

EVALUATING ACADEMIC SUPPORT SERVICE QUALITY IN DISTANCE LEARNING: A FUZZY-SERVQUAL GAP ANALYSIS AT UNIVERSITAS TERBUKA

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Abstract—The quality of academic support services is critical for student success and retention in distance learning. This study evaluates the service quality of the Distance Learning Skills Training (PKBJJ) at Universitas Terbuka using a Fuzzy-SERVQUAL gap analysis. A 22-item SERVQUAL instrument measured Expectations (E) and Perceptions (P) across five dimensions: Tangibles, Reliability, Responsiveness, Assurance, and Empathy. Linguistic ratings (Likert 1–5) were mapped to triangular fuzzy numbers (TFN) and defuzzified to obtain crisp scores for E and P. The Fuzzy Gap = $P_{\text{fuzzy}} - E_{\text{fuzzy}}$ was calculated and ranked to identify priority areas for improvement. Results show negative gaps across all dimensions, with Reliability (−0.038) and Responsiveness (−0.0127) as the most critical, followed by Tangibles (−0.0092), while Assurance (−0.0060) and Empathy (−0.0010) perform comparatively better. The findings provide an actionable improvement map, emphasizing process consistency, timely responses, and incremental facility enhancement, while maintaining strengths in assurance and empathy. This study demonstrates that Fuzzy-SERVQUAL effectively translates subjective linguistic judgments into decision-ready metrics for quality improvement in distance education.

Index Terms— Service Quality; Fuzzy-SERVQUAL; Academic Support; Gap Analysis; Universitas Terbuka.

I. INTRODUCTION

Academic support services are critical determinants of student success and retention in distance education, particularly at Universitas Terbuka (UT), which operates nationally with both online and in-person learning activities [1]. As student expectations evolve ranging from procedural clarity and schedule reliability to facility readiness and responsiveness of communication channels UT requires a valid, reliable, and context-specific mechanism to monitor service quality [2]. Optimizing service quality is essential not only to meet operational goals [3] but also to maintain student satisfaction and strengthen engagement in

learning processes [4].

Service quality is typically conceptualized as the discrepancy between perceived and expected service [5]. Despite the recognized importance of service quality in higher education, a comprehensive mapping of gaps (Expectations vs. Perceptions) for academic support in distance-learning contexts remains limited. While conventional SERVQUAL provides a structured framework for evaluating five dimensions Tangibles, Reliability, Responsiveness, Assurance, and Empathy its effectiveness can be enhanced by incorporating fuzzy logic, which accommodates linguistic ambiguity and subjective assessments [6] [7]. for decision-making [8] and the fuzzy concept is employed to help respondents provide more objective ratings, while SERVQUAL defines service satisfaction as the extent of discrepancy between perceived reality and expectations [6]

This study addresses the research gap by applying a Fuzzy-SERVQUAL approach to evaluate academic support services in UT's Distance Learning Skills Training (PKBJJ) program. Specifically, the objectives are to: (i) measure and compare students' Expectations (E) and Perceptions (P); (ii) calculate and rank the Fuzzy Gap ($P_{\text{fuzzy}} - E_{\text{fuzzy}}$) at item and dimension levels; and (iii) produce a priority map for actionable service improvement. In doing so, the study provides context-specific, operational insights for UT management, highlighting the areas where service quality improvements are most urgently needed while demonstrating the practical utility of Fuzzy-SERVQUAL in higher-distance-education environments.

II. METHODOLOGY

This study adopts a descriptive quantitative design to evaluate the quality of academic support services in the Distance Learning Skills Training (PKBJJ) program at Universitas Terbuka (UT). The primary focus is on measuring and mapping gaps between student Expectations (E) and Perceptions (P) using a Fuzzy-SERVQUAL framework, rather than testing hypotheses or explanatory relationships [9]. The hypothesis itself describes the relationship between two or more variables, to determine whether a variable is associated

with other variables or not, or whether a variable is caused/influenced by other variables or not [10].

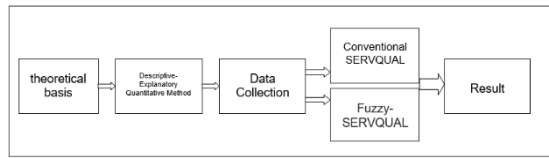


Fig. 1. Methodology

The population includes UT students who participated in PKBJJ at regional UT centers. A combination of accidental and purposive sampling was applied to select active participants during the data-collection period. After data cleaning and screening, a total of $n = 100$ valid responses were included in the analysis. Ethical procedures, including informed consent, anonymity, and data confidentiality, were strictly followed. A 22-item SERVQUAL instrument was used, covering five dimensions: Tangibles (1–5), Reliability (6–10), Responsiveness (11–14), Assurance (15–18), and Empathy (19–22). The instrument was administered with a 1–5 Likert scale (1 = very low; 5 = very high) tailored to the context of UT services, including facility/platform readiness, schedule accuracy, information consistency, responsiveness, procedural clarity, and individual attention/flexibility. Before main analysis, item validity was assessed using corrected item–total correlations (r) compared to the r -table at $\alpha = 0.05$ (two-tailed, $df = n - 2$), and reliability was evaluated using Cronbach’s α . Items were considered valid when $r \geq r$ -table and/or $p < 0.05$, and reliable when $\alpha \geq 0.70$ for each dimension and the overall scale.

Tabel. 1. Question Attributes

Dimensi	Pertanyaan
Tangibles	The PKBJJ classroom/space is clean, comfortable, and well-organized.
	Supporting facilities (projector, sound system, Wi-Fi) function properly.
	Materials/handouts/slides are provided in an organized format and easily accessible.
	Visual information (schedule, banners, instructions) is clear and easy to find.
	The digital platform (attendance, etc.) appears professional and is easy to use.
Reliability	PKBJJ sessions are conducted on time according to the announced schedule.
	Provided information (materials, exam procedures) is accurate and consistent.
	Materials and guidance are complete and delivered as promised.
	Technical/administrative issues are handled until fully resolved.
	Assessment results/feedback are delivered according to the specified deadlines.
Responsiveness	Tutors/staff respond promptly to student inquiries.
	The PKBJJ team is easily reachable via official channels (WhatsApp/email).
	Quick notifications are provided in case of schedule or link changes.
	Consultation queues are managed fairly with reasonable waiting times.
Assurance	Tutors/staff demonstrate competence in PKBJJ material.
	Procedures (assignments, exams, ethics) are clearly and convincingly explained.

	Interactions foster student confidence in handling exams/assignments.
	Student data is managed securely and professionally.
Empathy	Tutors/staff pay attention to individual student needs.
	PKBJJ schedules consider limitations of distance-learning students.
	Tutors/staff are friendly, patient, and respectful of differences.
	Alternative consultation modes are available (face-to-face/online/asynchronous).

The study implements Fuzzy-SERVQUAL for all items and dimensions. Likert-scale responses were mapped to triangular fuzzy numbers (TFN):

- 1 → (0.00, 0.00, 0.25)
- 2 → (0.00, 0.25, 0.50)
- 3 → (0.25, 0.50, 0.75)
- 4 → (0.50, 0.75, 1.00)
- 5 → (0.75, 1.00, 1.00)

TFNs were aggregated at item and dimension levels and then defuzzified (centroid method) to obtain crisp E_{fuzzy} and P_{fuzzy} scores. The Fuzzy Gap = $P_{fuzzy} - E_{fuzzy}$ was calculated for all items and dimensions and ranked to generate a priority map for actionable service improvements. Only methods directly implemented and reported in the results are included; paired t-tests and effect-size estimations were not applied in this study.

III. FINDING AND DISCUSSION

This study involved 100 Universitas Terbuka (UT) students who participated in the Distance Learning Skills Training (PKBJJ) organized by UT Regional. Offline attendance at UT Regional shows more contextual service dynamics, such as the need for consistent scheduling, clarity of local procedures, and facility readiness. Meanwhile, quality of interaction in online learning [12] highlight the importance of communication channel responsiveness, information updates, and clarity of remotely accessed materials/guidelines. These contextual variations form an important interpretive background for the main findings of this study regarding the gap between students' expectations and perceptions of service quality.

The research instrument adopted the SERVQUAL framework with two parallel scales, namely Expectations (E) and Perceptions (P), each containing 22 identical items in terms of construct and wording. The placement of items in these two parallel scales was intended to estimate the gap ($Gap = P - E$) at both the item and dimension levels. All items were designed using a 1–5 Likert scale (1 = strongly disagree/very low; 5 = strongly agree/very high) and there were no reverse-coded items, thereby minimizing potential confusion for respondents.

The questionnaire, containing 22 questions, was distributed directly to respondents, namely Universitas Terbuka (UT) students who participated in the Distance Learning Skills Training (PKBJJ) organized by UT

Regional.

The distribution of the questionnaire results distributed to 100 respondents for the Perception question is as follows :

Tabel. 2 Summary of Questionnaire Results on Perceptions

Dimensi	ID Pertanyaan	SR	R	C	T	ST	Total
Tangibles	P1	1	4	26	28	41	100
	P2	0	2	28	39	31	100
	P3	2	1	25	25	47	100
	P4	1	3	24	30	42	100
	P5	0	2	23	36	39	100
Reliability	P6	0	2	23	35	40	100
	P7	1	1	18	39	41	100
	P8	1	1	21	35	42	100
	P9	1	4	30	31	34	100
	P10	1	8	31	30	30	100
Responsiveness	P11	2	2	33	24	39	100
	P12	1	9	36	25	29	100
	P13	0	2	22	41	35	100
	P14	1	2	33	35	29	100
Assurance	P15	0	3	20	41	36	100
	P16	1	1	14	44	40	100
	P17	0	2	27	36	35	100
	P18	1	1	13	35	50	100
Empathy	P19	2	1	28	32	37	100
	P20	0	3	22	38	37	100
	P21	1	2	18	32	47	100
	P22	0	3	19	22	56	100

A. Questionnaire results on perceptions

1) Perception Validity Test

In this study, there were 100 respondents who filled out the questionnaire, so we need to calculate the degrees of freedom and obtained the following results:

$$Df = 100 - 2 = 98$$

The value of Df = 98 was obtained. According to the r product moment table, the value of Df 98 r in the table is 0.197. The validity test results are as shown in the following table:

Tabel. 3 Perception Validity Test Results

Variabel	ID Pertanyaan	rHitung	rTabel	Keterangan
Tangibles	P1	0.746	0.197	Valid
	P2	0.862	0.197	Valid
	P3	0.844	0.197	Valid
	P4	0.838	0.197	Valid
	P5	0.752	0.197	Valid
Reliability	P6	0.782	0.197	Valid
	P7	0.818	0.197	Valid
	P8	0.901	0.197	Valid

Responsiveness	P9	0.905	0.197	Valid
	P10	0.82	0.197	Valid
	P11	0.883	0.197	Valid
	P12	0.769	0.197	Valid
	P13	0.835	0.197	Valid
Assurance	P14	0.842	0.197	Valid
	P15	0.811	0.197	Valid
	P16	0.874	0.197	Valid
	P17	0.714	0.197	Valid
	P18	0.763	0.197	Valid
Empathy	P19	0.837	0.197	Valid
	P20	0.774	0.197	Valid
	P21	0.827	0.197	Valid
	P22	0.747	0.197	Valid

Table 3 shows that all research questions have a Pearson product moment correlation value higher than the acceptable value of 0.197. This means that the respondents' perceptions of all research questions are valid.

2) Perception Reliability Test

The following are the Cronbach's Alpha reliability values as shown in the table below:

Tabel. 4 Reliability Test Results for the Perception Questionnaire.

Variabel	rHitung	rTabel	Keterangan
Assurance	0.906	0.7	Reliabel
Empathy	0.91	0.7	Reliabel
Overall	0.979	0.7	Reliabel
Reliability	0.942	0.7	Reliabel
Responsiveness	0.925	0.7	Reliabel
Tangibles	0.925	0.7	Reliabel

Table 4 shows that all items have a Cronbach's Alpha of more than 0.7 for suitability. Thus, it can be concluded that the respondents' perceptions of all research questions are RELIABLE.

B. Questionnaire Distribution Results for Expectations

The distribution of questionnaire results distributed to 100 respondents for the question on expectations is as follows:

Tabel. 5 Summary of Questionnaire Results on Expectations

Dimensi	ID Pertanyaan	SR	R	C	T	ST	Total
Tangibles	E1	1	5	23	33	38	100
	E2	0	3	30	33	34	100
	E3	1	0	17	39	43	100
	E4	1	1	20	34	44	100
	E5	1	1	17	47	34	100
Reliability	E6	0	2	13	29	56	100
	E7	1	0	16	39	44	100
	E8	1	0	18	36	45	100

	E9	0	2	18	42	38	100
	E10	2	2	22	40	34	100
Responsiveness	E11	2	3	20	35	40	100
	E12	1	8	35	20	36	100
	E13	0	1	27	37	35	100
	E14	1	2	31	34	32	100
Assurance	E15	0	1	22	40	37	100
	E16	1	0	20	34	45	100
	E17	0	1	22	43	34	100
	E18	0	1	15	33	51	100
Empathy	E19	2	1	28	35	34	100
	E20	0	1	29	31	39	100
	E21	1	0	14	40	45	100
	E22	0	1	19	32	48	100

1) Expectations Validity Test

In this study, there were 100 respondents who filled out the questionnaire, so we need to calculate the degrees of freedom and obtained the following results:

$$Df = 100 - 2 = 98$$

The value of $Df = 98$ was obtained. According to the r product moment table, the value of $Df 98$ r in the table is 0.197. The validity test results are as shown in the following table:

Table 6. Expected Validity Test Results

Variabel	ID Pertanyaan	rHitung	rTabel	Keterangan
Tangibles	E1	0.675	0.197	Valid
	E2	0.744	0.197	Valid
	E3	0.758	0.197	Valid
	E4	0.717	0.197	Valid
	E5	0.796	0.197	Valid
Reliability	E6	0.641	0.197	Valid
	E7	0.793	0.197	Valid
	E8	0.798	0.197	Valid
	E9	0.867	0.197	Valid
	E10	0.752	0.197	Valid
Responsiveness	E11	0.773	0.197	Valid
	E12	0.818	0.197	Valid
	E13	0.822	0.197	Valid
	E14	0.781	0.197	Valid
Assurance	E15	0.907	0.197	Valid
	E16	0.816	0.197	Valid
	E17	0.777	0.197	Valid
	E18	0.747	0.197	Valid
Empathy	E19	0.786	0.197	Valid
	E20	0.758	0.197	Valid
	E21	0.786	0.197	Valid
	E22	0.669	0.197	Valid

Table 6 shows that all research questions have a Pearson product moment correlation value higher than the acceptable value of 0.197. This means that the respondents' expectations for all research questions are valid.

2) Expectancy Reliability Test

The following are the Cronbach's Alpha reliability values as shown in the table below:

Table 7. Reliability Test Results for the Expectancy Questionnaire

Variabel	rHitung	rTabel	Keterangan
Assurance	0.917	0.7	Reliabel
Empathy	0.884	0.7	Reliabel
Overall	0.973	0.7	Reliabel
Reliability	0.908	0.7	Reliabel
Responsiveness	0.908	0.7	Reliabel
Tangibles	0.891	0.7	Reliabel

Table 7 shows that all items have a Cronbach's Alpha of more than 0.7 for suitability. Thus, it can be concluded that the respondents' perceptions of all research questions are RELIABLE.

C. Fuzzy Set Process

In this step, the score is determined as a fuzzy number that needs to be provided by respondents for each criterion proposed in the questionnaire. The following is the determination of fuzzy scores as an assessment tool:

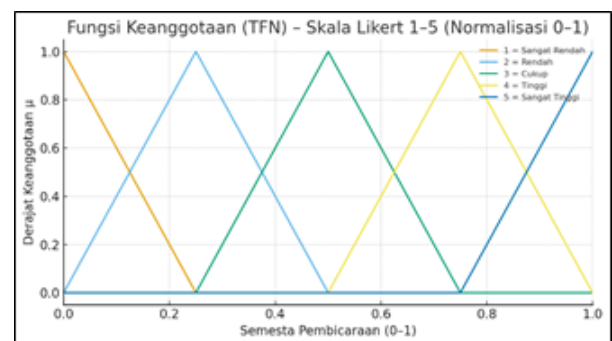


Fig. 2 Fuzzy Set Process

D. Calculation of Fuzzification and Defuzzification Values of Customer Perceptions and Expectations

At this stage, the students' questionnaire responses are processed into triangular fuzzy numbers (TFN) for each indicator item on the Expectation (E) and Perception (P) scales. Fuzzification is the process of converting input from a crisp form into a linguistic variable (fuzzy)[13] and Fuzzification is a crucial step in applying fuzzy logic [14]. Each Likert score of 1–5 is mapped to three components—lower bound (a), middle bound (b), and upper bound (c)—according to the specified membership function. Next, the TFN values for each item are aggregated (averaged across components a, b, c) to obtain a collective fuzzy representation of respondents per indicator and per SERVQUAL dimension. To obtain a single, easily comparable measure, the TFN is then defuzzified using the centroid approach to produce crisp values for E and P. A crisp solution is obtained by taking the center point of the fuzzy region. [15] These crisp values are used to rank

the indicators on each scale and calculate the Fuzzy Gap = $P_{fuzzy} - E_{fuzzy}$. The order of improvement priority is determined based on the most negative gap (indicators with relatively low P_{fuzzy} compared to E_{fuzzy}), and summarized again at the dimension level (Tangibles, Reliability, Responsiveness, Assurance, Empathy) to guide targeted managerial recommendations. In this way, students' linguistic and potentially ambiguous assessments are quantified more representatively, while maintaining sensitivity to the uncertainty of perception that is common in the PJJ context.

Tabel. 8 Fuzzification and Defuzzification Process of Perception

Dimensi	Kode	TFN			Defuzzifikasi	Rank
		a	b	c		
Tangibles	P1	0.5125	0.76	0.9075	0.7267	15
Tangibles	P2	0.4975	0.7475	0.92	0.7217	17
Tangibles	P3	0.54	0.785	0.9175	0.7475	8
Tangibles	P4	0.525	0.7725	0.9175	0.7383	13
Tangibles	P5	0.53	0.78	0.9325	0.7475	8
Reliability	P6	0.5325	0.7825	0.9325	0.7492	7
Reliability	P7	0.5475	0.795	0.9425	0.7617	5
Reliability	P8	0.5425	0.79	0.935	0.7558	6
Reliability	P9	0.485	0.7325	0.8975	0.705	19
Reliability	P10	0.4525	0.7	0.875	0.6758	21
Responsiveness	P11	0.495	0.74	0.8925	0.7092	18
Responsiveness	P12	0.4325	0.68	0.8575	0.6567	22
Responsiveness	P13	0.5225	0.7725	0.935	0.7433	11
Responsiveness	P14	0.475	0.7225	0.9	0.6992	20
Assurance	P15	0.525	0.775	0.935	0.745	10
Assurance	P16	0.555	0.8025	0.9525	0.77	3
Assurance	P17	0.51	0.76	0.9225	0.7308	14
Assurance	P18	0.5825	0.83	0.955	0.7892	1
Empathy	P19	0.5075	0.7525	0.91	0.7233	16
Empathy	P20	0.5225	0.7725	0.93	0.7417	12
Empathy	P21	0.5575	0.805	0.9375	0.7667	4
Empathy	P22	0.5775	0.8275	0.9375	0.7808	2

On the Perception (P) scale, the three items with the highest defuzzification scores came from the Assurance and Empathy dimensions (e.g., P18–Assurance, P22–Empathy, P16–Assurance), indicating that students rated the aspects of competency assurance, clarity, and service attitude/empathy relatively strongly. Conversely, items with the lowest scores appear in Responsiveness and Reliability (e.g., P12–Responsiveness, P10–Reliability), indicating that the speed of response from official channels and the consistency of information/schedules still need to be improved.

Tabel. 9 Fuzzification and Defuzzification Processes

Dimensi	Kode	TFN			Defuzzifikasi	Rank
		a	b	c		
Tangibles	E1	0.5075	0.755	0.91	0.7242	18

	E2	0.495	0.745	0.91	0.7167	20
	E3	0.56	0.8075	0.95	0.7725	7
	E4	0.55	0.7975	0.9375	0.7617	9
	E5	0.5325	0.78	0.945	0.7525	11
Reliability	E6	0.5975	0.8475	0.9575	0.8008	1
	E7	0.565	0.8125	0.9525	0.7767	5
	E8	0.5625	0.81	0.9475	0.7733	6
	E9	0.54	0.79	0.945	0.7583	10
	E10	0.51	0.755	0.92	0.7283	17
Responsiveness	E11	0.525	0.77	0.92	0.7383	14
	E12	0.4575	0.705	0.865	0.6758	22
	E13	0.515	0.765	0.9275	0.7358	16
	E14	0.4875	0.735	0.905	0.7092	21
Assurance	E15	0.5325	0.7825	0.94	0.7517	12
	E16	0.5575	0.805	0.9425	0.7683	8
	E17	0.525	0.775	0.94	0.7467	13
	E18	0.585	0.835	0.9575	0.7925	2
Empathy	E19	0.5	0.745	0.91	0.7183	19
	E20	0.52	0.77	0.9225	0.7375	15
	E21	0.5725	0.82	0.9575	0.7833	3
	E22	0.5675	0.8175	0.9475	0.7775	4

The highest expectations of students are concentrated on Reliability (E6), Assurance (E18), and Empathy (E21)—emphasizing the importance of process consistency, assurance of competence/clarity of procedures, and individual attention. On the other hand, expectations are relatively more moderate for Tangibles (E2) and Responsiveness (E14, E12), indicating a need for improvement in facility readiness and response speed.

Tabel. 10 Fuzzy Servqual Results

Dimensi	Kode	Defuzzifikasi (P)	Defuzzifikasi (E)	GAP (P-E)	RANK
Tangibles	E1/P1	0.7267	0.7242	0.0025	17
	E2/P2	0.7217	0.7167	0.005	20
	E3/P3	0.7475	0.7725	-0.025	5
	E4/P4	0.7383	0.7617	-0.0233	6
	E5/P5	0.7475	0.7525	-0.005	14
Reliability	E6/P6	0.7492	0.8008	-0.0517	3
	E7/P7	0.7617	0.7767	-0.015	11
	E8/P8	0.7558	0.7733	-0.0175	8
	E9/P9	0.705	0.7583	-0.0533	1
	E10/P10	0.6758	0.7283	-0.0525	2
Responsiveness	E11/P11	0.7092	0.7383	-0.0292	4
	E12/P12	0.6567	0.6758	-0.0192	7
	E13/P13	0.7433	0.7358	0.0075	22
	E14/P14	0.6992	0.7092	-0.01	12
Assurance	E15/P15	0.745	0.7517	-0.0067	13

	E16/P16	0.77	0.7683	0.0017	16
	E17/P17	0.7308	0.7467	-0.0158	10
	E18/P18	0.7892	0.7925	-0.0033	15
Empathy	E19/P19	0.7233	0.7183	0.005	20
	E20/P20	0.7417	0.7375	0.0042	19
	E21/P21	0.7667	0.7833	-0.0167	9
	E22/P22	0.7808	0.7775	0.0033	18

From Table 10, the items with the largest negative gaps are primarily within the Reliability dimension, notably E9/P9 and E10/P10, indicating inconsistencies in schedule and information delivery. When viewed from the dimension perspective, the gap value comparison is presented in the following table:

Tabel. 11 Fuzzy Servqual Results by Dimension

Dimensi	Persepsi	Harapan	GAP	RANK
Tangibles	0.7363	0.7455	-0.0092	3
Reliability	0.7295	0.7675	-0.038	1
Responsiveness	0.7021	0.7148	-0.0127	2
Assurance	0.7588	0.7648	-0.006	4
Empathy	0.7531	0.7542	-0.001	5

Based on the ranking of negative gaps, management should prioritize interventions in Reliability (e.g., schedule adherence, material availability) and Responsiveness (e.g., response time to student inquiries) while maintaining strengths in Assurance and Empathy."

IV. CONCLUSION

This study demonstrates that academic support services in UT's Distance Learning Skills Training (PKBJJ) do not fully meet student expectations, with negative gaps across all five SERVQUAL dimensions. Among the dimensions, Reliability exhibits the largest gap, followed by Responsiveness, highlighting these areas as the most urgent priorities for service improvement. The findings provide an actionable map for UT management, emphasizing process consistency, timely communication, and incremental enhancements of facilities, while maintaining strengths in Assurance and Empathy.

Despite these contributions, the study has several limitations. The sample is restricted to 100 students from selected regional UT centers, limiting generalizability across all UT regions or programs. Additionally, the analysis is cross-sectional, capturing service quality at a single point in time, and does not include longitudinal or multi-period comparisons.

Future research could address these limitations by implementing broader sampling, comparing service gaps across different UT regions, or employing longitudinal monitoring to track improvements over

time. Such extensions would provide a more comprehensive understanding of academic support service quality in distance education and strengthen the empirical basis for decision-making.

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