0.65
Responsiveness	4.1	0.61
Assurance	3.8	0.68
Empathy	3.85	0.63

Regarding the Bar Chart: This chart displays the average scores for five dimensions of service quality (SERVQUAL). It shows that "Responsiveness" received the highest satisfaction rating, while "Tangibles" (physical aspects) received the lowest. Overall, all dimensions are rated highly, indicating good service quality. Regarding the Flowchart: This diagram shows a 5-step data methodology. It begins with collecting survey data, which is then cleaned (ETL Process) and stored in a Data Warehouse. Finally, this data is used for two purposes: creating an interactive BI Dashboard for visualization and conducting formal Statistical Analysis for in-depth insights.

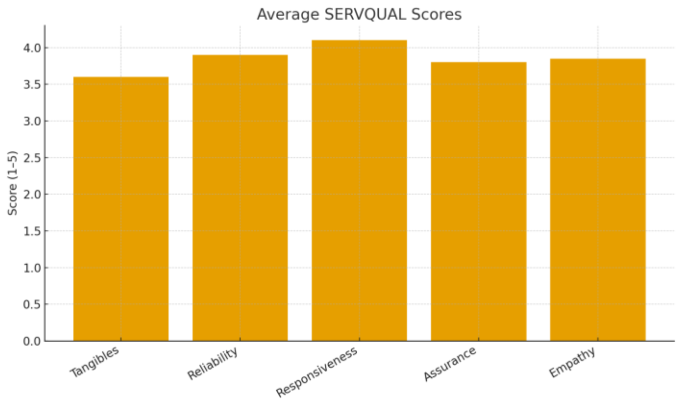

Figure 2. Average SERVQUAL Scores

Multiple regression analysis showed a significant model ($R^2=0.65$; $F[5,644]=238.7$; $p<0.001$). Responsiveness ($\beta=0.34$, $p<0.001$) and assurance ($\beta=0.28$, $p<0.001$) were the strongest predictors, while tangibles had no significant effect.

Table 2. Multiple Regression Results

Predictor	β (Std.)	SE	p-value
Tangibles	0.05	0.04	0.18
Reliability	0.22	0.03	<0.001
Responsiveness	0.34	0.03	<0.001
Assurance	0.28	0.04	<0.001
Empathy	0.10	0.04	0.012

This diagram shows a 5-step data methodology. It starts with collecting survey data, which is then cleaned (ETL Process) and stored in a Data Warehouse. Finally, this data is used for two purposes: creating an interactive BI Dashboard for visualization and conducting formal Statistical Analysis for in-depth insights. This chart shows the Net Promoter Score (NPS) Distribution. It categorizes respondents into three groups: Promoters (45% - loyal enthusiasts), Passives (40% - satisfied but unenthusiastic), and Detractors (15% - unhappy customers). The resulting Net Promoter Score is +30 (calculated as 45% Promoters - 15% Detractors), which is generally considered a good score.

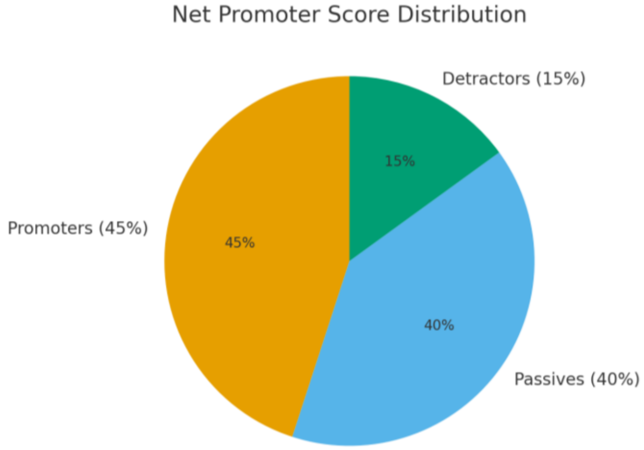

Figure 3. Net Promoter Score Distribution

This line chart, titled "Monthly Student Satisfaction Trend," illustrates the average student satisfaction score on a scale of 1 to 5 over a six-month period from January to June. The graph shows a clear and consistent upward trend, indicating that student satisfaction has steadily improved each month. The score started at 3.7 in January and increased to approximately 4.05 by June, reflecting a positive growth in student sentiment during the first half of the year.

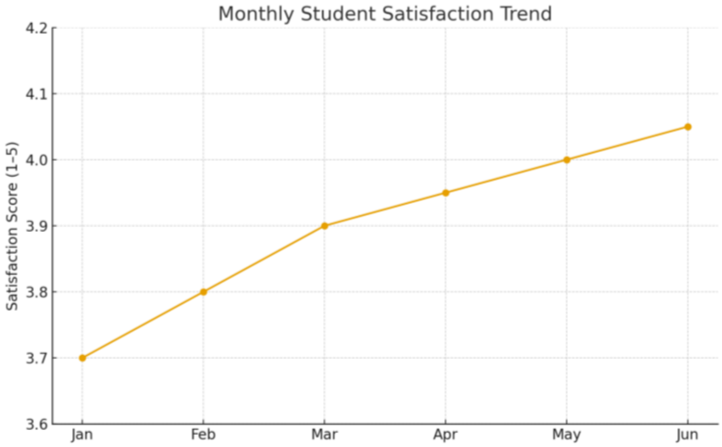

Figure 4. Average Satisfaction per Faculty

4. Conclusion

The study demonstrated that BI-based academic information systems are effective tools for analyzing and improving student satisfaction. Responsiveness and assurance emerged as key determinants, while NPS confirmed strong loyalty tendencies. The dashboard approach enables real-time monitoring and evidence-based interventions. Future work may include predictive analytics and text mining of open feedback.

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