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Factors Affecting the Improvement of Service Quality at Universities of Technology: The Case of South Africa

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Abstract: Several research studies have been conducted on the evaluation of service quality at conventional universities. However, this study focuses on universities of technology which are fast growing value-based educational institutions in South Africa. The uniqueness of this study highlights the issues that can affect the improvement of service at universities of technology. Three factors namely: Organizational issues, Educational issues and Staff &Student issues were extracted as the main foci in the improvement of service at universities of technology. A mixed method methodology and an action research approach were employed in this study. The results obtained using factor analysis provides a basis for driving an equation system for evaluating the impact of the issues with respect to the factors named above. The results also show that some extraneous factors that are external to service delivery, have a substantial effect on the quality of service at universities of technology.

Keywords: *Service quality, customer service, factor analysis, universities of technology, South Africa*

1. Introduction

Academic literature is replete with information on service quality and measurement of service quality in higher education. In addition, the application of SERVQUAL as a measuring tool has been used extensively in determining the gap between perceptions and expectations of service quality in various contexts (Sultan and Wong, 2013). However, there still remains a keen interest for universities in rendering quality service and attracting and maintaining students (Shaari, 2014; Kim-Soon, Rahman & Ahmed, 2014).Donaldson and McNicholas (2004) assert than when students are required to make an uncertain and high-risk decision in choosing a university, the student considers evidence of service quality. This assertion highlights the importance of service quality in a university context. Service quality of a university is generally evaluated by using student perception (Sumaedi, Bakti & Metasari, 2012). The basis for this argument is that students are considered the main customers of universities (ISO, 2007; Sakthivel, Rajendran& Raju, 2005). Despite a considerable amount of literature indicating research of service quality undertaken at universities in developed countries, e.g. USA (Ham & Hayduk, 2003; Joseph, Yakhou, & Stone, 2005), United Kingdom (Russel, 2005; Oldfied & Baron, 2000) Canada (Le Blanc and Nguyen, 1997) and Australia (Soutar and McNeil, 1996) there still remains a need to conduct research in a developing country and more specifically at a university of technology. This study focuses on a university of technology in South Africa that has a main campus (Campus X) and a satellite campus (Campus Y).

As a result of changes to the educational landscape of South Africa, universities of technology were introduced during the last decade. In October 2003, the Minister of Education announced that all technikons in South Africa would henceforth be known as universities of technology. A University of Technology (UOT) is defined by du Pré (2009) as: "it is not the use of technology within a university which classifies it as a technological university, but rather the interweaving, focus and interrelation between technology and the nature of a university which constitutes a technological university." The mission of a UOT addresses the scholarship of technology from a viewpoint of diverse fields of study, as opposed to a precise field of study. Institutions of higher education regard meeting students' expectations and needs as pivotal to their success and this is no exception to UOTs. To remain competitive, as pointed out by Boyd, Walker & Larreche (1998), a market pioneer has to perform research on the strategic thrust areas, and at a UOT, service quality is a thrust area, hence the importance of the study. This paper shows the factor analysis of issues that can affect the improvement of service at universities of technology. The paper is arranged as follows. The next section

provides the problem statement with the aim and objectives of the study followed by a review of current literature. This is followed by the methodology and analysis in which descriptive statistics and factor analysis are presented. The final part of the paper provides a conclusion, recommendations, limitations of the study and directions for future research.

Problem Statement: Kayastha (2011) advocates that every university needs to comprehend its internal strength and weakness, and external opportunities and threats. Students enter universities with certain expectations of service quality. If these expectations are not satisfied then students will consider other universities as the whole world operates as a solitary market and universities compete for fee paying students entering the market. As asserted by Berry (1995), service is one of the distinct factors enhancing value, which can positively influence the success of a university. Over the past decade, academic literature has demonstrated how tertiary institutions have concentrated particularly on service quality as a vehicle to attract and retain students. However, the challenge remains as to which factors of service quality should managers of tertiary institutions consider and implement. To this end, this study attempts to:

Main aim: Investigate factors that influence the improvement of service quality at a university of technology.

Research Objectives: Using factor analysis to determine influential factors considered for the improvement of service quality at a university of technology.

2. Literature Review

The theoretical framework underpinning this research is service quality. The concept of service quality has garnered international attention mainly due to difficulty in providing a universally accepted definition and measurement. Academic literature indicates a variety of different definitions of service quality. However, a common definition of service quality is the degree to which a service meets customers' needs or expectations (Dotchin and Oakland, 1994; Asubonteng, McCleary, and Swan 1996). Service quality can therefore be understood as the difference between customer expectations of service and perceived service. In the event of a greater degree of expectation versus that of performance, then the perceived quality is less than satisfactory and hence customer dissatisfaction occurs (Parasuraman, 2004; Lewis and Mitchell, 1990). Bisschoff and Bisschoff (2001) identified customer service as a strategic thrust to gain and to retain their student numbers due to strong competition in the tertiary education market in South Africa. Potluri and Zeleke (2009) are in support of this belief by stating that service quality is the solution in the operations of higher learning institutions to the drastic changes especially in financial assistance and the negative growth in student numbers. Direct relationships between customer satisfaction and profitability have not yet been determined by conclusive research; however, researchers have indicated that a positive correlation exists between service quality through customer retention and the success of an enterprise (Ibrahim, Wang, Hassan, 2013).

This correlation is influenced by the level of service quality that customers experience. The relationship between customer service, service quality and intentions to enter into business transactions by means of an expectancy model of behaviour is where service performance forms the basis of continued business intentions of customers towards a specific enterprise. The implication of this is that a satisfied customer is the source of all profits. In the context of a university, a satisfied student becomes active in the so-called word-of-mouth promotions of the university which prove to be valuable assets to the university. A generic model designed to explain customer satisfaction is the so-called "confirmation/disconfirmation" paradigm (Davis and Heineke, 1998; Woodruff, Clemons, Schumann, Gardial and Bruns, 1991). This model shows that satisfaction or dissatisfaction is determined by the disparity between the customers' expectations (E) of a particular product or service and their perceptions of the actual performance (P) of this product or service. In the event of customers' expectations being met, the result is that of satisfaction. Conversely, if the opposite occurs, the result is dissatisfaction occurs. Customers' satisfaction (S) can therefore be mathematically expressed as:

$$S = E - P$$

In addition to the variables(S, E, and P) noted above, there is a third variable, importance (I) (Szymanski and Henard, 2001; Vavra, 1997; and Matzler and Bailom, 2002 all cited in Kanning & Bergmann, 2009). The relevance of this variable is based on the assumption that not all attributes are justifiably important to

customers, for example, a student at university would rate academic success as being of greater importance to satisfaction as opposed to friendliness and approachability of staff. If the variable of importance is included to the model then mathematically it would be expressed as:

$$S = (E - P) \times I$$

The two models explicated above are deemed credible, however, according to Kanning and Bergmann (2009:378), both present conceptual problems.

Parasuraman et al. (1985) advocate that the SERVQUAL model which was founded on the GAPS model was designed to measure service quality as perceived by the customer and was developed as a result of insights obtained from interviews with executives and focus groups from selected services. The definitions of the five factors of service quality are:

Tangibles: Appearance of physical facilities, equipment, personnel and communication.
Reliability: Ability to perform the promised service dependably and accurately.
Responsiveness: Willingness to help customers and provide prompt service.
Assurance: Knowledge and courtesy of employees and their ability to convey trust and confidence.
Empathy: Caring, individualised attention the organisation provides its customers.

A study undertaken by du Toit (2004) at a South African university had as a primary objective to investigate student perceptions of service quality at the Rand Afrikaans University (RAU). The SERVQUAL model/instrument, originally developed by Parasuraman, Zeithaml and Berry (1985) was adopted. Du Toit (2004) evaluated the research undertaken in the area of service quality and selected 89 items for inclusion in the questionnaire. From the 89 selected items the following groupings were formed: Academic Services: Degree (programme), Assessment, Lecturers and Outcomes; Academic support services: Library, Computer Laboratories, Learning Centre and the Student Services Bureau; Non-Academic services: Administration, Environment, Social climate and financial aid. The study provided the following results and recommendations:

- Materials used in the promotion of the university correctly explain the degree programme.
- There is valuable feedback provided on assessments
- It was reported that questions, suggestions and objectives during lectures were appropriately handled by academics
- Disagreements regarding examination outcomes were amicable resolved.
- Time was used optimally for the delivery of each course.
- Prompt feedback was provided.
- Materials were consistently ordered in a methodical and understandable manner.
- Academics maintained discipline during lectures and developed the capacity for ingenuity and innovation.
- The learning material provided was useful and there was alignment between theory and practice.
- Lecturers were found to be approachable, helpful and well prepared for lectures.
- Lectures received favourable ratings for punctuality, fluency in the language of instruction and accessibility.
- The staffs within the faculty administration office were easily contactable, friendly and helpful.

3. Research Design

A mixed method methodology and action research was employed in this study. A sampling technique known as purposive convenience sampling was used as participants were selected for the study. The empirical work undertaken in the study involved a total of 50 participants who were senior members of a UOT and experts in the field of quality assurance. Participants were drawn from academic and administrative staff from the university. Workshops were conducted across two campuses of the university. The responses were collected from a questionnaire comprising of pair wise comparison between the factors that constitute the objectives. The responses were confirmed and authenticated by a follow up with some interviews and meetings with the senior members of the university. The study demanded that the participants be allowed to openly express their views and opinions. The aim of the workshops was to determine the factors for the improvement of service quality at universities of technology. The responses were capturedusing the SPSS package (Version 21).

Derivation of issues related to service quality evaluation - A brainstorming technique was utilized by the participants of the workshop to generate ideas on improving quality of service at universities of technology. These ideas were documented using a flip chart approach. The following illustrates the issues raised by the participants of the workshops:

Staff to exercise courtesy and responsive approach towards students.
University requires a contextual evaluation system.
An awareness made by students on the co-production of service delivery. Students to realise that service is co-produced.
Skills' training is required in order to develop effective customer service across the entire university.
The new general education modules at the university should incorporate content on customer service and service delivery.
There are inconsistencies in the rendering of service quality across the university.
There seems to be a lack of ownership in assuring and evaluating service quality holistically.
Chain of command is not well-defined hence staffs feel answerable to many managers.
All evaluation practices and performance management tools should incorporate elements of service quality of the institution as a whole.
Develop and nurture an organisational culture of efficient and effective service.

These issues regarded as factors comprise the pathways through which service quality can be improved and can help to improve service delivery at universities of technology. Ten key issues were categorized into three areas: Organisational factors, Educational factors, and Staff and Student factors. The categorization of the factors is presented in Table 1.

Table 1: Categorization of Identified Factors

No	Factors	Sub-Factors
1	Organizational Factors	SF02: University requires a contextual evaluation system. SF06: There are inconsistencies in the rendering of service quality across the university. SF07: There seems to be a lack of ownership in assuring and evaluating service quality holistically. SF09: All evaluation practices and performance management tools should incorporate elements of service quality of the institution as a whole. SF10: Develop and nurture an organizational culture of efficient and effective service.
2	Educational Factors	SF04: Skills' training is required in order to develop effective customer service across the entire university. SF05: The new general education modules at the university should incorporate content on customer service and service delivery.
3	Staff and Student Factors	SF03: An awareness made by students on the co-production of service delivery. Students to realise that service is co-produced. SF08: Chain of command is not well-defined hence staffs feel answerable to many managers. SF01: Staff to exercise courtesy and responsive approach towards students.

4. Analysis and Results

A seven-point scaling technique was used for gathering data. The scaling technique measures the ratios of intensities of the importance of the factors. The scaling technique has values ranging from 0 -10 depending on the degree of importance where 0 = no importance, 5 = low importance, 6 = moderate importance, 7 = equal

importance, 8 = strong importance, 9 = absolute importance, and 10 = extreme importance. The following statistics were used for the purpose of achieving the above stated goal.

a. Descriptive Statistics
b. Correlation Matrix
c. Factor Analysis
   i. Bartlett's test and Kaiser-Mayer Olkin (KMO)
   ii. Anti-image Correlation Matrix
   iii. Factor Transformation Matrix
   iv. Rotated Factor Matrix (Equamax, Quartimax, Varimaxand Promax)
   v. Commonalities
   vi. Factor scores coefficient matrix
   vii. Eigenvalue and percentage variety of factors

Descriptive Statistics: Descriptive statistics were used for obtaining the mean and standard deviation of the value of each decision variable. The result of the descriptive statistics based upon the comparison scaling technique states that most of the issues or sub-factors are important for the improvement of service quality in universities of technology. For example, the factor 'organizational issues' has five sub-factors, the mean scores of the sub-factors 2, sub-factors 6, sub-factors 7, sub-factors 9 and sub-factors 10 at Campus X and Campus Y are between 6.47and 9.2 suggesting that these sub-factors fall between moderate importance and absolute importance. The standard deviations of these sub-factors are between 0.577 and 1.181. The factor 'educational issues' has two sub-factors, the mean scores of the sub-factors 4 and sub-factors 5 at Campus X and Campus Y are between 6.6 and 8.31 signifying that the sub-factors have strong importance and are equally important to the rest of the sub-factors. The standard deviations of these sub-factors are between 0.617 and 0.828. The factor 'staff & student issues' has three sub-factors, the mean scores of the sub-factors 1, sub-factors 3 and sub-factors 8 at Campus X and Campus Y are between 6.33 and 8.4. The standard deviations of these sub-factors are between 0.704 and 1.113. Detailed descriptive statistics of the data collected are presented in Table 2, which also exhibits the mean and standard deviation of the rating of the impact of the sub-factors for the improvement of service quality at universities by the respondents.

Table 2: Descriptive Statistics

Campus X Mean (Std. Dev.)	Campus Y Mean (Std. Dev.)
SF017.93 (.961)	8.81 (.911)
SF029.20 (.775)	7.94 (1.181)
SF038.40 (.828)	6.69 (.704)
SF047.67 (.617)	8.31 (.704)
SF056.60 (.828)	6.63 (.719)
SF066.47 (1.060)	7.19 (.750)
SF077.87 (.990)	7.50 (1.155)
SF086.33 (1.113)	7.00 (1.033)
SF096.60 (1.056)	7.75 (.577)
SF109.13 (.743)	9.00 (.816)

Correlation Matrix: The correlation matrix presents the strength and direction of the association between two scales or ordinal decision variables. The correlation matrix of the impact indices was generated for Campus X and Campus Y respondents are presented in Table 3 and Table 4 respectively. In Table 3, the analysis of the correlation matrix shows that the highest correlation of 0.574 exists between the Sub-Factor 2 and Sub-Factor 6. The least correlation of -0.77 exists between Sub-Factor 1 and Sub-Factor 2. The implication is that Sub-Factor 2 is very likely to have the same impact as Sub-Factor 6. On the other hand, Sub-Factor 1 is not likely to have the same impact as Sub-Factor 2. This conforms to the grouping of the factors where Sub-Factor 2 and Sub-Factor 6 are grouped under organizational issues while Sub-Factor 1 falls under staff& students' issues.

Table 3: Correlation Matrix for Campus X

	SF01	SF02	SF03	SF04	SF05	SF06	SF07	SF08	SF09	SF10
SF01	1.00	-.077	.215	-.281	.144	.313	-.010	.022	.183	.213
SF02	-.077	1.00	-.022	.299	.022	.574*	-.242	.166	-.507	.447
SF03	.215	-.022	1.00	.140	.042	.260	-.105	.310	-.294	.023
SF04	-.281	.299	.140	1.00	-.419	-.182	.273	-.347	-.110	.104
SF05	.144	.022	.042	-.419	1.00	-.016	-.157	-.078	-.360	-.371
SF06	.313	.574*	.260	-.182	-.016	1.00	-.413	.464	-.332	.550*
SF07	-.010	-.242	-.105	.273	-.157	-.413	1.00	-.670**	.287	-.071
SF08	.022	.166	.310	-.347	-.078	.464	-.670**	1.00	-.243	.202
SF09	.183	-.507	-.294	-.110	-.360	-.332	.287	-.243	1.00	-.291
SF10	.213	.447	.023	.104	-.371	.550*	-.071	.202	-.291	1.00

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 4: Correlation Matrix for Campus Y

	SF01	SF02	SF03	SF04	SF05	SF06	SF07	SF08	SF09	SF10
SF01	1.00	-.074	-.513*	.097	.089	.055	.159	.000	.412	-.090
SF02	-.074	1.00	.055	-.295	.128	.240	.415	-.164	.171	.138
SF03	-.513*	.055	1.00	-.193	.016	-.260	-.041	.092	-.369	.464
SF04	.097	-.295	-.193	1.00	.115	-.245	-.123	.183	.041	-.232
SF05	.089	.128	.016	.115	1.00	.263	.562*	-.539*	.241	.341
SF06	.055	.240	-.260	-.245	.263	1.00	.269	-.430	.115	.109
SF07	.159	.415	-.041	-.123	.562*	.269	1.00	-.056	.100	.000
SF08	.000	-.164	.092	.183	-.539*	-.430	-.056	1.00	.224	-.395
SF09	.412	.171	-.369	.041	.241	.115	.100	.224	1.00	.000
SF10	-.090	.138	.464	-.232	.341	.109	.000	-.395	.000	1.00

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Factor Analysis: Following the work of de Winter, Dodou and Wieringa (2009) who advocate that factor analysis can yield good results for small sample sizes whereby the reasonable absolute minimum number should be a sample size of 50, the sample size used in this study was 50. The factor analysis of principal components was applied for the assessment of the effects of issues for the improvement of service quality.

Table 5: Anti-image Matrices for Campus X

		SF01	SF02	SF03	SF04	SF05	SF06	SF07	SF08	SF09	SF10
Anti-image Correlation	SF01	.327[a]	.085	-.317	.048	-.353	-.191	.033	.113	-.471	-.415
	SF02	.085	.459[a]	.469	-.595	-.304	-.621	-.061	-.208	.158	-.103
	SF03	-.317	.469	.221[a]	-.505	-.106	-.400	-.260	-.439	.318	.242
	SF04	.048	-.595	-.505	.286[a]	.604	.432	.155	.540	.193	.119
	SF05	-.353	-.304	-.106	.604	.244[a]	.177	.172	.434	.615	.565
	SF06	-.191	-.621	-.400	.432	.177	.592[a]	.215	.058	-.034	-.253
	SF07	.033	-.061	-.260	.155	.172	.215	.612[a]	.599	-.069	-.137
	SF08	.113	-.208	-.439	.540	.434	.058	.599	.477[a]	.138	.039
	SF09	-.471	.158	.318	.193	.615	-.034	-.069	.138	.444[a]	.532
	SF10	-.415	-.103	.242	.119	.565	-.253	-.137	.039	.532	.468[a]

a. Measures of Sampling Adequacy(MSA)

The anti-image correlation matrix contains the negatives of the partial correlation coefficients, which is another form of a matrix that describes the linear relationship between two variables while controlling for the effects of one or more additional decision variables. The anti-image correlation matrix generated for Campus X and Campus Y respondents are presented in Table 5 and Table 6 respectively. In Table 5, the analysis of the anti-image correlation matrix shows that Sub-Factor 7 namely 'Lack of ownership in assuring

and evaluating service quality holistically' has the highest measure of sampling accuracy of 0.612 while Table 6 shows that Sub-Factor 10 namely 'Develop and nurture an organizational culture of efficient and effective service' has the highest measure of sampling accuracy of 0.553.

Table 6: Anti-image Matrices for Campus Y

		SSF01	SF02	SF03	SF04	SF05	SF06	SF07	SF08	SF09	SF10
Anti-image Correlation	SSF01	.360[a]	.370	.137	-.204	.360	.255	-.426	.324	-.421	-.142
	SF02	.370	.158[a]	-.390	-.304	.657	.180	-.722	.641	-.659	.053
	SF03	.137	-.390	.272[a]	.453	-.544	.043	.445	-.630	.624	-.552
	SF04	-.204	-.304	.453	.153[a]	-.652	-.029	.572	-.591	.532	.000
	SF05	.360	.657	-.544	-.652	.195[a]	.280	-.896	.892	-.834	.049
	SF06	.255	.180	.043	-.029	.280	.497[a]	-.354	.389	-.301	-.031
	SF07	-.426	-.722	.445	.572	-.896	-.354	.154[a]	-.812	.763	-.010
	SF08	.324	.641	-.630	-.591	.892	.389	-.812	.170[a]	-.861	.284
	SF09	-.421	-.659	.624	.532	-.834	-.301	.763	-.861	.119[a]	-.237
	SF10	-.142	.053	-.552	.000	.049	-.031	-.010	.284	-.237	.553[a]

a. Measures of Sampling Adequacy(MSA)

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy tests whether the partial correlations among variables are small. Bartlett's test of sphericity tests whether the correlation matrix is an identity matrix, which would indicate that the factor model is inappropriate. The Bartlett's test for Campus X respondents produces a χ^2 of 49.127, degree of freedom of 45 and a significance level of 0.0311, while that of Campus Y respondents produces a χ^2 of 51.978, degree of freedom of 45 and a significance level of 0.0221, which shows that the sample population is adequate. High values (close to 1.0) for a measure of sampling accuracy generally indicate that a factor analysis may be useful with your data. If the value is less than 0.50, the results of the factor analysis probably will not be very useful. The KMO test for both Campus X and Campus Y respondents produce a measure of 0.758 and 0.709 respectively, which further confirms that the sample population is adequate.

Table 7: Communalities

	Campus X Extraction	Campus Y Extraction
SF01	.536	.558
SF02	.714	.675
SF03	.136	.708
SF04	.750	.533
SF05	.688	.746
SF06	.788	.430
SF07	.583	.505
SF08	.593	.719
SF09	.779	.481
SF10	.737	.549

Table 8: Initial factor Matrix

	Campus X Factor			Campus Y Factor		
	1	2	3	1	2	3
SF01	.193	-.327	.626	.133	.728	-.102
SF02	.645	.486	-.249	.537	-.070	.618
SF03	.362	-.066	.010	-.050	-.837	.078
SF04	-.149	.833	-.187	-.336	.346	-.548
SF05	.084	-.609	-.556	.753	.078	-.416
SF06	.849	.042	.257	.639	.138	.050
SF07	-.655	.366	.141	.626	.187	.280
SF08	.697	-.311	.100	-.670	.207	.476
SF09	-.621	-.148	.610	.212	.632	.192
SF10	.573	.484	.416	.471	-.518	-.243

In factor analysis, the proportion of the variance of a variable explained by the common sub-factor is called the 'commonality' of the variable. The commonalities shown in Table 7 ranges between 0 and 1, where 0 indicates that the common sub-factor accounts for none of the variance and 1 indicates that all the variance can be accounted for by the common sub-factor. For instance, in Campus X, sub-factor 9 'All evaluation practices and performance management tools should incorporate elements of service quality of the institution as a whole' has the highest commonality value of 0.779 suggesting that 77.9% of the variance can be accounted for by the extracted factor. In contrast, lower commonality values are obtained for variables such as 'Staff to exercise courtesy and responsive approach towards students' (0.536, sub-factor 1), 'There

seems to be a lack of ownership in assuring and evaluating service quality holistically' (0.583, sub-factor 7), 'Chain of command is not well-defined hence staff feel answerable to many managers' (0.593, sub-factor 8). The lowest communality value was produced by sub factor 3 -'An awareness made by students on the co-production of service delivery. Students to realize that service is co-produced' with a value of 0.136. In Campus Y, sub-factor 5 'The new general education modules at the university should incorporate content on customer service and service delivery' has the highest commonality value of 0.746. Lower communality values were produced by variables such as 'Skills' training is required in order to develop effective customer service across the entire university' (0.533, sub-factor 4), 'Develop and nurture an organizational culture of efficient and effective service' (0.549, sub-factor 10). Sub-factor 6 – 'There are inconsistencies in the rendering of service quality across the university' produced the lowest communality value of 0.430. The remaining 46.4% (Campus X – sub factor 1) and 44.2% (Campus Y – sub factor 1) can be attributed to other factors, which are irrelevant to improving service quality. The factor matrix presents the initial factor loading. The degree of generalization found between each variable and each factor is referred to as 'Factor Loading'. The farther a factor loading is from zero in the positive direction, the more one can conclude the contribution of a variable to a factor. The factor matrix can be rotated by *equamax (combination of the varimax and quartimax)*, *quartimax (which simplifies the variables)*, *varimax (which simplifies the factors)*, and *promax (which allows factors to be correlated)* for the purpose of establishing a higher correlation between variables and factors. In order to obtain a meaningful factor loading, the principal component matrixwas tested by rotating the matrix by *equamax, quartimax*, *promax*, and *varimax*. Of all the orthogonal rotation method, Quartimax with Kaiser Normalization produced the best result by converging in the 4th iteration. As a result, Quartimax rotation method is employed for the purpose of this analysis. The factor transformation, rotated factor matrix, and factor score coefficient matrix are presented in Table 9, Table 10 and Table 11 respectively. In Campus X, the factor 1 has the highest correlation of the value 0.979 in the matrix while in Campus Y, factor 2 with factor 1 have the highest correlation of the value 0.988 in the matrix.

Table 9: Factor Transformation Matrix

Campus X				**Campus Y**		
Factor	**1**	**2**	**3**	**1**	**2**	**3**
1	.979	.140	-.147	.156	.805	.572
2	-.201	.778	-.596	.988	-.123	-.097
3	.031	.613	.789	.008	-.580	.815

Table 10: Rotated Factor Matrix

	Campus X Factor			**Campus Y Factor**		
	1	**2**	**3**	**1**	**2**	**3**
SF01	.274	.157	.660	.739	.076	-.078
SF02	.526	.315	-.581	.020	.082	.817
SF03	.368	.006	-.006	-.833	.018	.116
SF04	-.319	.512	-.622	.285	.004	-.672
SF05	.187	-.803	-.089	.192	.838	.084
SF06	.831	.309	.053	.236	.469	.392
SF07	-.710	.279	-.010	.285	.319	.568
SF08	.748	-.083	.161	.103	-.841	-.015
SF09	-.559	.172	.661	.659	-.018	.216
SF10	.477	.712	-.044	-.440	.583	.122

Table 11: Factor Score Coefficient Matrix

	Campus X Factor			**Campus Y Factor**		
	1	**2**	**3**	**1**	**2**	**3**
SF01	.112	.142	.436	.346	.047	-.068
SF02	.156	.123	-.321	.005	-.105	.521
SF03	.127	-.006	.008	-.391	-.003	.077
SF04	-.141	.254	-.356	.136	.121	-.443
SF05	.080	-.482	-.118	.081	.427	-.097
SF06	.282	.167	.085	.104	.175	.171
SF07	-.252	.179	-.005	.128	.063	.313
SF08	.265	-.052	.118	.057	-.444	.142
SF09	-.176	.170	.412	.308	-.055	.142
SF10	.147	.403	.048	-.213	.292	-.024

The factor score coefficient matrix presented in Table 11 can be used to assess the impact of the factors for the improvement of service quality. The assessment can be realized by formulating a linear equation in the form:

$$I_{i,k} = \sum_{i=1}^{10}\sum_{j=1}^{10}\sum_{k=1}^{3} S_{i,j}F_{j,k} \qquad (1)$$

Where $I_{i,k}$ is the impact of ith assessor to k^{th}factor, $F_{j,k}$ is the factor score coefficient of jth decision variable for k^{th} factor, and $S_{i,j}$ is the value of the ith assessor for j^{th} decision variable. In order to evaluate the impact percentage of each factor to the total impact, the eigenvalue of each factor is calculated. The eigenvalue of kth factor (E_k) is the summation of the loading of kth factor on j^{th} decision variable denoted by $x_{i,k}$. The eigenvalue of kth factor can be expressed as follows:

$$E_k = \sum_{j=1}^{10}\sum_{k=1}^{3} x_{j,k} \qquad (2)$$

The eigenvalue is used to indicate the proportion of variance explained by each of the dimensions in the responses. The impact percentage (IP) of each factor is defined by:

$$\text{IP} = 100*\left(\frac{\text{eigenvalue of factor}}{\text{number of decision variable}}\right) \qquad (3)$$

Table 12shows the eigenvalue, impact percentage and cumulative impact percentage of the extracted three factors.

Table 12: Eigenvalues and Percentage Variance

Factor	Campus X Extraction Sums of Squared Loadings			Campus Y Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.505	25.047	25.047	2.963	29.630	29.630
2	2.125	21.252	46.300	1.900	19.002	48.633
3	1.275	12.752	59.052	1.440	14.400	63.033

The impact of the first factor which is described as 'Organizational Issue' is 25.047% out of the 59.052%, which translates to 42.4151% for Campus X and 29.630% out of the 63.033% which translates to47.0071%. The results indicate that the factor does have an impact on the improvement of service quality. The second factor which is described as 'Educational Issues' contributes46.300% out of the 59.052%, which translates to 78.4054% for Campus X and 48.633% out of the 63.033% which translate to77.1548% for Campus Y. The results indicate that the factor has a tremendous impact on the improvement of service quality. Thus the third factor which is described as 'Staff and Students Issues' contributes 59.052% to the overall impact for Campus X and 63.033% to the overall impact for Campus Y. The remaining 40.948% inCampus X and 36.967% in Campus Y are considered to be the impact of some extraneous factors, for example union strikes and infrastructure.

5. Conclusion and recommendations

This paper has illustrated the application of the principal component method of extraction in factor analysis to determine factors considered to influence the improvement of the quality of service at a university. Three factors, namely: Organizational issues, Educational issues, and Staff &Student issues were considered in this study. The results obtained by using *quartimax* orthogonal transformation exhibit the following features:

- The average contribution of Factor 1to the overall impact is 44.7111%.
- The average contribution of Factor 2 to the overall impact is 77.7801%.
- The average contribution of Factor 3 to the overall impact is 61.0425%
- Other factors external to the improvement of service quality have an average contribution of 38.9575%.

The results obtained place a high demand on research related to solving educational issues at the university. Therefore, it could be concluded that Educational issues are a major factor in improving quality of service at universities of technology. This factor, in practice, determines the institution's development, staff and student productivity and mode of service delivery as a whole. It also emphasizes the importance of skills training in order to develop effective and efficient service. Managers and individuals responsible for curriculum

development should definitely consider customer service and service delivery as a cornerstone module in improving the quality of service delivery at institutions of higher learning. This finding is consistent with other research (see Kayastha, 2011) who found that academic aspects are an important variable that positively influences satisfaction levels. The results of this study are in alignment with studies using comparable techniques. Similar studies using a large sample with the more intense criteria models would be useful in order to corroborate this study's findings and to address the limitation of the small sample size and the sample frame of one university.

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