

Learning Environment Service Quality and Graduate Engineering Student Satisfaction: A Comparative Study of Two Ethiopian Institutions

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Abstract. This study examines the relationship between perceived learning environment service quality and satisfaction among postgraduate engineering students at Addis Ababa Institute of Technology (AAiT) and Ethiopian Defense University College of Engineering (EDUCE). Using a predominantly quantitative mixed-methods design, the study collected survey responses from 236 students (148 at AAiT and 88 at EDUCE), supplemented by open-ended responses and interviews. The questionnaire assessed five perceived service quality dimensions and student satisfaction. Descriptive statistics, Cronbach's alpha, Pearson correlations, and an independent-samples t-test were analysed using SPSS. All five service quality dimensions were positively associated with satisfaction, with tangibility showing the strongest reported association ($r = .631$). The correlation between the perceived learning environment and satisfaction was positive at both EDUCE ($r = .597$) and AAiT ($r = .689$). Overall satisfaction differed significantly between institutions, favouring EDUCE ($t(234) = 3.764$, $p < .001$; mean difference = 0.363). Tangibility and responsiveness emerged as priority concerns, particularly at AAiT. These findings support institution-specific improvements to infrastructure, academic support, and student feedback systems.

Keywords: Graduate Engineering Education, Learning Environment, Service Quality, Student Satisfaction, SERVQUAL, Ethiopia

Introduction

Higher education institutions increasingly evaluate educational quality through students' experiences of teaching, academic support, and the physical learning environment. These experiences influence how students assess institutional services and their satisfaction with studying. Research links classroom conditions, learning resources, and student engagement to satisfaction in higher education (Gray & DiLoreto, 2016; Wilson & Cotgrave, 2016). Engineering programmes warrant particular attention because laboratories, digital systems, and opportunities for practical learning form an integral part of the educational experience (Guney & Al, 2012).

In Ethiopia, quality assurance initiatives have sought to strengthen higher education, yet resource constraints and institutional differences continue to shape learning conditions. Enyew et al. (2024) document the importance of learning environments in Ethiopian universities, while Haile (2024) describes challenges surrounding curriculum implementation at Ethiopian Defense University. Evidence from Ethiopian higher education also connects institutional service quality with student satisfaction (Workie et al., 2017; Alamirew, 2024). These findings establish the need to examine not only academic provision but also the services and facilities through which postgraduate engineering students experience university life.

Five dimensions of perceived service quality offer a useful framework: reliability, tangibility, assurance, empathy, and responsiveness (Parasuraman et al., 1988). Recent studies report relationships between these dimensions and student satisfaction, although the relative importance of individual dimensions varies across institutional contexts (Rahman et al., 2024; Stankovska et al., 2024). Existing findings do not, however, establish whether the same patterns characterize

postgraduate engineering programmes operating within military and civilian institutional settings in Ethiopia. This context-specific gap motivates the present comparative analysis.

The study compares Ethiopian Defense University College of Engineering (EDUCE) with Addis Ababa Institute of Technology (AAiT). The institutions differ in organizational setting, and research on collaboration in military and engineering education suggests that institutional learning cultures can vary (Carneiro et al., 2019; Mercier et al., 2018). Nevertheless, institutional designation alone cannot explain satisfaction; direct evidence from students is necessary. Accordingly, the study asks: (1) How are perceived service quality dimensions and the overall learning environment associated with postgraduate engineering students' satisfaction? (2) How do satisfaction and perceived service quality compare between EDUCE and AAiT?

By addressing these questions within the same analytical framework, the study contributes an institution-level comparison and identifies service dimensions that merit targeted improvements. Given its observational design, the analysis evaluates associations and group differences rather than causal effects.

Literature Review

Theoretical Framework

SERVQUAL conceptualizes service quality through reliability, responsiveness, assurance, empathy, and tangibles (Parasuraman et al., 1988). The original approach distinguishes perceived performance from prior expectations. In contrast, SERVPERF measures perceived performance directly (Cronin & Taylor, 1992). Higher education adaptations include HEDPERF, HiEdQUAL, and UnivQual, which recognize that institutional services, teaching, curricula, and facilities interact in shaping students' experiences (Abdullah, 2006; Annamdevula, 2012; Marimon et al., 2019).

The present questionnaire measures students' perceptions of the five SERVQUAL dimensions; it does not implement the original SERVQUAL expectation-minus-perception gap score. Reliability refers to consistent delivery of educational services; tangibility to facilities, equipment, and learning resources; assurance to staff competence and fair treatment; empathy to individual attention; and responsiveness to timely support and receptiveness to student feedback (Parasuraman et al., 1988). This distinction between a SERVQUAL-derived framework and the full SERVQUAL measurement procedure is essential for interpreting the results.

Empirical Studies and Conceptual Framework

Evidence from Ethiopia and other higher education settings relates service experiences to satisfaction, although institutional conditions may change the prominence of individual dimensions. For example, Alamirew (2024) identifies responsiveness as a concern in an Ethiopian public university, while Rahman et al. (2024) examine the contribution of SERVQUAL dimensions to university student satisfaction. Studies of campus facilities further underscore the role of learning infrastructure (Wilson & Cotgrave, 2016; Mattah & Kwarteng, 2018). Complementary research explores service quality across diverse higher education settings (Khondkar, 2024; Pedro et al., 2018; Polyakova & Mirza, 2015; Rezaei et al., 2017). The present study therefore assesses the relationship of each perceived service quality dimension with satisfaction, alongside an overall perceived learning environment measure and a comparison of institutional satisfaction scores.

Methods

The study adopted a cross-sectional, predominantly quantitative mixed-methods design. The quantitative component assessed perceptions, correlations, and differences between institutions, while qualitative responses provided illustrative accounts of learning conditions. The qualitative component was embedded in the survey-based comparison rather than treated as an independent explanatory phase (Johnson & Onwuegbuzie, 2004). The design supports description and statistical association but does not identify causal impacts.

The institutional registers identified a population of 467 postgraduate engineering students

enrolled during the 2024/2025 academic year: 362 at AAiT and 105 at EDUCE. Researchers circulated a Google Forms questionnaire through institutional communication channels, and students participated voluntarily. The sample therefore reflected self-selection following broad recruitment rather than probability sampling. A total of 236 students responded, equivalent to 50.5% of the combined population: 148 students at AAiT (40.9%) and 88 at EDUCE (83.8%). Table 1 reports the source manuscript's demographic breakdown. The original EDUCE male total is internally inconsistent and requires verification against the registrar records.

Table 1. *Student population and respondents by institution and academic year*

Institution	Academic year	Population male	Population female	Population total	Respondents male	Respondents female	Respondents total
AAiT	First year	86	22	108	63	5	68
AAiT	Second year	170	68	238	60	10	70
AAiT	Other years	12	4	16	8	2	10
AAiT	Total	268	94	362	131	17	148
EDUCE	First year	30	0	30	24	0	24
EDUCE	Second year	69	1	70	59	1	60
EDUCE	Other years	5	0	5	4	0	4
EDUCE	Total	104	1	105	87*	1	88

The questionnaire contained 12 five-point Likert items for perceived learning environment service quality, four items for student satisfaction, and four open-ended questions. Response options ranged from 1 (strongly disagree) to 5 (strongly agree). The source manuscript also reports interviews but does not specify the interview sample, recruitment method, interview guide, or recording procedure. These procedural details should be supplied to make the qualitative component reproducible.

Data analysis used IBM SPSS Statistics version 26. The study reported means, standard deviations, Cronbach's alpha coefficients, Pearson product-moment correlations, and an independent-samples t-test with a two-sided significance criterion. Levene's test informed the equal-variance assumption. Responses to open-ended questions and interviews underwent narrative analysis. The original manuscript does not report checks of scale dimensionality, normality, outliers, missing-data handling, or the qualitative coding process; these elements require methodological clarification (Field, 2018).

Participation in the online questionnaire was voluntary. [AUTHOR ACTION REQUIRED: Specify the ethics review or institutional authorization, informed-consent procedures, confidentiality safeguards, and treatment of interview quotations. The source manuscript does not provide sufficient information to substantiate these statements.

Results and Discussion

Reliability of the Measures

The reported Cronbach's alpha coefficients ranged from .851 to .885 for the five perceived service quality dimensions, with $\alpha = .872$ for student satisfaction and $\alpha = .866$ for the combined item set (Table 2). All dimension-level coefficients exceeded the commonly used .70 threshold, indicating satisfactory internal consistency (Cronbach, 1951; Taber, 2018). However, alpha alone does not demonstrate construct validity or establish that the proposed dimensions have the expected factor structure.

Table 2. *Internal consistency of questionnaire dimensions*

Dimension	Cronbach's α	Interpretation
Empathy	.885	Good
Assurance	.875	Good
Tangibility	.854	Good
Reliability	.851	Good
Responsiveness	.859	Good
Student satisfaction	.872	Good
Overall items	.866	Good

Source: SPSS version 26 output, as reported in the original manuscript.

Service Quality Dimensions and Student Satisfaction

All five perceived service quality dimensions were positively correlated with student satisfaction in the pooled sample (Table 3). Tangibility displayed the largest reported association ($r = .631$), followed by assurance ($r = .577$), responsiveness ($r = .572$), empathy ($r = .527$), and reliability ($r = .403$). The source manuscript reports significance at the .01 level for these correlations. These findings are consistent with the relevance of facilities and relational service quality in higher education, but cross-sectional correlations do not establish that improving one dimension will necessarily cause satisfaction to increase (Alamirew, 2024; Rahman et al., 2024).

Table 3. *Pearson correlations among satisfaction and perceived service quality dimensions*

Variable	Satisfaction	Reliability	Tangibility	Assurance	Empathy	Respons.
Student satisfaction	1					
Reliability	.403	1				
Tangibility	.631	.347	1			
Assurance	.577	.440	.612	1		
Empathy	.527	.571	.581	.579	1	
Responsiveness	.572	.298	.649	.617	.528	1

For the aggregate perceived learning environment measure, the relationship with satisfaction was positive at both institutions (Table 4). EDUCE yielded $r = .597$ ($n = 88$) and AAiT $r = .689$ ($n = 148$), both reported as $p < .01$. Although the AAiT sample correlation was numerically higher, this observation alone cannot establish a statistically significant difference between institutional correlations. A direct between-correlation test would be needed to support that claim.

Table 4. *Correlation between the perceived learning environment and satisfaction*

Institution	Respondents (n)	Pearson r	Reported significance
EDUCE	88	.597	$p < .01$
AAiT	148	.689	$p < .01$

Perceptions at Ethiopian Defense University College of Engineering

At EDUCE, the five dimension means ranged from 3.341 to 3.667 on a five-point scale (Table 5). Empathy received the highest rating ($M = 3.667$, $SD = .595$), followed by reliability ($M = 3.536$) and assurance ($M = 3.502$). Tangibility received the lowest mean ($M = 3.341$), while responsiveness showed the greatest dispersion ($SD = .756$). These results indicate comparatively favourable perceived interpersonal support, alongside opportunities to improve equipment and

the consistency of service responses. Scores above the midpoint reflect positive average perceptions; they do not, by themselves, demonstrate that pre-existing expectations were exceeded.

“There was a limitation in the integration of technology in teaching, such as online platforms and multimedia resources. But my overall experience at the university has been positive. The faculty members are supportive, and the learning environment is conducive to academic growth. (student x, May 2, 2024)”

The quoted response combines an appreciation of faculty support with a concern about limited technology integration. Other respondents likewise reported constraints on library and laboratory resources, even while valuing extracurricular opportunities. These contrasting experiences illustrate why the quantitative mean should not be interpreted as evidence that all students encountered uniformly favourable conditions.

“Access to resources like libraries or online materials in the lab classes especially ICT classes is limited. There are inadequate resources and Limited focuses on practical skills and real-world relevance. (Student A, May 2, 2024)”

“I appreciate the variety of extracurricular activities and resources available, which have helped me, develop both academically and personally. (Student K, May 2, 2024)”

Table 5. Descriptive statistics for EDUCE service quality dimensions

Dimension	n	Mean	SD	SE
Reliability	88	3.536	.7105	.0762
Tangibility	88	3.341	.6705	.0719
Assurance	88	3.502	.6547	.0702
Empathy	88	3.667	.5950	.0638
Responsiveness	88	3.471	.7562	.0811

Perceptions at Addis Ababa Institute of Technology

At AAiT, mean scores ranged from 2.739 to 3.306 (Table 6), consistently below the corresponding EDUCE dimension means. Reliability was the highest-rated dimension (M = 3.306), followed by empathy (M = 3.241) and assurance (M = 3.054). Tangibility (M = 2.739) and responsiveness (M = 2.791) fell below the neutral midpoint of 3.00, suggesting dissatisfaction or ambivalence concerning learning resources and timely institutional responses. These are descriptive observations, not dimension-specific hypothesis-test results.

Open-ended responses identified obsolete laboratory equipment, inadequate research resources, unreliable internet service, and inconsistencies in academic support. One respondent described operational limitations in laboratory facilities as follows:

“Lab resources in terms of quality and availability are highly obsolete. Indicatively, Windows XP, an operating system since 2001, is used in the Power Engineering stream and the SCADA model and lab PCs. Scientific devices like oscilloscopes are either damaged or faulty, and thus practical education becomes inefficient and irritating. This does not only hinder knowledge but also minimizes the level of education we get in a subject that we are supposed to put into practice. (Student L, May 8, 2024)”

“Labs are under-equipped. Internet is slow and unreliable. Library has few recent journals. Computer labs have old PCs. Research spaces are shared and crowded. (Student M May 9, 2024)”

The same pattern extended beyond infrastructure to perceived staff responsiveness and student wellbeing. The original qualitative material describes variable faculty response times and limited consideration of student suggestions, alongside some respondents’ concerns about emotional and academic support.

“Although the campus provides a respectable studying atmosphere, more assistance and improved facilities might be provided. While some teachers respond more slowly, others are helpful. The university

also does not take student input into account when making decisions. (Student G, May 8, 2024)”

“Many times, emotional health is neglected, and some teachers seem more concerned with finishing the semester schedule than with whether or not their pupils actually comprehend the subject matter. (Student M May 9, 2024).”

Table 6. Descriptive statistics for AAiT service quality dimensions

Dimension	n	Mean	SD	SE
Reliability	148	3.306	.7259	.0597
Tangibility	148	2.739	.6852	.0563
Assurance	148	3.054	.6507	.0535
Empathy	148	3.241	.6777	.0557
Responsiveness	148	2.791	.7377	.0606

Comparison of Item-Level Perceptions

Across the 12 reported items, EDUCE’s mean scores exceeded AAiT’s means (Table 7). Particularly large gaps appeared in preparation for professional practice (3.45 versus 2.49), consideration of student suggestions (3.40 versus 2.53), and access to visually appealing facilities and modern technology. The lowest AAiT item means concerned access to modern equipment (2.47), preparation for professional practice (2.49), and responsiveness to suggestions (2.53). Item-level inferential tests were not reported, so the observed gaps should be described as descriptive differences rather than statistically significant item-level effects.

Table 7. Item-level perceptions of the learning environment at AAiT and EDUCE

Dimension	Survey item	AAiT M	EDUCE M	AAiT SD	EDUCE SD
Reliability	Faculty members consistently provide support during the learning process	3.51	3.58	.907	.956
Reliability	The institution consistently provides a supportive physical learning environment	3.06	3.36	.920	.996
Tangibility	Modern technology and essential equipment are readily accessible	2.47	3.08	.914	.962
Tangibility	Teaching and learning facilities are visually appealing	2.82	3.45	.822	.772
Tangibility	Support-service materials are visually appealing	2.93	3.47	.809	.857
Assurance	The institution provides suitable physical learning environments	2.73	3.35	.885	.935
Assurance	The institution equips students for professional practice	2.49	3.45	.837	.815
Assurance	The institution treats students fairly and without bias	3.01	3.66	.804	.843
Empathy	The learning environment fosters an inclusive atmosphere	3.34	3.48	Verify*	.909
Empathy	The learning environment accommodates diverse learning needs	2.99	3.68	Verify*	.766
Respons.	The institution provides accessible and responsive support services	3.05	3.56	.909	.828

Dimension	Survey item	AAiT M	EDUCE M	AAiT SD	EDUCE SD
Respons.	The institution considers student suggestions when making improvements	2.53	3.40	.853	.917

Between-Institution Difference in Student Satisfaction

The independent-samples t-test found a difference in reported student satisfaction between EDUCE and AAiT (Table 8). Levene's test did not provide evidence against equal variances ($F = .023$, $p = .881$); accordingly, the equal-variance t-test was reported, $t(234) = 3.764$, $p < .001$. The positive reported mean difference (EDUCE minus AAiT) was 0.36341 ($SE = .09654$), with an approximate 95% confidence interval of $[0.173, 0.554]$ calculated from the reported summary statistics. The associated Cohen's d is approximately 0.51, indicating a moderate standardized difference. These derived estimates should be verified against the underlying data and the authors' designated group ordering.

Table 8. *Independent-samples t-test of overall student satisfaction*

Comparison	Levene F	Levene p	t	df	Two-sided p	Mean difference	SE difference
EDUCE vs. AAiT	.023	.881	3.764	234	< .001	.36341	.09654

Discussion

The findings indicate that perceived service quality and student satisfaction are closely related in both institutional settings. The pooled-sample association was strongest for tangibility, while each institution reported resource-related concerns. The study thus extends the institution-specific evidence discussed by Alamirew (2024) and Rahman et al. (2024) to postgraduate engineering education. Physical facilities may matter especially where laboratory work and technical training are central to learning, although the observational design cannot establish causal mechanisms (Wilson & Cotgrave, 2016).

The descriptive advantage observed for EDUCE across the five dimensions and the significant difference in overall satisfaction suggest that institutional setting merits attention. However, the two groups had different response rates and were recruited through self-selection, limiting generalizability and making selection bias plausible. Without baseline demographic adjustment or additional institutional measures, it would be premature to attribute differences to military versus civilian governance, or to infer that a numerically larger correlation at AAiT indicates greater causal sensitivity to learning conditions.

In practical terms, AAiT should prioritize the availability and maintenance of laboratory equipment, stable internet connectivity, up-to-date learning resources, transparent handling of student suggestions, and preparation for professional practice. EDUCE should sustain its perceived strengths in empathy and academic support while addressing residual problems in equipment access and responsiveness. More systematic feedback channels would help both institutions assess whether improvements translate into student-perceived benefits (Stankovska et al., 2024; Tran et al., 2026).

Several limitations qualify these conclusions. Convenience-based participation, unequal institutional response rates, reliance on self-reported cross-sectional measures, and incomplete reporting of qualitative procedures constrain both inference and transferability. Furthermore, the manuscript does not report validity testing, complete inferential outputs for item comparisons, ethics approval details, or consistent values for every table cell. Future work should apply probability-based or stratified sampling where feasible, verify instrument structure, examine potential covariates, and triangulate student surveys with institutional service records.

Conclusion

Perceived learning environment service quality was positively associated with postgraduate engineering students' satisfaction at both EDUCE and AAiT. Tangibility showed the strongest pooled correlation with satisfaction ($r = .631$), and the overall learning environment was positively correlated with satisfaction within each institution (EDUCE: $r = .597$; AAiT: $r = .689$). EDUCE reported higher descriptive means on the five service quality dimensions and a higher overall satisfaction score in the reported independent-samples comparison ($t(234) = 3.764, p < .001$).

The findings identify practical priorities rather than causal prescriptions. AAiT would benefit particularly from improved laboratory and digital infrastructure and more responsive student services, whereas EDUCE should preserve its strengths in interpersonal support while enhancing physical resources. Institutional leaders can use repeated student feedback and independently verified service indicators to evaluate these improvements. Further research should address sampling limitations and test whether the observed institutional differences persist after accounting for programme and student characteristics.

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