Measurement at Student Service Satisfaction Using Fuzzy Service Quality Method at Indramayu State Polytechnic

Ahmad Lubis Ghozal[1*], *Budi* Warsito[2], *Munengsih Sari* Bunga[1], *Darsih* Darsih[1] , *Moh Ali* Fikri[1]

[1]Department of Informatics, Indramayu State Polytechnic, West Java, Indonesia
[2]Department of Statistics, Faculty of Science and Mathematics, Diponegoro University, Central Java, Indonesia

Abstract. Providing satisfaction to students and preventing students from all campus facilities services is very important to improve the quality of higher education. Therefore, this study aims to build a system to measure student satisfaction with campus services using the fuzzy servqual method. The number of samples is 100 students. The measuring instrument used in the study was declared valid with a significance level of 5% or a 95% confidence level. The reliability test with the result of 0.746 means that the measuring instrument used has high mobility. Data processing is done by calculating the value of fuzzification, defuzzification, and calculating the value of GAP between students' perceptions and expectations. From the results of the fuzzy servqual gap ranking with 5 variables, it shows that empathy gets to level 1 with the smallest value of -0.74. Level 2 is an assurance with a value of -0.85; then level 3 is reliability with a gap value of -0.89, the 4th position is the reaction force with a gap value of -0.97, and the 5th position is real with a value of -1.27. The results obtained can help the Indramayu State Polytechnic in improving the performance and quality of service.

1 Introduction

An important factor in increasing progress in every aspect of the world is one of them, which is education [1]. In Indonesia, education is divided into several levels, and college is the final level of education based on Law Number 12 of 2012 on higher education. At present, the number of universities in Indonesia reaches 4,574.

Higher education as a community service institution in education has an important role as a vehicle to develop and shape its students into high-quality graduates ready in the face of competition in this modern era. Therefore, the quality of higher education needs to be observed to produce quality graduates. Higher education's internal quality assurance system is the plan, implementation, control, and development of high-quality standards consistently

* Corresponding author: alghoz@gmail.com

and continuously to obtain stakeholder satisfaction and graduate quality assurance following assigned competencies [2,3].

One of the ways to compete, every college is required to be able to develop and improve its quality. Improving the quality is the right strategy to achieve an international scale college or a World Class University. Higher education services can be rated good and quality based on the good achievements of teaching staff, administrative staff and existing facilities. To provide a level of satisfaction to the number of students with the services provided and in accordance with what students expect to improve the quality of campus services.

The problem is the choice of the university to provide services for students such as adequate internet access, good computer labs, a comfortable library and a complete collection of books, comfortable and safe vehicles and other services, in order to provide something profitable for the campus, in this case providing satisfaction for students as well as free student dissatisfaction on all campus facility services [4]. Measuring the level of student satisfaction with the service becomes important and must be done by the university.

Satisfaction level analysis has been done by several researchers the world, one of the successes is to measure the satisfaction level of e-learning services using fuzzy servqual at Universiti Pendidikan Indonesia with 21 respondents obtained a gap value of -1.584 with a perceived value of 7.695 and an expectation of 9.277 [5]. Analysis of the quality level of outpatients in PUSKESMAS Baktiya using the fuzzy-servqual method has been successfully done with a value of 5.5. The results of defuzzification can be seen from the expected value of the quality of outpatient services [6]. Fuzzy Service Quality has been implemented to measure student service satisfaction at Universiti Dian Nuswantoro Semarang. The results of the overall gap calculation show a negative gap value with the meaning that the perception or service that users do not meet student expectations [1].

The success and success of fuzzy servqual in solving the satisfaction with the service are very appropriate if implemented at the Indramayu State Polytechnic. Indramayu State Polytechnic is the only polytechnic in region III of Cirebon. The number of students of 1,229 in the academic year 2019/2020 is based on the emergence of questions about the quality of campus services provided by the campus is in line with what is promised to students.

2 Materials and Methods

2.1 Materials

The research took place at Indramayu State Polytechnic, West Java, Indonesia. The study material used a web-based information system. Development system on a virtual private server with the domain http://kpm.polindra.ac.id. With web-based technologies that can be reached to all networks, the data collection process becomes faster and more effective. Measuring material in the form of a questionnaire for Indramayu state polytechnic students.

Data collection using sampling techniques to students from 3 (three) departments at Indramayu State Polytechnic. *Sampling* in empirical research is defined as the process of selecting or determining a sample (samples). Conventionally, the concept of a sample refers to a section of the population. The number of respondents of the study used was 100 students from 3 majors. The following are the measuring instruments used in the questionnaire:

Table 2. Questionnaire Measurement Tool.

No.	Question Attributes
Tangible	
1	Comfort, cleanliness and safety of the college board
2	Completeness, comfort, maximum cleanliness
3	Completeness, comfort, cleanliness of the library
4	Completeness, comfort, cleanliness and ease of exercise
5	Comfort, cleanliness and availability of a train location
6	Comfort, cleanliness, completeness and safety of the Student Activity Unit cubicles
7	Hotspot broadband availability
8	Comfort, cleanliness and safety of the prayer room (mosque)
9	The comfort, completeness, cleanliness and safety of the room await during class breaks
10	Availability of Green Areas
11	Comfort, completeness, and safety of campus operating vehicles
12	Comfort, completeness and cleanliness of the Tandas-WC room
Reliability	
13	Curriculum and learning process
14	Quality and eligibility Lecturer
15	Lecture and practicum atmosphere
16	The material presented by the penyarah was clear and pleased to be understood
17	Alumni quality
Responsiveness	
18	Respect and appropriateness in reverence
19	The overall quality of service in supporting the smooth running of college activities
20	Conformity, Accuracy and Accuracy of SIAKAD Period (Academic Information System)
Assurance	
21	Knowledge and skills acquired after college
22	Mastery of the field of work
23	Campus safety
Emphaty	
24	Initiative in helping
25	Hospitality, courtesy and attitude in serving
26	Good communication between students and positions is established

The instrument used to measure service quality was a written questionnaire or list of questions (statements) distributed to users, using a Likert scale. There are usually several types of Likert scales used, namely:

Table 3. Likert scale.

Scale	Perception	Expectation
1	Very Dissatisfied	Very unimportant
2	Dissatisfied	Not too important
3	Quite satisfied	Quite important
4	Satisfied	Important
5	Very satisfied	Very important

The Likert perception scale provides information on the respondents 'state of satisfaction with the measured questions. Meanwhile, the Likert expectation scale provides information on respondents 'satisfaction expectations with the measured questions.

2.2 Methods

2.2.1 Service Quality (Servqual)

Service quality can be interpreted as a comparison between customer trust and service perception. The SERVQUAL model developed by Parasuraman et al. (1985) is one of the most widely used service quality measurement models to identify the gap between customers and service providers6. In the SERVQUAL model, there are five dimensions of service quality that include aspects of tangibles, reliability, responsiveness, assurance, and empathy. An explanation of the five dimensions can be seen in table 4 [7].

Table 4. Explanation of Servqual dimensions.

Dimension	Explanation of dimensions
Tangible	The ability to display physical facilities and infrastructure
Reliability	The ability to provide services as promised accurately and reliably
Responsiveness	Willingness to help and provide fast and appropriate service to customers
Assurance	The ability of service providers to grow the trust of customers
Empathy	Give personal attention and understand the desires of customers

2.2.2 Fuzzy

Fuzzy *Fuzzy set theory* is a mathematical framework used to represent uncertainty, ambiguity, uncertainty, lack of information, and partial truth [8]. Lack of information in problem-solving is often found in various areas of life. Discussions about ambiguity have been going on since 1937, when a philosopher named Max Black put forward his opinion on ambiguity.

Convert the scale value to a fuzzy number from the input variable for each attribute as in table 3. Here are the steps to solve the servqual fuzzy algorithm: [9,10]

Step 1: Determine the fuzzy set for the linguistic variables and measurement scale.

In this step, each value given by the respondent in the questionnaire for each attribute will be calculated. Calculations are made on perceptions and expectations. The calculation is done using the following equation:

$$A_1 + A_2 = (a_1 + a_2, b_1 + b_2, c_1 + c_2) \quad (1)$$

Step 2: Determine the fuzzy set for the linguistic variables and measurement scale

In identifying user perceptions and expectations, linguistic variables are used. The measurement scale used is as shown in table 5.

Table 5. TFN Fuzzy Servqual.

TFN	Perception	Expectation
1,1,2	Very Dissatisfied	Very unimportant
1,2,3	Dissatisfied	Not too important
2,3,4	Quite satisfied	Quite important
3,4,5	Satisfied	Important
4,6,6	Very satisfied	Very important

Step 3: Establishment of TFN value perceptions and value of user expectations

The fuzzy calculation process is performed to form the TFN of the perceived value and the expected value of the user. Calculation to get the average weight of all users using the arithmetic mean with the following equation:

$$a_m = \frac{(a_{m1} + a_{m2} + a_{m3} \ldots\ldots a_{mi})}{N} \quad (2)$$

$$b_m = \frac{(b_{m1} + b_{m2} + b_{m3} \ldots\ldots b_{mi})}{N} \quad (3)$$

$$c_m = \frac{(c + c_{m2} + c_{m3} \ldots\ldots c_{mi})}{N} \quad (4)$$

Step 4: Get a single value from the average weight of each variable

The next step confirms the fuzzification value obtained using the defuzzification calculation. The result of defuzzification will be the single value of the average weight of each variable. The defuzzification stage uses the following equation:

$$X = \frac{a_m + b_m + c_m}{3} \quad (5)$$

Step 5: Calculate the gap for each attribute

The role of each attribute gap will show how important these attributes are in providing improved service quality. After getting the defuzzification value for perception and defuzzification for expectation, the gap for each attribute can be calculated using the following equation.

$$Gap_i = MA_{pi} - MA_{ei} \quad (6)$$

3 Implementation

The fuzzy servqual application to determine student satisfaction with campus services was performed by testing questionnaires with validity and reliability tests. The total number of respondents was 100 students with table r-0.195. Table R is a table of numbers commonly used to test the test results of the validity of study instruments.

Table 6. Instrument Validity Test.

Perception			**Expectation**		
***r*-table 0.195**			***r*-table 0.195**		
P1	0.606	Valid	H1	0.386	Valid
P2	0.570	Valid	H2	0.396	Valid
P3	0.492	Valid	H3	0.405	Valid
P4	0.510	Valid	H4	0.353	Valid
P5	0.519	Valid	H5	0.421	Valid
P6	0.615	Valid	H6	0.440	Valid
P7	0.577	Valid	H7	0.335	Valid
P8	0.464	Valid	H8	0.492	Valid
P9	0.671	Valid	H9	0.449	Valid
P10	0.581	Valid	H10	0.333	Valid
P11	0.560	Valid	H11	0.359	Valid
P12	0.534	Valid	H12	0.474	Valid

Perception			**Expectation**		
***r*-table 0.195**			***r*-table 0.195**		
P13	0.650	Valid	H13	0.493	Valid
P14	0.564	Valid	H14	0.536	Valid
P15	0.708	Valid	H15	0.535	Valid
P16	0.639	Valid	H16	0.524	Valid
P17	0.368	Valid	H17	0.389	Valid
P18	0.674	Valid	H18	0.481	Valid
P19	0.640	Valid	H19	0.495	Valid
P20	0.670	Valid	H20	0.624	Valid
P21	0.604	Valid	H21	0.531	Valid
P22	0.511	Valid	H22	0.479	Valid
P23	0.495	Valid	H23	0.497	Valid
P24	0.432	Valid	H24	0.582	Valid
P25	0.704	Valid	H25	0.471	Valid
P26	0.524	Valid	H26	0.501	Valid

If we look at the diagram, at *df* or N 100 with a significance level of 5%, the value of table *r* is 0.195. If the calculated value of *r*> the value of *r* of the table, then the item on the question instrument is said to be valid or there is a correlation between the linked variables. However, if the calculated value of *r* is <*r* table value, then the item on the instrument is invalid or this means that there is no relationship between the linked variables. This *R* count was obtained from the test results with SPSS. The next step is a reliability test with results as shown in Table 7.

Table 7. Case Processing Summary.

		N	**%**
Cases	Valid	100	100.0
	Excluded[a]	0	,0
	Total	100	100.0

Table 8. Reliability Statistics.

Cronbach.s Alpha	**N of Items**
0.746	53

Reliability testing refers to the understanding that the instruments used in research to obtain the information used are reliable as data collection tools and can reveal real information in the field. Reliability testing is also a tool for measuring questionnaires that are indicators of variables or constructs. A questionnaire is said to be reliable or trustworthy if a person's answer to the statement is consistent or stable over time. The reliability test results of table 8 show that the measuring instrument used is of high reliability indicated by the value

of rxx 0.746 close to the number 1. In general, the reliability is considered satisfactory if ≥ 0.700.

The characteristics of the respondents are Indramayu State Polytechnic students with a composition of 13 Departments of Informatics Engineering, 17 Departments of Mechanical Engineering and 70 Departments of Air Conditioning and Air Conditioning Engineering as shown in Figure 1.

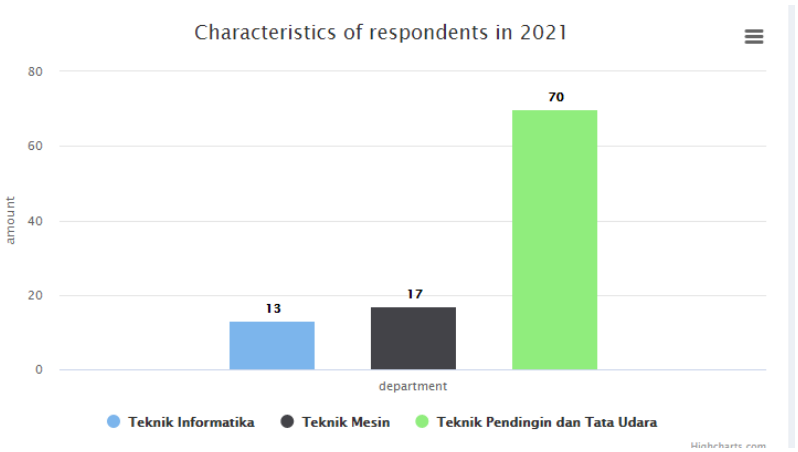

Fig. 1. Characteristics of Respondents.

The next step is to calculate the number of answers on the respondents' Likert scale based on equation 1. The results of the calculation of perceptions and expectations are shown in table 9.

Table 9. Number of respondents based on Likert scale.

No	Question	Perception					Expectation				
		1	2	3	4	5	1	2	3	4	5
1	Comfort, cleanliness and safety of the college board	2	26	26	39	7	1	0	8	23	68
2	Completeness, comfort, maximum cleanliness	1	27	26	34	12	0	0	10	17	73
3	Completeness, comfort, cleanliness of the library	0	8	31	45	16	0	1	13	25	61
4	Completeness, comfort, cleanliness and ease of exercise	25	30	20	21	4	1	2	15	35	47
5	Comfort, cleanliness and availability of a train location	8	32	22	28	10	0	0	11	27	62
6	Comfort, cleanliness, completeness and safety of the Student Activity Unit cubicles	11	26	26	32	5	0	0	13	24	63
7	Hotspot broadband availability	8	36	22	26	8	0	0	9	12	79
8	Comfort, cleanliness and safety of the prayer room (mosque)	1	16	19	49	15	0	0	6	17	77
9	The comfort, completeness, cleanliness and safety of the room await during class breaks	13	30	24	28	5	0	0	13	28	59
10	Availability of Green Areas	18	37	19	20	6	0	1	10	18	71
11	Comfort, completeness, and safety of campus operating vehicles	14	25	22	33	6	0	1	13	31	55
12	Comfort, completeness and cleanliness of the Tandas-WC room	12	26	29	25	8	0	0	14	19	67
13	Curriculum and learning process	2	17	21	54	6	0	0	7	20	73
14	Quality and eligibility Lecturer	0	10	29	52	9	0	0	8	18	74
15	Lecture and practicum atmosphere	1	13	27	47	12	0	0	10	19	71
16	The material presented by the penyarah was clear and pleased to be understood	0	16	38	38	8	0	0	9	16	75
17	Alumni quality	2	11	34	43	10	1	1	17	21	60
18	Respect and appropriateness in reverence	7	22	24	38	9	0	0	9	29	62

No	Question	Perception					Expectation				
		1	2	3	4	5	1	2	3	4	5
19	The overall quality of service in supporting the smooth running of college activities	3	11	36	40	10	0	0	14	25	61
20	Conformity, Accuracy and Accuracy of SIAKAD Period (Academic Information System)	2	12	40	38	8	0	0	12	26	62
21	Knowledge and skills acquired after college	0	16	25	50	9	0	0	10	17	73
22	Mastery of the field of work	1	14	28	49	8	0	0	10	19	71
23	Campus safety	3	8	22	47	20	0	0	8	16	76
24	Initiative in helping	4	8	30	44	14	0	0	13	25	62
25	Hospitality, courtesy and attitude in serving	1	10	27	49	13	0	0	10	26	64
26	Good communication between students and positions is established	2	9	24	43	22	0	0	8	18	74
Number of respondents		**100**									

Table 9 provides information that question number 1 respondents answered the perception of Likert scale 1, which is 11 students, Likert scale 2 is 26 students, Likert scale 3 is 26 students, Likert scale 4 is 32 students and Likert scale 5 is 5 students. While question number 1, respondents answered the expectation of Likert scale 1, which is 0 students, Likert scale 2 is 0 students, Likert scale 3 is 13 students, Likert scale 4 is 24 students and Likert scale 5 is 63 students.

Table 10. Student Satisfaction Defuzzification.

No	Question	Perception				Expectation			
		a	b	c	Xp	a	b	c	Xe
1	Comfort, cleanliness and safety of the college board	2.25	3.23	4.16	3.21	3.58	4.57	4.89	4.35
2	Completeness, comfort, laboratory cleanliness	2.30	3.29	4.17	3.25	3.63	4.63	4.90	4.39
3	Completeness, comfort, cleanliness of the library	2.69	3.69	4.53	3.64	3.46	4.46	4.85	4.26
4	Completeness, comfort, cleanliness of sports facilities	1.74	2.49	3.45	2.56	3.26	4.25	4.78	4.10
5	Comfort, cleanliness and availability of parking space	2.08	3.00	3.90	2.99	3.51	4.51	4.89	4.30
6	Comfort, cleanliness, completeness and safety of the Student Activity Unit room	2.05	2.94	3.89	2.96	3.50	4.50	4.87	4.29
7	Hotspot bandwidth availability	1.98	2.90	3.82	2.90	3.70	4.70	4.91	4.44
8	Comfort, cleanliness and safety of the prayer room (mosque)	2.62	3.61	4.46	3.56	3.71	4.71	4.94	4.45
9	The comfort, completeness, cleanliness and safety of the waiting room during class breaks	1.95	2.82	3.77	2.85	3.46	4.46	4.87	4.26
10	Availability of Green Areas	1.77	2.59	3.53	2.63	3.59	4.59	4.88	4.35
11	Comfort, completeness, and safety of campus operational vehicles	2.06	2.92	3.86	2.95	3.40	4.40	4.85	4.22
12	Comfort, completeness and cleanliness of the toilet room	2.03	2.91	3.83	2.92	3.53	4.53	4.86	4.31
13	Curriculum and learning process	2.47	3.45	4.39	3.44	3.66	4.66	4.93	4.42
14	Lecturer quality and qualifications	2.60	3.60	4.51	3.57	3.66	4.66	4.92	4.41
15	The atmosphere of lectures and practicum	2.57	3.56	4.44	3.52	3.61	4.61	4.90	4.37
16	The material presented by the lecturer was clear and easy to understand	2.38	3.38	4.30	3.35	3.66	4.66	4.91	4.41
17	Quality of alumni	2.50	3.48	4.38	3.45	3.39	4.38	4.78	4.18
18	Response and speed in service	2.27	3.20	4.11	3.19	3.53	4.53	4.91	4.32
19	Overall service quality in supporting the smooth running of lecture activities	2.46	3.43	4.33	3.41	3.47	4.47	4.86	4.27
20	Relevance, Accuracy and Timely SIAKAD (Academic Information System)	2.40	3.38	4.30	3.36	3.50	4.50	4.88	4.29
21	Knowledge and skills acquired after college	2.52	3.52	4.43	3.49	3.63	4.63	4.90	4.39
22	Mastery of the field of work	2.50	3.49	4.41	3.47	3.61	4.61	4.90	4.37
23	Campus security	2.76	3.73	4.53	3.67	3.68	4.68	4.92	4.43
24	Initiative in helping	2.60	3.56	4.42	3.53	3.49	4.49	4.87	4.28
25	Friendliness, courtesy and attitude in service	2.64	3.63	4.50	3.59	3.54	4.54	4.90	4.33
26	Good communication between students and the department is established	2.76	3.74	4.52	3.67	3.66	4.66	4.92	4.41

After knowing the result of the respondent's Likert scale, the next step is to calculate the fuzzy by applying equations 2 and 3 so as to produce the value of deflux education perception (*X*p) and defluxification perception (*X*p), as shown in Figure 2. value a is a low fuzzy number, b is the medium fuzzy number, and c is the upper fuzzy number. The defufation value of each perception and expectation will then calculate the performance gap through equation 5 and produce figure 2.

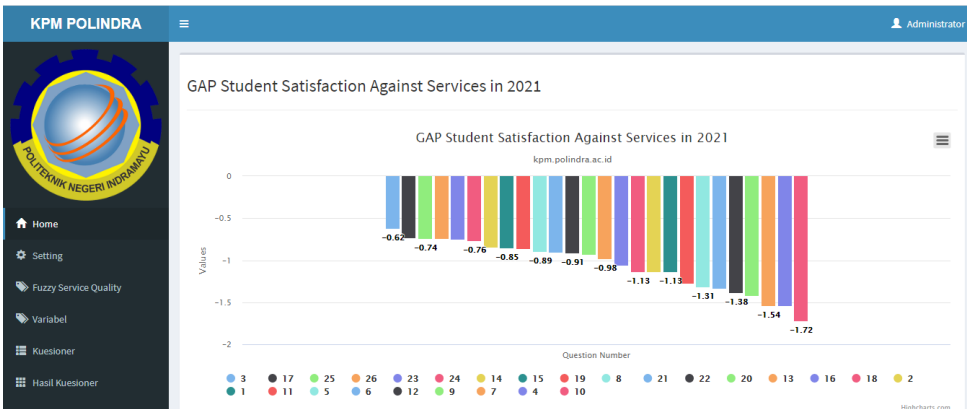

Fig. 2. GAP Student Satisfaction Against Services in 2021.

The results of the application of gap performance analysis provide information by means of graphic pictures in accordance with the ranking obtained through equation 5. Position 1 (first) with the smallest gap value shows in question number 3, which is -0.63. In comparison, the largest gap value is question number 10, which is -1.72. The values obtained from the respondents are all reduced, indicating that each student's satisfaction with the campus services is still beyond expectations, with measures necessary to improve management for the total number of gaps that occur between students and campus.

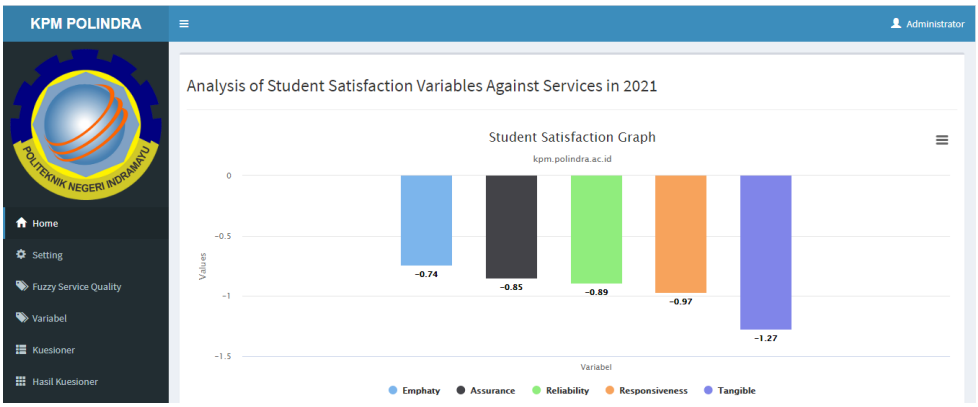

Fig. 3. Analysis of Student Satisfaction Variables Against Services in 2021.

The fuzzy servqual gap level with 5 variables indicates that emphaty gets position 1 with the smallest value, i.e. -0.74, then the 2nd level is assurance with a value of -0.85, then the 3rd level is reliability with a gap value of -0.89, the 3rd level is 4 is responsive with a gap value of -0.97 and the 5th stage is real with a value of -1.27 The detailed position can be seen in table 11.

Table 11. Table Ranking of Student Satisfaction Variables Against Service in 2021.

Rank	Variable	Perception	Expectation	GAP	Explanation
1	Emphaty	3.60	4.34	-0.74	Needs improvement
2	Assurance	3.54	4.40	-0.85	Needs improvement
3	Reliability	3.47	4.36	-0.89	Needs improvement
4	Responsiveness	3.32	4.29	-0.97	Needs improvement
5	Tangible	3.04	4.31	-1.27	Needs improvement

The stage provides information that the management of Indramayu State Polytechnic must improve management so that there is no minus value. Especially for a real variable that gets a gap value of -1.27.

4 Result and Discussion

The questionnaire as a measuring tool used in the study was declared valid with a significance level of 5% or a confidence level of 95%. In addition, the questionnaire was tested for its reliability with a result of 0.746, and thus the measuring instrument used had high mobility as it was above 0.700.

The analysis of student satisfaction with the service using the fuzzy servqual method obtained the value of the minus gap until the management of the Indramayu State Polytechnic campus is treated with better management improvement. By obtaining the value of the gap from this study, management can read the state of campus services to students to facilitate decision-making.

The fuzzy servqual gap level with 5 variables indicates that empathy gets position 1 with the smallest value, i.e. -0.74, then the 2nd level is an assurance with a value of -0.85. The 3rd level is reliability with a gap value of -0.89; the 3rd level is 4 is the reaction force with a gap value of -0.97, and the 5th stage is real with a value of -1.27.

References

1. N. F. Kartika and . S., Sisfotenika **7**, 38 (2017)
2. M. Ali Fikri, R. Gernowo, and B. Surarso, in *E3S Web Conf.* (2020)
3. F. E. Daromes and S. Ng, Procedia - Soc. Behav. Sci. **211**, 660 (2015)
4. R. S. Hariady Turnip, Marihat Situmorang, Saintia Mat. **2**, 163 (2014)
5. A. R. Prayudha, S. Sumarto, and A. G. Abdullah, IOP Conf. Ser. Mater. Sci. Eng. **830**, (2020)
6. Bakhtiar, M. Zakaria, K. Anshar, and F. Wahyuni, IOP Conf. Ser. Mater. Sci. Eng. **1003**, (2020)
7. S. Miranda, P. Tavares, and R. Queiró, J. Bus. Res. **89**, 371 (2018)
8. B. R. Smith, 519 (1983)
9. R. Liu, L. Cui, G. Zeng, H. Wu, C. Wang, S. Yan, and B. Yan, Appl. Soft Comput. J. **26**, 508 (2015)
10. I. Firdaus, Farikhin, and B. Surarso, E3S Web Conf. **202**, (2020)