



Application of Fuzzy AHP and New Fuzzy Servqual Methods for Performance Evaluation Based on Perceptions Service Quality and Satisfaction Towards the Implementation of Educational Programs

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Abstract. The Indonesian government, through the Ministry of Education, Culture, Research and Technology, offers various educational programs, including the Kampus Merdeka initiative. This program provides valuable real-world experiences for college students by connecting them with workplaces and entrepreneurs across the country. However, measuring program success requires clear indicators. This study proposes a novel method to evaluate the Kampus Merdeka program's service quality based on student satisfaction. The proposed approach utilizes a modified "New Fuzzy ServQual" method with three fuzzy numbers to assess student perceptions of service quality. This is followed by the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) to determine the relative importance of different service aspects. This combined method aims to achieve a more accurate and comprehensive evaluation of the program's effectiveness, ultimately leading to improvements and maximizing service quality for student participants.

Keywords: Performance Evaluation, New Fuzzy Servqual, Fuzzy AHP.

1 Introduction

Indonesia's Ministry of Education and Culture (Kemdikbud) launched the Merdeka Belajar - Kampus Merdeka policy (Regulation No. 3/2020) [1]. This initiative allows students to spend up to three semesters outside their major, aiming to broaden their real-world skills and career prospects. Learning can take place in diverse settings, from villages and businesses to research centers and communities. Students can choose from various activities like internships, community service projects, research, entrepreneurship ventures, and independent studies. The program seeks to equip graduates with robust soft and hard skills, preparing them for the demands of a rapidly evolving world. This emphasis on experiential learning with flexible pathways empowers students to

develop their potential based on their interests and talents. However, it's crucial to evaluate the program's effectiveness in achieving its goals. As with any service or product, ensuring quality and effectiveness through a strong managerial model is paramount [2].

Ensuring high-quality services in educational programs requires ongoing evaluation. This evaluation helps determine if the program's impact aligns with its goals. Furthermore, it allows for improvement plans and efficiency assessments. A significant challenge in implementing quality programs is resource scarcity. Studies by Khan & Mahapatra [3], Mosahab et al. [4], Shekarchizadeh et al. [5], and Akhlaghi et al. [6] all highlight the importance of service quality evaluation in educational settings. Their research explores various methods for measuring service quality, including the SERVQUAL model [7] [8]. These studies suggest that optimizing program implementation goes hand-in-hand with improving the quality of resources available.

This paper proposes a new approach for educational program evaluation based on service quality. This approach, unlike traditional methods, incorporates fuzzy logic to account for the inherent uncertainty in human perception. It utilizes a "New Fuzzy ServQual" model with three fuzzy numbers to address the limitations of earlier methods. The primary objectives of this approach are: (a) to consider the inherent fuzziness of data using fuzzy numbers, (b) to assess student perceptions and expectations of service quality in the program, (c) to determine the relative importance of various service quality dimensions and sub-dimensions, and (d) to evaluate the overall performance of educational programs based on service quality. By incorporating fuzzy logic and a more nuanced understanding of student perceptions, this approach aims to provide a more accurate and insightful evaluation of educational program effectiveness.

2 Method

This paper proposes a two-stage fuzzy approach for evaluating educational program performance based on service quality. The first stage utilizes a "New Fuzzy ServQual" method to assess service quality through student surveys. This method employs three types of fuzzy numbers (shoulder, triangle, and trapezoidal) to capture the nuances in student responses. This approach calculates the "GAP" (difference between expectations and reality) for each program service dimension and analyzes the gaps to identify areas for improvement. Additionally, the questionnaire's validity and reliability are assessed during this stage.

The second stage focuses on determining the relative importance (weights) of service quality sub-dimensions using the Fuzzy Analytic Hierarchy Process (FAHP). This method relies on the judgments of a selected student group to assign weights to different sub-dimensions, providing a more comprehensive understanding of student priorities regarding service quality.

Table 1. Fuzzy number for linguistic values in New fuzzy Servqual with 3 Fuzzy Number

Linguistic Value	Fuzzy Number
Very Low	(1,1,3)
Low	(1,3,5)
Medium	(3,5,7)
High	(5,7,9)
Very High	(7,9,9)

Table 2. Fuzzy number for linguistic values in fuzzy AHP

Linguistic Value	Fuzzy Number
Absolutely unimportant	(1,1,2)
Weakly important	(2,3,4)
Essentially important	(4,5,6)
Very strongly important	(6,7,8)
Extremely important	(8,9,9)

Delivering high-quality services hinges on three key factors: systems, technology, and most importantly, people. Human resources are the most challenging to replicate compared to product quality and price, highlighting their substantial impact on service quality [9]. To assess service quality, this research utilizes five key dimensions:

- a. Reliability: This refers to a company's ability to consistently deliver promised services accurately.
- b. Responsiveness: This measures the service provider's willingness and speed in assisting customers.
- c. Assurance: This assesses employee knowledge, courtesy, and their ability to instill trust and confidence in customers.
- d. Empathy: This dimension focuses on a company's understanding of customer needs, acting in their best interests, and providing personalized attention with convenient service hours.
- e. Physical Evidence: This refers to the tangible aspects of the service experience, including facilities, equipment, personnel, and communication materials.

This research methodology section (refer to Tables 1 and 2 for details) will elaborate on the specific methods used throughout the study, including the research topic, target population and sample size, data collection techniques, and data analysis methods.

3 Result and Discussion

3.1 Fuzzy Numbers

To provide some background on fuzzy numbers, a triangular fuzzy number is a specific type with a membership function shaped like a triangle. Essentially, a fuzzy number

(denoted by \tilde{A}) is considered triangular if its membership function ($\mu_{\tilde{A}}$) follows a specific formula. This formula defines the degree of membership for each possible value within the fuzzy number.

$$\mu_{\tilde{A}}(x) = \begin{cases} 0, & x < a_l \text{ or } x > a_u, \\ \frac{x - a_l}{a_m - a_l}, & a_l \leq x \leq a_m, \\ \frac{a_u - x}{a_u - a_m}, & a_m < x \leq a_u. \end{cases} \tag{1}$$

A triangular fuzzy number, denoted by \tilde{A} , is represented by the triplet (a_l, a_m, a_u) , as illustrated in Fig. 1. This triplet represents the three key parameters of the triangular fuzzy number:

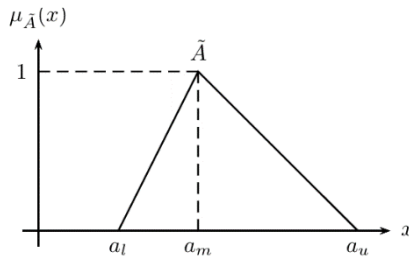


Fig. 1. Triangular fuzzy number \tilde{A}

3.2 New Fuzzy ServQual Build with 3 Fuzzy Number

Fuzzy ServQual combines the strengths of ServQual, a service quality evaluation method, and fuzzy logic, a method for handling uncertainty. ServQual provides a structured framework, while fuzzy logic allows us to account for ambiguity and lack of precise information in service evaluations. This can be particularly relevant when dealing with subjective factors like customer perceptions.

The "New Fuzzy ServQual" method utilizes three types of fuzzy numbers (right shoulder, left shoulder, triangle, and trapezoid) to represent membership functions. These functions map data points to membership values between 0 and 1, reflecting the degree to which a data point belongs to a particular category. This approach provides a more nuanced way to capture the inherent fuzziness of human perception in service quality evaluations compared to traditional methods.

3.3 Fuzzy Analytical Hierarchy Process (Fuzzy AHP)

Saaty developed the Analytical Hierarchy Process (AHP) to explore a method for scaling measurements using the main eigenvector of a positive matrix where each element represents a pairwise comparison [10].

4 Conclusion

This study proposes a novel two-stage evaluation approach for a government education program. The first stage utilizes a modified "New Fuzzy ServQual" method with three fuzzy numbers to assess student satisfaction with service quality in the Kampus Merdeka program. The second stage employs the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) to determine the relative importance of different service quality aspects. This combined approach aims to achieve a more precise and comprehensive evaluation of the program's effectiveness based on student experience. It's expected that this modified method will yield more accurate results, ultimately leading to improvements and higher service quality within the program.

Acknowledgments. This research is funded by Research and Community Service Institution of Institut Teknologi Statistika dan Bisnis Muhammadiyah Semarang.

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