



Research Article

Determination of transportation service quality factors for university campuses: evidence from bus service quality in Yildiz Technical University

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ABSTRACT

Managing service quality is an important element in customer satisfaction and loyalty for any business organization. Even though service quality in public transportation systems has widely been investigated, service quality inside university campuses is overlooked in the literature. To fill this gap, this study aims to determine factors affecting quality of public transportation service for students, staff, and academic personnel inside the university campuses. 30 service quality elements were determined through an in-depth literature review, accompanied by a focus group discussion. A questionnaire survey was designed, and 472 secured responses were attained from public transportation users in Yildiz Technical University Davutpasa Campus (YTUDC). Then, collected data were analysed by adopting both SERVQUAL and SERVPERF approaches. According to the results of exploratory factor analysis, seven factors were determined as; responsiveness, courtesy, punctuality (service), information accessibility, tangibles, occupancy, and security. Independent sample t-test was also conducted to explore perception differences between female and male users. The results indicate that female respondents have experienced better performance related to appearance of the bus drivers, while male users have experienced better performance related to passenger safety in the bus. The findings can be regarded as a tool to develop a policy promoting sustainable public transportation service in university campuses.

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INTRODUCTION

Managing service quality is an important element of almost every service industry, such as health sector, social

security, education, advertising agencies, market research companies, electronic commerce, retailing, banking, and many others [1]–[6]. Evidence suggest that there is a strong

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relationship between service quality, and customer satisfaction in terms of loyalty [7]. Thus, companies should provide a good service for their customers and evaluate the service provided [8].

A service can be defined as a process with a series of intangible activities that occur due to the interaction between the customer and service provider [7]. Thus, it should be ready to interact with the customers through its best conditions to solve customer problems. However, the feedback is usually different, due to various expectations of the customers and provisions of service providers [9]. Therefore, service quality can be considered as a crucial determinant of competitiveness [10]. There is a vast diversity of studies related to service quality in terms of modelling and measurement [11]. In order to standardize service quality, two major methods were introduced in the literature; SERVQUAL by Parasuraman et al. [12] and SERVPERF by Cronin and Taylor [13]. By adopting either SERVQUAL or SERVPERF approaches, various researchers investigated factors affecting service quality in different sectors [14]–[17]. However, service quality inside the campuses has not been investigated deeply.

The importance of measuring service quality in a school campus is as important as other transportation systems. Norzalwi and Ismail [18] imitated school campuses as “small cities” since they have their own communities and typical daily activities such as studying and working. They also addressed that the campus administrators and planners should have an appropriate plan to manage effective transportation behavior based on the campus population. Another important study was performed by Bond and Steiner [19] in the campus of the University of Florida. They indicated that parking defaces the campus landscape and occupies a valuable space which could be devoted to laboratories and classrooms, highlighting the necessity of attracting people to the public transportation in the school campuses. In addition, Norgate et al. [20] and Litman [21] addressed that public transportation could affect the mental health of people. In the light of these, service quality measurement carries great value in university campuses with respect to well-beings of the occupants.

This study aims to investigate service quality factors in public transportation in the main campus of Yildiz Technical University in Esenler, Istanbul. There are two transit lines providing access inside the campus. One of them is 41AT bus service provided by Istanbul Municipality and the other one is school shuttle bus service provided by a private company. In this study, only quality components of 41AT bus service were investigated by using exploratory factor analysis. The data from 472 respondents who are the users of 41AT was collected and the results of SERVQUAL and SERVPERF approaches were compared. In order to examine perception differences, independent sample t-test was also used. The findings of this research are expected

to assist decision entities in public transportation dealing with improvements of service quality in university campuses.

LITERATURE REVIEW

There are many studies in the literature investigating service quality, customer loyalty and customer satisfaction from various aspects [22]–[25]. The relationship between them is also another important research area. For instance, Sureshchandar et al. [26] investigated the relationship between service quality and customer satisfaction, and found that the two components are independent but closely related. An increase in one component is likely to increase another. Another study was conducted by Minh and Huu [27] to determine the relationship between service quality, customer satisfaction and customer loyalty with respect to retail banking sector in Vietnam and showed that customer satisfaction and service quality are important antecedents of customer loyalty. They also suggested that there are non-linear relationships between service quality, customer satisfaction and customer loyalty.

In order to measure service quality, two major methods which are used substantially for this purpose were suggested in the literature [28]–[31]. The first method is SERVQUAL, which was developed by Parasuraman et al. [12]. This model consists of 22 service quality components and five major dimensions. According to the authors, service quality is a function of expectations and perceptions. Basically, the mathematical explanation of the model can be summarized as the distance between the perceived performance and expectations. Other commonly used method is SERVPERF, which was suggested by Cronin and Taylor [13]. They advocated that the SERVQUAL method was not enough to measure service quality. They developed a new method predicating on SERVQUAL method with the same 22 components. They addressed that the SERVPERF method is just a function of perceptions related to the performance of the service.

More specifically, there are numerous studies in the literature analyzing service quality. Ojo et al. [32] examined students' satisfaction of campus shuttling bus services by using QUALBUS approach and found that reliability is the only parameter having a remarkable relationship with student satisfaction with campus shuttle bus service. Kheng et al. [33] examined the impact of service quality on customer loyalty in bank industry by adopting SERVQUAL method. They found that reliability, empathy, and assurance played significant role in customer loyalty. Another pursuant example can be given from the study of Cunningham et al. [34]. They investigated service quality and risks in air transportation. It was a cross-cultural study (Korean and U.S. citizens attended), which demonstrated the wide range of service quality using SERVPERF method

to measure service quality. They found that SERVPERF method is applicable in cross-cultural studies. Awasthi et al. [35] examined transportation service quality by using a hybrid approach with both SERVQUAL and fuzzy TOPSIS, demonstrated on metro transportation service of Montreal. The strength of their approach was to perform evaluation of service quality in transportation systems under lack of information.

Ingaldi [30] used SERVPERF method to measure service quality in a transportation company and showed that the services of the investigated company met customers' expectations about 65%. Yao and Ding [6] adopted SERVPERF approach to measure passengers' perceptions of taxi service. They found that assurance and reliability were the most crucial aspects of service quality in terms of performance and importance, respectively. Another SERVPERF study was conducted by Koçoğlu and Aksoy [36] for bus companies. They found that there is no relationship between gender, education level and income level with customer satisfaction. Randheer et al. [37] investigated the measurement of commuters' perception on service quality by adopting SERVQUAL method in public transportation. They concluded that the service quality delivery meets the perception of commuters. Barabino et al. [29] used a modified SERVQUAL method for the measurement of service quality in urban bus transport and found a high level of importance on attributes such as frequency, cleanliness, bus reliability, and on-board security. Also, cleanliness, frequency, and reliability were characterized by the widest negative gaps between perceptions and expectations. A comparative study was conducted by Bülbül and Demirer [9] to compare SERVPERF and SERVQUAL in banking sector. Their results showed that both methods are statistically valid and reliable. However, SERVPERF was better than SERVQUAL in explaining the dimensions of

service quality. They also asserted that SERVPERF is not a single dimensional model, it has five dimensions similar to SERVQUAL. Summary of pertinent literature about service quality is provided in Table 1. All past studies showed that public transportation in university campus has been rarely investigated in the literature.

METHODOLOGY

This study was performed to identify critical service quality factors in public transportation in university campuses. Yildiz Technical University Davutpasa Campus (YTUDC) was selected as a case study to investigate both expectations and perceptions of the students and personnel. Questionnaire survey was formed based on literature review, and then final arrangement of the service quality components were listed through a focus group discussion. Required sample sized was computed through a sample size formula proposed by Yamane [39]. A total number of 472 responses were collected. Questionnaire survey was formed consisting of two main sections. In the first section, demographic characteristics of the respondents were sought. This is of paramount significance to examine perception differences. In the second section, respondents were asked to evaluate service quality of public transportation they used inside the YTUDC based on 1–5 Likert scale with respect to perceptions and expectations. Both the SERVPERF and SERVQUAL methods were used to measure service quality as a comparative approach. Then, required reliability tests were performed for further analyses. At the end, exploratory factor analysis was performed to ascertain factors affecting service quality in YTUDC. In addition, independent sample t-test was also conducted to examine perception differences of female and male respondents. Abovementioned steps adopted in this study are illustrated in Figure 1.

Table 1. Summary of the studies investigating service quality

Reference	Study Area	Method used to measure service quality
Bülbül and Demirer [9]	Banking industry	SERVPERF and SERVQUAL
Kheng et al. [33]	Banking industry	SERVQUAL
Randheer et al. [37]	Public transport	SERVQUAL
Yao and Ding [6]	Taxi	SERVPERF
Barabino et al. [29]	Urban bus transport	SERVQUAL
Koçoğlu and Aksoy [36]	Bus companies	SERVPERF
Ojo et al. [32]	Campus shuttling bus services	QUALBUS
Ingaldi [30]	Transportation company	SERVPERF
Leninkumar [31]	Banking Industry	SERVQUAL
Silva et al. [15]	Higher education institutions	HEDPERF
Akdere et al. [14]	Hospital	SERVPERF
Carvalho and Medeiros [38]	Air transportation	SERVPERF vs SERVQUAL

Service Quality Components in Transportation

As an initial stage of this study, a comprehensive literature review has been conducted to identify service quality components in transportation, which formed the first structure of the questionnaire survey. Service quality components in transportation, which are determined through

literature review, are provided in Table 2 with corresponding references from pertinent literature.

Focus Group Discussion

Despite literature review can provide a valuable output in terms of service quality components in transportation,

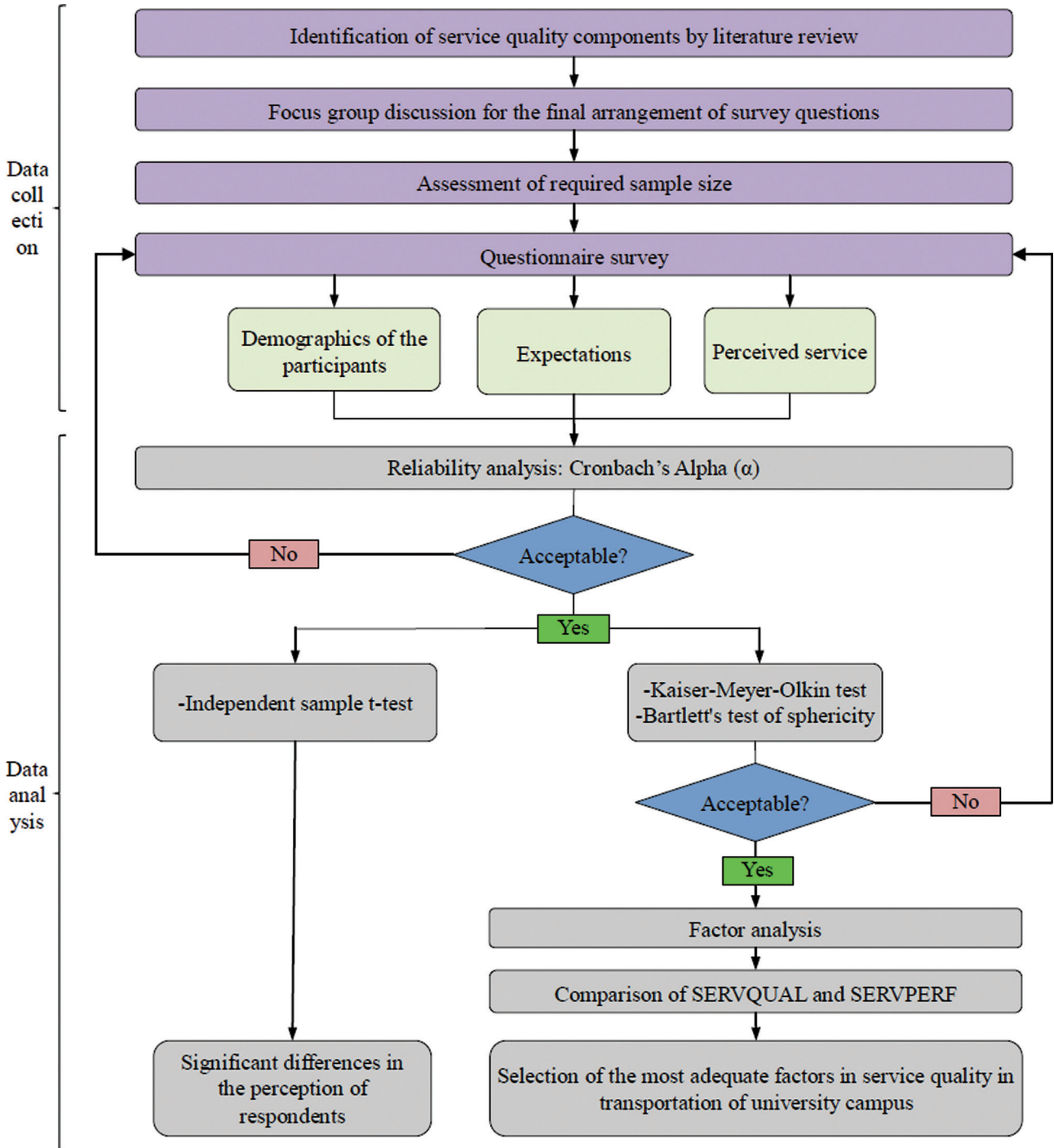


Figure 1. Research flow.

Table 2. Service quality components and their resources

ID	Components	[12]	[40]	[37]	[35]	[29]	[36]	[32]
C1	Interior temperature of the bus	✓	✓		✓	✓	✓	
C2	Waiting conditions in the bus stops	✓	✓	✓	✓	✓	✓	
C3	Appearance of the bus drivers (clean, standard etc.)	✓		✓	✓		✓	✓
C4	Interior hygiene of the bus	✓	✓	✓	✓	✓	✓	
C5	Passenger capacity of the bus	✓	✓			✓		✓
C6	Waiting time of the bus	✓	✓	✓	✓	✓	✓	✓
C7	Punctuality of the bus	✓	✓	✓	✓	✓	✓	✓
C8	In-vehicle waiting time on the first stop before the bus departure		✓	✓	✓		✓	
C9	Bus stops at all stations	✓	✓			✓		
C10	Operator's capacity to respond to cancellations	✓	✓	✓	✓		✓	✓
C11	Comprehensibility of the schedule				✓	✓		✓
C12	Access to tariff information at stops	✓	✓			✓		✓
C13	Sufficiency of bus announcements							✓
C14	Driver response in emergency situations	✓	✓	✓	✓		✓	✓
C15	Access to tariff information with mobile application				✓			✓
C16	Attitude and behaviour of drivers	✓	✓	✓	✓	✓	✓	✓
C17	Passenger safety in the bus (robbery etc.)	✓	✓	✓	✓	✓		
C18	Passenger safety at stops	✓	✓	✓	✓			
C19	Driving ability of drivers	✓		✓	✓	✓	✓	✓
C20	Travel safety in traffic (in terms of speed)	✓	✓	✓	✓	✓	✓	✓
C21	Drivers waiting for passengers' boarding	✓	✓	✓	✓	✓		✓
C22	Number of expeditions during peak hours							
C23	Density at stops during peak hours							
C24	Number of expeditions during off-hours (i.e. between 18.00–08.00, and weekends)							
C25	Off-stop boarding in bad weather conditions							
C26	Access to on-campus card refill points					✓	✓	✓
C27	On-campus fare	✓	✓		✓		✓	
C28	Access to operators in case of complaints	✓	✓	✓	✓		✓	✓
C29	Distance between bus stops and faculty buildings	✓				✓		✓
C30	Effect of bus occupancy on boarding	✓	✓			✓		

still a final arrangement is required since this study examines the quality of bus service in the university campus. Therefore, a focus group discussion (FGD) was performed to finesse predetermined components. This approach was selected since consultation with experts is commonly used technique to form questionnaire surveys [41].

The FGD is an exploratory approach based on collection opinions of a group of experts from various firms who are investigating the same subject from different points of view [42]. In this approach, interactions between focus group participants could provide better outputs compared to one-to-one interviews [43]. This approach has widely been used for qualitative research from different disciplines [44]. Ajayi

and Oyedele [45], addressed that experts with 5 to 25 year experience are required to perform FGD. In this study, judgment sampling technique was used to select focus group participants [43]. Therefore, the background and role of each expert were carefully investigated [46]. A total number of 6 experts accepted to contribute to this study out of 10. FGD was performed with experts from transportation departments, and universities. The discussion lasted nearly three hours. The profile of the participants is shown in Table 3.

Study Area

The study area was determined as Davutpaşa Campus, which is the main campus of Yildiz Technical University.

Currently, there are 10 bus stops in the campus to maintain access between facilities. (Figure 2). The population of the school is 27,390 including students, academics and staff. 45% and 55% of the students were female and male, respectively. The distribution of the respondents in terms of their role is provided in Figure 3.

Data Collection

As the first step of data collection, the required sample size needs to be determined. Sample size determination can be regarded as one of the most important phases of data collection since the sample should represent the whole campus. One of the well-known sample size formula was used in this study as follows [39]:

$$n = \frac{N}{1 + N(e)^2} \tag{1}$$

where n is the sample size, N is the population size, and e is the level of precision. By considering total population of 27,390, and setting e equals to 0.05 as a common approach [48], the required sample was calculated as 394. Since different demographics could impact on the total population,

the rate of demographics was also considered in data collection phase.

After determining required sample size, questionnaire survey was formed consisting of two main sections. In the first section, demographic characteristics of the respondents were sought. In the second section, respondents were asked to evaluate service quality of public transportation they used insideYTUDC based on 1–5 Likert scale with respect to i) expectations, and ii) perceptions. At the end, a total number of 472 responses were collected through face-to-face interviews. The profile of the respondents is summarized in Table 4.

Reliability Analysis

One of the major concerns related to the obtained data is the reliability of it. Therefore, prior to further analysis, reliability of the collected data needs to be ensured. Cronbach's Alpha analysis is one of the most widely used reliability test to measure internal consistency of the components [49]. The values Cronbach's alpha varies from 0 to 1, such that closer the value to 1, higher the internal consistency of the components. The threshold value of Cronbach's Alpha is often considered as 0.7.

Table 3. Profile of focus group participants

ID	Role	Proficiency	Organization	Experience (year)	Experience in transportation (year)
E1	Asst. Prof. Dr.	Civil engineer	University	14	14
E2	Res. Asst.	Civil engineer	University	6	2
E3	Owner	Civil engineer	Transportation consultant	15	8
E4	Manager	Civil engineer	Directorate of highways	17	11
E5	Manager	Architect	Private company	12	6
E6	Site engineer	Civil engineer	Directorate of highways	8	3



Figure 2. Route and the Stops of the bus service in YTUDC (Adapted from [47]).

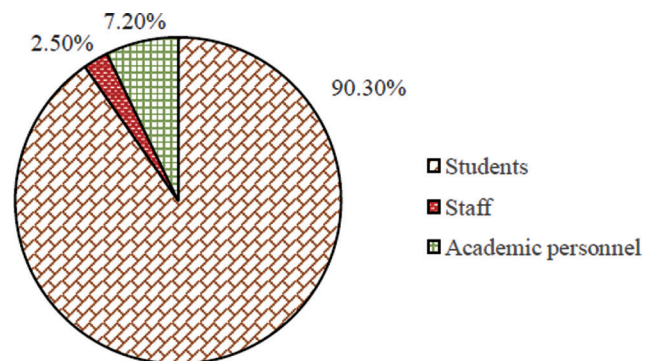


Figure 3. Distribution of the population.

Table 4. Profile of respondents

Category	Characteristic	Count	Percent (%)
Gender	Female	245	51.9
	Male	227	48.1
Role	Student	433	91.7
	Staff	9	1.9
	Academic personnel	30	6.4
Building	Faculty of Education	60	12.7
	Electric-Electronic Faculty	66	14.0
	Faculty of Arts and Sciences	80	16.9
	Economics and Administrative Sciences	47	10.0
	Faculty of Civil Engineering	60	12.7
	Faculty of Metallurgy and Chemistry	75	15.9
	Faculty of Art and Design	30	6.4
	School of Foreign Languages	39	8.3
	Other	15	3.2
	Age	17–19	83
20–21		200	42.4
22–24		141	29.9
25 and more		48	10.2

In this study, the reliability analyses were performed for responses related to expectations and perceptions of the bus service users. Cronbach's Alpha values were calculated as 0.956 and 0.907, for expectations and perceptions, respectively. Therefore, the data obtained from respondents can be considered consistent, and used for further analyses.

Perceptions and Expectations

The results of the survey with respect to SERVPERF and SERVQUAL approaches are provided in Table 5. The results indicate that the number of expeditions during peak hours (C22), and access to on-campus card refill points (C26) are the weakest service elements in the campus by considering both SERVPERF and SERVQUAL approaches.

Factor Analysis

This study adopted exploratory factor analysis technique since it is a widely used method in transportation service quality measurement. Factor analysis was performed to differentiate the components of a structure so that the variables that are related to each other can be categorized. Therefore, complex structures can be simplified through factor analysis method [50].

Statistical Package for the Social Sciences (SPSS 17) software was used in this study to conduct factor analysis.

It should be noted that both SERVQUAL and SERVPERF approaches were adopted and extracted factors were discussed with focus group experts. According to the comments of focus group participants, SERVPERF methodology was found to be more powerful in factor analysis. Therefore, in further explanation, the results of SERVPERF approach, which is based on perception only, are considered. There are mainly five steps in exploratory factor analysis [51], [52].

Step 1. Suitability: Data set was tested to determine whether it is appropriate to perform factor analysis. According to Hair et al. [53], the size of the data should be higher than 100 to perform factor analysis. In addition, before performing factor analysis, Kaiser-Meyer-Olkin (KMO) and Barlett's test of sphericity should be performed to ensure the suitability of data set. These two tests indicate the strength of the relationship among variables used in the structure [51]. According to the results of KMO test, KMO value was calculated as 0.904. Barlett's test of sphericity resulted in p value equals to 0.000. Hair et al. [53] addressed that the minimum value of KMO is 0.5, while p value should be lower than 0.05. Therefore, the results indicate that the data is adequate to perform factor analysis.

Step 2. Factor extraction: The second step in factor analysis is to determine how the factors are extracted. In general, there are seven different extraction methods in SPSS software as principal components, unweighted least squares, generalized least squares, maximum likelihood, principal axis factoring, alpha factoring, and image factoring. However, principal component analysis method was chosen in this study since reliable outputs can be attained when a model has not been developed before conducting the analysis [54]. In addition, this method is one of the most widely used extraction methods [51].

Step 3. Criteria for factor extraction: After extraction method has been determined, the criteria required to extract factors should be determined. The Kaiser's criteria (eigenvalue >1) was used in this study to assist factor extraction [53]. Therefore, whenever the eigenvalue becomes lower than 1, the factor extraction ends.

Step 4. Selection of rotational method: In SPSS software, there are five different rotation methods which are Varimax, Direct Oblimin, Quartimax, Equamax, and Promax. The literature has been reviewed and it was found that Varimax method is one of the most widely used approaches considered as a rotational method [52].

Step 5. Interpretation and modelling: Interpretation is the last step of factor analysis. It involves the researcher investigating which variables are attributable to a factor, and providing that factor a name or theme [51]. In this process three variables were found to be inappropriately loaded. C14, C27, and C28 variables were eliminated sequentially, and in each phase new factors were examined.

Table 5. The results of SERVQUAL and SERVPERF

ID	Variables	SERVQUAL	Rank	SERVPERF	Rank
C1	Interior temperature of the bus	-0.881	4	3.121	14
C2	Waiting conditions in the bus stops	-1.617	22	2.487	25
C3	Appearance of the bus drivers (clean, standard etc.)	-0.309	1	3.557	3
C4	Interior hygiene of the bus	-1.244	16	3.076	16
C5	Passenger capacity of the bus	-1.614	21	2.604	21
C6	Waiting time of the bus	-1.981	28	2.286	28
C7	Punctuality of the bus	-1.581	20	2.794	20
C8	In-vehicle waiting time on the first stop before the bus departure	-1.114	13	3.108	15
C9	Bus stops at all stations	-0.597	2	3.816	1
C10	Operator's capacity to respond to cancellations	-1.002	8	3.203	13
C11	Comprehensibility of the schedule	-0.913	6	3.530	4
C12	Access to tariff information at stops	-1.485	19	2.909	19
C13	Sufficiency of bus announcements	-1.333	17	3.000	17
C14	Driver response in emergency situations	-0.949	7	3.256	11
C15	Access to tariff information with mobile application	-1.036	11	3.407	8
C16	Attitude and behaviour of drivers	-1.419	18	2.989	18
C17	Passenger safety in the bus (robbery etc.)	-1.025	10	3.299	9
C18	Passenger safety at stops	-1.163	14	3.208	12
C19	Driving ability of drivers	-1.068	12	3.413	7
C20	Travel safety in traffic (in terms of speed)	-1.167	15	3.297	10
C21	Drivers waiting for passengers' boarding	-1.013	9	3.472	6
C22	Number of expeditions during peak hours	-2.280	30	2.244	29
C23	Density at stops during peak hours	-1.742	25	2.566	23
C24	Number of expeditions during off-hours (i.e. between 18.00–08.00, and weekends)	-1.650	23	2.574	22
C25	Off-stop boarding in bad weather conditions	-1.758	26	2.441	26
C26	Access to on-campus card refill points	-2.271	29	2.127	30
C27	On-campus fare	-0.883	5	3.604	2
C28	Access to operators in case of complaints	-1.672	24	2.557	24
C29	Distance between bus stops and faculty buildings	-0.862	3	3.525	5
C30	Effect of bus occupancy on boarding	-1.956	27	2.352	27

Table 6. Eigenvalues and total variances explained

Number of factors	Eigenvalues	% of variance	Cumulative %
1	7.550	27.96	27.96
2	1.967	7.287	35.25
3	1.494	5.533	40.78
4	1.332	4.932	45.71
5	1.102	4.081	49.8
6	1.074	3.978	53.77
7	1.014	3.757	57.53
8	0.881	-	-
9	0.855	-	-
10	0.822	-	-

At the end, seven factors explained 57.53% of the total variance, as shown in Table 6. Seven determined factors were named as responsiveness, courtesy, punctuality (service), information accessibility, tangibles, occupancy, and security. Variables related factor loadings are provided in Table 7.

Perception Differences

Respondents provided responses about the variables affecting service quality in bus services inside YTUDC. In order to investigate whether there is a perception difference between respondents' opinions, independent sample t-test was performed to observe if there is significant difference based on the gender. The level of significance was set at $\rho = 0.05$ since it indicates perception differences at 0.05 level

Table 7. Factor loadings of rotated component matrix

Factors	ID	Variables	Components							
			1	2	3	4	5	6	7	
Responsiveness	C24	Number of expeditions during off-hours (i.e. between 18.00–08.00, and weekends)	0.694							
	C22	Number of expeditions during peak hours	0.599							
	C25	Off-stop boarding in bad weather conditions	0.574							
	C26	Access to on-campus card refill points	0.543							
	C29	Distance between bus stops and faculty buildings	0.452							
Courtesy	C20	Travel safety in traffic (in terms of speed)		0.714						
	C19	Driving ability of drivers		0.694						
	C16	Attitude and behaviour of drivers		0.589						
	C21	Drivers waiting for passengers' boarding		0.564						
Punctuality (service)	C8	In-vehicle waiting time on the first stop before the bus departure			0.661					
	C7	Punctuality of the bus			0.612					
	C9	Bus stops at all stations			0.603					
	C6	Waiting time of the bus			0.479					
Information accessibility	C13	Sufficiency of bus announcements				0.703				
	C12	Access to tariff information at stops				0.653				
	C11	Comprehensibility of the schedule				0.607				
	C15	Access to tariff information with mobile application				0.594				
Tangibles	C4	Interior hygiene of the bus					0.718			
	C3	Appearance of the bus drivers (clean, standard etc.)					0.593			
	C1	Interior temperature of the bus					0.589			
	C10	Operator's capacity to respond to cancellations					0.520			
Occupancy	C30	Effect of bus occupancy on boarding						0.669		
	C23	Density at stops during peak hours						0.662		
	C5	Passenger capacity of the bus						0.536		
Security	C17	Passenger safety in the bus (robbery etc.)							0.722	
	C18	Passenger safety at stops							0.683	
	C2	Waiting conditions in the bus stops							0.456	

[55]. This test is commonly used method to observe perception differences [56]–[58]. Independent sample t-test can be considered when the sample consists of two groups, while ANOVA test is required if the sample have more than two groups. Since gender is selected in this study to investigate perception differences, only independent sample t-test is required. In the test, the null hypothesis (H_0) is that there is no significant difference between the means of female and male respondents. On the other hand, the alternative hypothesis (H_1) is that there is a significant difference between the means of groups [56]. The results of independent sample t-test with respect to gender are provided in Table 8. Bolded variables in the table indicates that the mean values are significant at 0.05 level. Note that if mean difference is negative, then it means that the mean

values of responses of female respondents are higher than that of male respondents. Similarly, if the mean difference is positive, then it means that male respondents gave higher points with respect to corresponding variable compared to female respondents, on average.

DISCUSSION

Results of both SERVQUAL and SERVPERF methods were examined after the analysis. It can be seen from Table 5 that C3 (Appearance of the bus drivers), C9 (Bus stops at all stations) and C29 (Distance to stops) were the best components for SERVQUAL method while C3, C9 and C27 (On-campus fare) were the best components for SERVPERF method. According to both methods, students, academics,

Table 8. The results of independent sample t-test

Variables	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
C1	-0.817	470	0.414	-0.080	0.098
C2	1.224	470	0.221	0.131	0.107
C3	-2.392	470	0.017	-0.242	0.101
C4	-1.614	470	0.107	-0.172	0.107
C5	1.566	470	0.118	0.186	0.119
C6	0.560	470	0.576	0.060	0.107
C7	-1.533	470	0.126	-0.181	0.118
C8	-0.415	470	0.678	-0.047	0.113
C9	-0.314	470	0.754	-0.035	0.112
C10	0.210	470	0.834	0.024	0.115
C11	-0.540	470	0.589	-0.061	0.114
C12	-1.990	470	0.047	-0.249	0.125
C13	-2.704	470	0.007	-0.306	0.113
C14	-1.725	470	0.085	-0.180	0.104
C15	-0.523	470	0.601	-0.062	0.119
C16	-1.871	470	0.062	-0.200	0.107
C17	2.324	470	0.021	0.265	0.114
C18	1.782	470	0.075	0.194	0.109
C19	1.397	470	0.163	0.146	0.105
C20	-0.176	470	0.861	-0.020	0.113
C21	1.387	470	0.166	0.151	0.109
C22	1.017	470	0.310	0.108	0.106
C23	-0.646	470	0.518	-0.088	0.137
C24	0.992	470	0.322	0.108	0.108
C25	2.922	470	0.004	0.348	0.119
C26	0.166	470	0.868	0.018	0.109
C27	1.110	470	0.268	0.152	0.137
C28	1.091	470	0.276	0.123	0.113
C29	1.787	470	0.075	0.193	0.108
C30	0.597	470	0.550	0.069	0.116

and staff were satisfied with the appearance of the bus drivers. C9 component indicates that bus stops in the campus were in good condition. In addition, the results imply that passengers were satisfied with the locations of the bus stops (C29). It can be seen from Figure 2 that locations of the stops were well-located. For the SERVPERF, C27 which was the 2nd ranked component, demonstrates that on-campus fare was proper for the passengers. Since school buses are mostly used by students, and travel length is not very long; it is important to provide convenient fare. It can be asserted that the service provider had a good pricing policy about on-campus fare for YTUDC. It is important to determine the best working components of the system, however, identifying and interpreting the worst components of the system can effectively increase the service quality rather than

upgrading the best components. Table 5 indicates that the worst 3 components for both SERVQUAL and SERVPERF methods were C6 (Waiting time of the bus), C22 (Number of expeditions during peak hours) and C26 (Access to on-campus refill points). Passengers were not satisfied with the waiting time for the buses, and the reason for this was probably the daily schedule set by the company. The schedule can be reorganized according to the needs of the passengers to solve this issue. In YTUDC, observations for the occupancy of the bus stops during peak hours are excessive, and the score of the C22 also advocates that. The time between two consecutive buses is approximately 15–20 minutes and constant during the day. Some additional bus services can be added to the peak hours according to the passenger population for certain hours. Another low-ranked component is C26, which is a significant aspect since passengers cannot use the bus without any credits in their cards and unfortunately there were only a few card-refill points in the campus. This could lead passengers to refill their cards out of the campus. University administration can place some additional card refill points with the collaboration of Istanbul Metropolitan Municipality.

After exploratory factor analysis based on SERVPERF method, the findings showed that there were 7 dimensions found in this study as; responsiveness, courtesy, punctuality (service), information accessibility, tangibles, occupancy and security. Parasuraman et al. [12] indicated that there were 5 main dimensions of service quality and, Cronin and Taylor [13] addressed that it was one-dimensional. However, this study showed that the dimensions of the service quality can be more than 5. The reason for this might be related to different and special characteristics of school campuses. For example, Cui et al. [59] found three factors by adopting SERVQUAL method while two factors by adopting SERVPERF method in banking sector out of 22 service quality components. The factors found in this study are similar to the 5 main dimensions of the service quality addressed by different authors, except occupancy and information accessibility. The factor occupancy is based on the passenger density or population in a specific area such as on-boarding density and bus stop density. In addition, information accessibility emphasizes the value of the information. The information should be easily accessible and comprehensible for all passengers, and information pollution must be avoided. Since this is the era of information, it can be a good component to focus on for future research attempts.

Lastly, after executing independent sample t-test, some other valuable findings were attained. Table 8 shows that the mean values of components C3 (Appearance of the bus drivers), C12 (Access to tariff information at stops), C13 (Sufficiency of bus announcements), C17 (Passenger safety in the bus) and C25 (Off-stop boarding in bad weather conditions) were significant at 0.05 level. It can be concluded that female passengers were more pleased than male passengers in terms of appearance of the bus drivers (-0.342).

Female passengers also indicated that access to tariff information at stops was relatively enough compared to male passengers (−0.249). According to female passengers, sufficiency of bus announcements was better compared to male passengers (−0.306). Notwithstanding, male passengers felt themselves safer than female passengers against robbery throughout their school bus experiences (0.265). Also, female passengers felt themselves less comfortable attempting off-stop boarding in bad weather conditions (0.348).

CONCLUSION

The attainment of service quality in transportation is one of the most significant pivotal concerns in public transportation to provide better services to its customers. Most of the transportation organizations evaluate their service quality on a regular basis. Therefore, classification of factors affecting service quality is essential.

In this study, factors affecting quality of public transport service for students, staff and academic personnel in Yildiz Technical University Davutpasa Campus were extracted. In addition, SERVQUAL and SERVPERF approaches were adopted to investigate the weakest elements in the current bus service inside the campus. Perception differences between male and female respondents were also investigated through independent sample t-test. The results highlighted seven factors in the university campuses as; responsiveness, courtesy, punctuality (service), information accessibility, tangibles, occupancy, and security. Number of expeditions during peak hours, and access to on-campus card refill points were found to be the weakest service elements in the campus by adopting both SERVQUAL and SERVPERF approaches. Perception differences were observed in some of the service quality elements based on gender. The results indicate that male respondents have experienced worse performance related to appearance of the bus drivers (clean, standard etc.), access to tariff information at stops, and sufficiency of bus announcements compared to females. By contrast, female users have experienced worse performance related to passenger safety in the bus (i.e. robbery) compared to males.

The strength of this study is to compare the results of SERVPERF and SERVQUAL approaches, and then to select the one that ensures better factor loadings. In addition, perception differences between male and female users provide decision makers with valuable information. The findings can be regarded as a tool to develop a policy promoting sustainable public transportation service in Yildiz Technical University Davutpasa Campus, as well as other university campuses.

DECLARATION OF ETHICAL STANDARDS

The author(s) of this article declare that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

AUTHORSHIP CONTRIBUTIONS

Concept: K.K and H.A.K; Design: K.K and H.A.K; Materials: K.K and H.A.K; Data: K.K and H.A.K; Analysis: K.K; Literature search: H.A.K; Writing: K.K and H.A.K; Critical revision: K.K and H.A.K.

DATA AVAILABILITY STATEMENT

No new data were created in this study. The published publication includes all graphics collected or developed during the study.

CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ETHICS

There are no ethical issues with the publication of this manuscript.

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