



Evaluating Training Service Quality Using the Fuzzy SERVQUAL Method to Enhance Training Effectiveness at PT. XYZ

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Abstract. PT. XYZ, as a work unit under the Ministry of Industry, is responsible for conducting training for industrial human resources. Improving the quality of training services is essential to ensure participant satisfaction. This study aims to analyze service quality using the Fuzzy Servqual method, which combines Fuzzy logic and servqual concepts to objectively measure the gap between customer expectations and perceptions. Data were collected through questionnaires distributed to in-house training participants at PT. XYZ. The results indicate that the service quality has met participants' expectations, with an average positive gap value of 0.061 and a quality (Q) average of 1.014. Based on the Fuzzy Servqual method and Cartesian diagram analysis, four attributes were prioritized for improvement: ease of using the SIDIA information system, ease of contacting PT. XYZ, training meal quality, and communication between instructors/organizers and participants.

Keywords: Service Quality, Fuzzy Servqual, Training, Participant Satisfaction

1. Introduction

Human resource (HR) development has become a critical factor in improving industrial competitiveness amid rapid technological advancement and global market dynamics. Organizations are increasingly required to provide effective training programs to ensure that employees possess the competencies needed to meet industry demands and support organizational performance (Noe, 2020). Training institutions therefore play a strategic role in producing skilled and industry-ready workers through competency-based learning programs.

As a government-affiliated training provider under the Ministry of Industry, PT. XYZ is responsible for delivering vocational and competency-based training programs in several industrial sectors, including footwear, plastics, garments, and furniture. Through in-house, on-site, and blended learning schemes, PT. XYZ seeks to improve workforce competence and support industrial development in Indonesia. The effectiveness of these training programs is strongly



influenced not only by the quality of learning materials and instructors but also by the overall quality of services experienced by participants throughout the training process (Parasuraman et al., 1988).

Service quality has been widely recognized as a determinant of customer satisfaction and organizational performance. According to Parasuraman et al. (1988), service quality is measured through the gap between customer expectations and perceptions of the services received. When perceived performance exceeds expectations, customers tend to report higher satisfaction levels. Conversely, a negative gap indicates dissatisfaction and highlights areas requiring improvement. In the context of training services, participant satisfaction reflects the extent to which training facilities, instructors, administrative services, communication, and supporting infrastructure meet participant expectations (Kotler & Keller, 2016).

Previous studies have demonstrated the effectiveness of the Service Quality (SERVQUAL) model in evaluating service performance across various sectors, including education, healthcare, hospitality, and public services (Zeithaml et al., 2018; Oihu & Tutuhatunewa, 2022). The SERVQUAL framework evaluates service quality through five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. These dimensions provide a comprehensive approach for identifying service attributes that contribute to customer satisfaction or dissatisfaction.

Despite its widespread application, the conventional SERVQUAL method has limitations because respondents often express perceptions and expectations using subjective linguistic judgments. Human assessments are frequently characterized by vagueness and uncertainty, making it difficult to capture service evaluations accurately using crisp numerical values alone (Zadeh, 1965). To address this limitation, researchers have integrated fuzzy logic with SERVQUAL analysis. Fuzzy logic enables the transformation of linguistic assessments into



mathematical representations, thereby reducing ambiguity and improving measurement accuracy (Kusumadewi & Purnomo, 2010).

The integration of fuzzy logic and SERVQUAL, commonly referred to as Fuzzy SERVQUAL, has been successfully applied in various service quality studies. Research by Büyüközkan et al. (2011) demonstrated that Fuzzy SERVQUAL provides a more realistic representation of customer perceptions by incorporating uncertainty into the evaluation process. Similar findings were reported by Awasthi et al. (2011), who showed that fuzzy-based approaches enhance decision-making accuracy in service quality assessment. In training and educational environments, Fuzzy SERVQUAL has proven effective in identifying priority areas for improvement and supporting continuous quality enhancement initiatives (Abdullah, 2006; Teeroovengadum et al., 2019).

Although PT. XYZ routinely collects participant satisfaction data through the SIDIA information system, approximately 15% of participants still report dissatisfaction with the training services provided. Existing evaluations primarily focus on overall satisfaction scores and do not adequately identify specific service attributes that require improvement. Consequently, management faces challenges in determining appropriate corrective actions and allocating resources effectively.

Based on these considerations, this study aims to evaluate the quality of training services provided by PT. XYZ using the Fuzzy SERVQUAL method. Specifically, the study seeks to (1) measure the gap between participant expectations and perceptions across the five SERVQUAL dimensions, (2) determine the overall quality level of training services, and (3) identify priority service attributes requiring improvement through Cartesian diagram analysis. The findings are expected to provide practical recommendations for enhancing training effectiveness and



participant satisfaction while contributing to the growing body of literature on service quality evaluation in vocational training institutions.

2. Methods

2.1 Research Design

This study employed a quantitative descriptive approach to evaluate the quality of training services provided by PT. XYZ. Service quality was assessed by measuring the gap between participants' expectations and perceptions using the Fuzzy SERVQUAL method. The integration of fuzzy logic with SERVQUAL was selected because it can reduce subjectivity and uncertainty in respondents' assessments, thereby providing more accurate service quality measurements compared with conventional SERVQUAL analysis (Parasuraman et al., 1988; Büyüközkan et al., 2015).

2.2 Population and Sample

The population consisted of participants who attended PT. XYZ's in-house training programs during the 2024 fiscal year. Four training cohorts were selected, resulting in a total population of 200 participants. The minimum sample size was determined using the Slovin formula with a 10% margin of error:

where n represents the sample size, N is the population size, and e is the tolerated sampling error. Based on the calculation, the minimum required sample was 66.67 respondents. A total of 100 valid responses were collected and used for further analysis, exceeding the minimum requirement. The four training cohorts were selected because they represented all in-house training programs conducted during the 2024 fiscal year and had comparable training characteristics. The questionnaire was distributed to all participants in these cohorts through the official WhatsApp groups managed by the training organizers. Participation was voluntary, and all completed



questionnaires returned during the data collection period were screened for completeness. A total of 100 valid responses were obtained and included in the final analysis, exceeding the minimum sample size required by the Slovin calculation.

2.3 Data Collection

Primary data were collected through an online questionnaire distributed using Google Forms. The questionnaire link was shared through WhatsApp groups managed by the training organizers. Respondents were asked to evaluate both their expectations and perceptions regarding the training services provided by PT. XYZ. The questionnaire was developed based on the five SERVQUAL dimensions proposed by Parasuraman et al. (1988), namely:

1. Tangibles (physical facilities and supporting infrastructure);
2. Reliability (ability to provide services accurately and dependably);
3. Responsiveness (willingness to assist participants promptly);
4. Assurance (knowledge, competence, and credibility of service providers);
5. Empathy (individualized attention and concern for participants).

A total of 27 service attributes were evaluated using a five-point Likert scale ranging from 1 (very low) to 5 (very high).

2.4 Instrument Testing

Prior to analysis, the questionnaire was evaluated through validity and reliability testing. Item validity was assessed using the Corrected Item–Total Correlation method, where an item was considered valid when the calculated correlation coefficient exceeded the critical value of the correlation table. Reliability was examined using Cronbach's Alpha coefficient, with values greater than 0.60 indicating acceptable internal consistency.

2.5 Fuzzy SERVQUAL Analysis



The Fuzzy SERVQUAL method combines SERVQUAL gap analysis with fuzzy set theory to accommodate uncertainty in respondents' judgments. The analysis was conducted through four stages (Wati & Riana, 2017; Sutinah & Simamora, 2018):

1. Fuzzy Set Determination

Linguistic responses obtained from the Likert scale were represented using Triangular Fuzzy Numbers (TFN), consisting of lower, middle, and upper values.

2. Fuzzification

The collected responses were transformed into TFN values to represent the degree of membership of each linguistic assessment.

3. Defuzzification

The fuzzy values were converted into crisp values using the centroid method to obtain a single representative score for each attribute.

4. Gap Analysis

Service quality was evaluated by calculating the difference between perception and expectation scores:

$$\text{Gap} = \text{Perception} - \text{Expectation}$$

A positive gap indicates that service performance exceeds participant expectations, whereas a negative gap indicates that the service does not fully satisfy participant expectations.

In addition, the service quality index (Q) was calculated as:

$$\text{quality index (Q)} = \frac{\text{Perception (P)}}{\text{Expectation (H)}}$$

where P represents the perception score and E represents the expectation score. A quality index greater than one ($Q > 1$) indicates satisfactory service performance.

2.6 Importance–Performance Analysis

To identify priority areas for improvement, the results were further analyzed using a Cartesian diagram based on Importance–Performance Analysis (IPA). Each service attribute was plotted according to its expectation and perception scores and classified into four quadrants: (1) focus improvement, (2) maintain performance, (3) low priority, and (4) possible overkill. Attributes located in Quadrant I were considered critical areas requiring immediate managerial attention.



2.7 Data Analysis

The results of the Fuzzy SERVQUAL and Cartesian diagram analyses were interpreted to determine the overall quality of training services and identify priority attributes for improvement. Recommendations were subsequently formulated to enhance participant satisfaction and improve the effectiveness of PT. XYZ's training programs.

3. Result and Discussion

3.1 Respondent Characteristics

A total of 100 valid questionnaires were collected from participants attending PT. XYZ training programs. The respondents represented various industrial sectors and training schemes conducted during the 2024 training period.

Table 1. Respondent Characteristics

Characteristics	Frequency	Percentage (%)
Male	62	62
Female	38	38
Age $\leq$ 25 years	41	41
Age 26–35 years	37	37
Age > 35 years	22	22
First-time participants	71	71
Returning participants	29	29

The respondent profile indicates that most participants were within the productive working-age group, suggesting that the training programs successfully reached their intended target audience.

3.2 Validity and Reliability Testing

All questionnaire items were subjected to validity and reliability testing before further analysis. The results indicated that all service attributes were valid, as their corrected item-total correlation values exceeded the critical correlation coefficient. Furthermore, Cronbach's Alpha values for both expectation and perception questionnaires were greater than 0.70, indicating good internal consistency.



Table 2. Reliability Test Results

Variable	Cronbach's alpha
Expectation	0.948
Perception	0.956

These results demonstrate that the questionnaire was reliable and suitable for evaluating training service quality.

3.3 Fuzzy SERVQUAL Analysis

The Fuzzy SERVQUAL analysis was conducted to evaluate the gap between participant expectations and perceptions. Positive gap values indicate that service performance exceeds participant expectations, whereas negative values indicate dissatisfaction and the need for improvement.

Table 3. Service Quality Gap by Dimension

Dimension	Gap Score
Tangibles	-0.638
Reliability	0.171
Responsiveness	-0.013
Assurance	0.327
Empathy	0.456
Average	0.061

The results show that the overall average service gap was positive (0.061), indicating that PT. XYZ generally met participant expectations. The quality index (Q) value was 1.014, which is greater than one, suggesting satisfactory service performance. Although the average gap value (0.061) is relatively small, its positive value indicates that participants generally perceived the quality of training services to be slightly better than their initial expectations. From a managerial perspective, this finding suggests that the current service delivery has reached an acceptable level of quality. Nevertheless, the relatively modest gap also indicates that there is limited room for complacency, and continuous improvement remains essential, particularly for service attributes that still exhibit negative gaps or are identified as priorities through the IPA analysis.

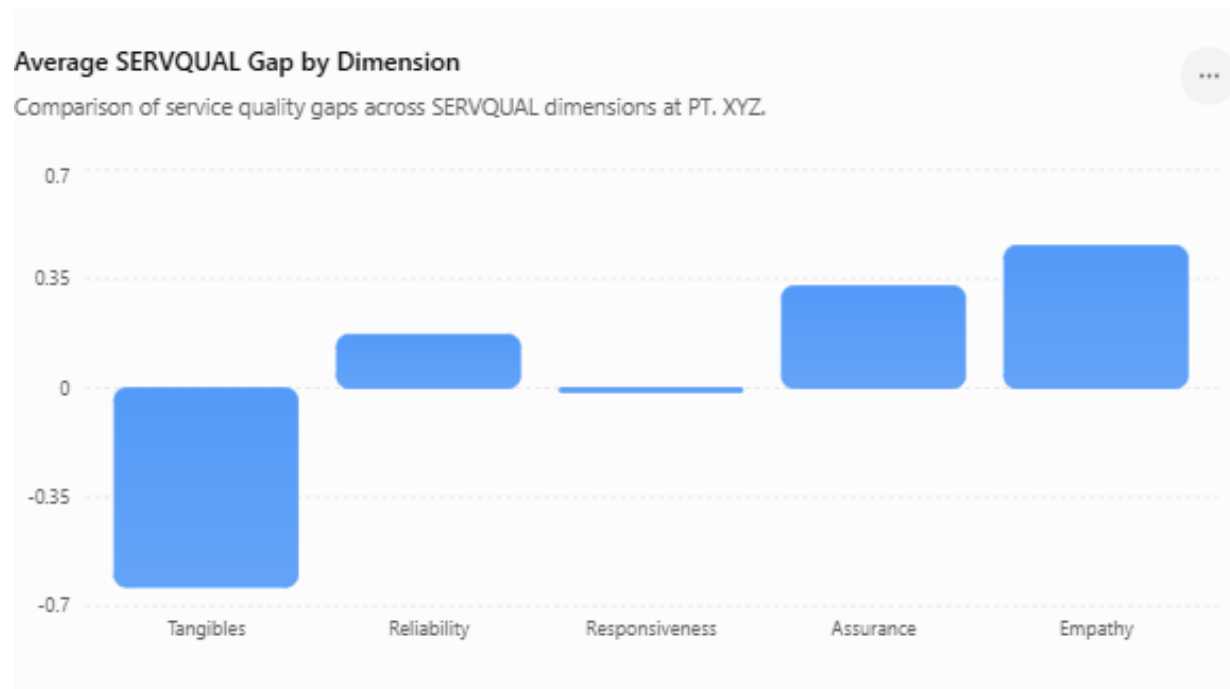


Figure 1. Average Service Gap by SERVQUAL Dimension

Among the five dimensions, Empathy achieved the highest positive gap (0.456), indicating that participants perceived strong personal attention and concern from training organizers. Assurance also showed a positive performance (0.327), reflecting participant confidence in the competence and professionalism of instructors and staff.

Conversely, the Tangibles dimension produced the largest negative gap (-0.638), suggesting that participants were less satisfied with physical facilities and supporting infrastructure. Similar findings were reported by Abdullah (2006), who found that tangible aspects frequently become the main source of dissatisfaction in educational and training services. Likewise, Teeroovengadum et al. (2019) emphasized that modern learning environments require adequate facilities and technological support to enhance learner satisfaction.

3.4 Importance–Performance Analysis

To identify attributes requiring managerial attention, Importance–Performance Analysis (IPA) was conducted using a Cartesian diagram. The results classified service attributes into four quadrants.

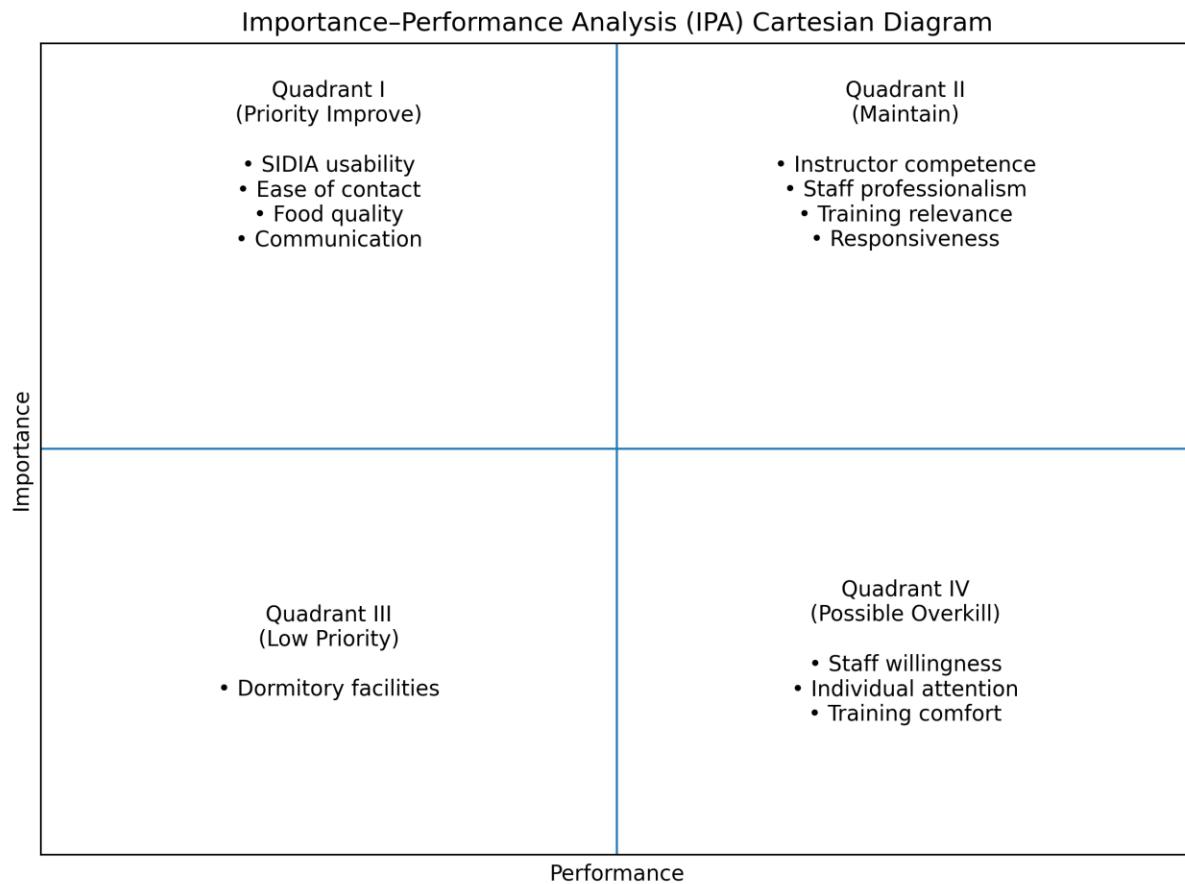


Figure 2. Importance–Performance Analysis (IPA) Cartesian Diagram

Quadrant I – Focus Improvement

Four attributes were identified as priority areas for improvement:

1. The SIDIA information system is easy to use.
2. Ease of contacting PT. XYZ.
3. Training meals are good in taste and quantity.
4. Good communication between instructors/committee and participants.

These attributes exhibit high importance but relatively low performance. Therefore, improvements in these areas are expected to provide the greatest impact on participant satisfaction.

The finding regarding information system usability is consistent with previous studies indicating that user-friendly digital services significantly influence customer satisfaction and



service effectiveness (Zeithaml et al., 2018). Difficulties in accessing information systems can reduce the overall training experience even when instructional quality remains satisfactory. Communication-related attributes were also identified as critical improvement areas. Effective communication between instructors and participants is essential for successful learning outcomes and participant engagement (Noe, 2020). Insufficient communication may lead to misunderstandings, reduced participation, and lower satisfaction levels.

Quadrant II – Maintain Performance

Several attributes were categorized into Quadrant II, indicating high importance and high performance. These attributes represent PT. XYZ's strengths and should be maintained. Examples include instructor competence, training relevance, staff professionalism, and responsiveness to participant needs.

The strong performance of these attributes explains the positive scores observed in the Assurance and Empathy dimensions. Previous studies have similarly found that instructor competence and staff professionalism are among the strongest determinants of satisfaction in vocational education and training services (Abdullah, 2006).

Quadrant III – Low Priority

Only one attribute was located in Quadrant III:

- Dormitory facilities are comfortable and attractive.

Although performance was relatively low, participants did not consider this attribute highly important compared with other aspects of the training service. Therefore, immediate investment in this area may not substantially improve overall satisfaction.

Quadrant IV – Possible Overkill

Three attributes were categorized into Quadrant IV:

1. Staff willingness to help participants.
2. Individual attention to participant complaints.
3. Comfort provided during training hours.

These attributes demonstrated high performance despite relatively lower perceived importance. While these aspects should not be neglected, excessive resource allocation may be less beneficial than focusing on attributes located in Quadrant I.



3.5 Improvement Recommendations

The IPA results indicate that the attributes located in Quadrant I represent the most critical areas because they are considered highly important by participants but have not yet achieved the expected level of performance. Therefore, the following recommendations were formulated by prioritizing these attributes, with the expectation that improvements in these areas will produce the greatest positive impact on participant satisfaction and the overall quality of training service. Based on the Fuzzy SERVQUAL and IPA analyses, several improvement strategies are recommended:

1. Redesign the SIDIA user interface and provide user guidance materials.
2. Improve communication channels through responsive websites, social media, and dedicated contact services.
3. Enhance meal quality and menu variation through closer coordination with catering providers.
4. Strengthen communication between instructors, committees, and participants through structured feedback mechanisms and digital communication platforms.

Implementing these recommendations is expected to reduce service quality gaps and further improve participant satisfaction in future training programs.

4. Conclusions

This study evaluated the quality of training services provided by PT. XYZ using the Fuzzy SERVQUAL method and Importance–Performance Analysis (IPA). The findings indicate that the overall service quality was satisfactory, as reflected by a positive average gap value of 0.061 and a service quality index (Q) of 1.014. These results suggest that, in general, the training services provided by PT. XYZ have met participant expectations. Similar findings have been reported in previous studies, where positive SERVQUAL gaps indicate that service performance is capable of satisfying users and supporting service effectiveness.

Among the five SERVQUAL dimensions, Empathy achieved the highest positive gap score (0.456), followed by Assurance (0.327), indicating that participants highly appreciated the personal attention, professionalism, and competence demonstrated by instructors and training organizers. In contrast, the Tangibles dimension showed the largest negative gap (-0.638), highlighting the need for improvements in physical facilities and supporting infrastructure. This result is consistent with previous Fuzzy SERVQUAL studies that identified tangible aspects as a common source of participant dissatisfaction in education and training services.



The IPA analysis revealed four priority attributes requiring immediate improvement, namely the usability of the SIDIA information system, ease of contacting PT. XYZ, quality of training meals, and communication between instructors, committees, and participants. These attributes were categorized in Quadrant I because of their high importance and relatively low performance. Therefore, management should prioritize corrective actions in these areas to maximize improvements in participant satisfaction and service quality.

Based on these findings, PT. XYZ is recommended to enhance its digital service platforms, strengthen communication channels, improve catering service quality, and establish more effective participant feedback mechanisms. Future studies may expand the analysis by integrating additional methods such as Quality Function Deployment (QFD), Kano Model, or Structural Equation Modeling (SEM) to provide a more comprehensive understanding of factors influencing participant satisfaction and training service quality.

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