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Education: a comparative structural equation modeling study

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Abstract

The increase in competition and intensifying market forces encouraged universities to sustain quality improvement in Higher Education Institutions. The aim of this paper is to introduce a conceptual model of student satisfaction with higher education experience based on the identification of the variable determinants of student perceived quality and the impact of those variables on student satisfaction and/or dissatisfaction with the overall student experience. This study concerns students in higher education institutions in İstanbul Turkey. This paper uses 41 item instrument of service quality which is applicable for TQM in education industry taking the SERVQUAL five dimensions for quality as basis. Exploratory and confirmatory factor analyses empirically verified and validated the underlying dimensions of perception of student satisfaction, TQM and organizational performance. Structural equation modeling was used to estimate the models and compare coefficients and latent means. In other words structural equation modeling was employed to test the model drawing on a sample of 1752 students from private universities. Decision makers will be able to use this instrument to identify the extent of TQM implementation in higher education institutions, while researchers will be able to use it for furthering TQM research in education. The results can be used by higher education institutions to renovate their quality-management processes and education quality strategies.

Keywords: Higher education institutions, Servqual, TQM, EFA, CFA, SEM

1. Introduction

The purpose of this paper is to introduce a conceptual model of student satisfaction with the higher education (HE) experience, based on the identification of the variable determinants of student perceived quality and the impact of those variables on student satisfaction and/or dissatisfaction with the overall student experience.

Higher education institutions (HEIs), particularly universities, hold a unique position in society, as they have the potential to promote and encourage societal response to sustainability challenges facing communities around the world through interactions of thousands of individuals on campus and outreach to millions (Stephens et al., 2008).

Higher education institutions (HEIs) are important components of the economy as they produce both human capital and new knowledge (Johnes, 2006). Johnes (2006) stated that the recent availability of student level data for HEIs has allowed more in-depth study of the determinants of student achievement. Studies which have used student data have demonstrated that a number of HEI- and student-related characteristics affect a students achievement level, and have confirmed the result from early aggregate level studies that rankings of universities

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constructed from raw output measures differ from those derived from measures which take into account the quality and background of students (Bratti, 2002; Naylor et al., 2000; Smith and Naylor, 2001a,b).

Even though there are several models available to measure the service quality for HEIs, it is seen from the literature review that no exact model has been developed so far to measure the service quality of higher educational service from the perception of students. Many researchers used the adapted version of SERVQUAL to evaluate students' course experience within a business school as part of the quality assurance system (Rigotti and Pitt, 1992; McElwee and Redeman, 1993; Hill, 1995; Cuthbert, 1996; Oldfield and Baron, 2000). Ho and Wearn (1996) incorporated SERVQUAL into HETQMEX, a higher education TQM excellence model. It can be indicated that many researchers are undertaking customization of established service quality dimensions in higher education in their measurement instruments.

These studies show that quality systems can be successfully applied in HEIs, that TQM has not been extensively applied in universities, and that one of the ways of developing a quality system is by using self-assessment. Thus, self-assessment is being applied in many universities as a method to identify areas for improvement. Organizations may resort to different approaches to self-assessment: questionnaire, workshop, proforma and award simulation (EFQM, 2003). The most common ones usually fall into three main categories: award applications, questionnaires and workshops (Ritchie and Dale, 2000).

Douglas et al, (2008), stated that measuring student satisfaction with their experience in HE is now commonplace.

The paper of Firdaus (2005), used a 41-item instrument which was empirically tested using both exploratory and confirmatory factor analysis. Therefore the paper compared different measures of the service quality construct within a single, empirical study utilizing customers of a single industry namely higher education. (Firdaus, 2005).

Other studies measure service quality by replicating or adapting Parasuraman et al. (1988) five-dimension (tangibles, reliability, responsiveness, assurance and empathy) SERVQUAL model. Brochado (2009) compares the main alternative instruments to measure service quality in higher education: SERVQUAL (Parasuraman et al., 1988), (SERVPERF) (Cronin and Taylor, 1992), weighted SERVQUAL (Parasuraman et al., 1991), weighted SERVPERF (Cronin and Taylor, 1992) and (HEdPERF) scale (Firdaus, 2006), concluded that SERVPERF and HEdPERF present the best measurement capability, but it is not possible to identify which one is the best.

2. Research Methodology

2.1. Survey Instrument

The questionnaire was developed based on students' choice criteria and student satisfaction topics, the customer evaluation questionnaire on lecturers and the customer satisfaction questionnaire used by the HEI chosen as the case study, as well as the quality attributes found by Smith and Ennew (2001), and those proposed by Joseph and Joseph (1998). The instrument constructed from the conceptual framework, and developed mainly based on the quality attributes found in Smith and Ennew (2001) and those proposed by Joseph and Joseph (1998), is also appropriate in determining the quality factors and measuring students' perceptions of service quality for HEIs. This was to ensure that the statements in the questionnaire have content validity. 41 item instrument of service quality which is applicable for TQM in education industry taking the SERVQUAL five dimensions for quality as basis. . Five-point Likert scale, with 1 for 'strongly disagree', 2 for 'disagree', 3 for 'neutral/impartial/no opinion', 4 for 'agree', and 5 for 'strongly agree' is used for the questionnaire.

To explore the relationship between the students' perceptions of service performance and the service gaps, service quality gaps were computed from the differences between students' perceptions of the services they received and their expectations of the same services.

2.2. Empirical Analysis of the Instrument

2.2.1. Data Analysis

The data collected were analyzed for the entire sample. Data analysis were performed with Statistical Package for Social Sciences (SPSS) using techniques that included descriptive statistics, correlation analysis and AMOS package for structural equation modeling (SEM) and Bayesian estimation and testing.

However, a series of separate multiple regressions had to be established based on “theory, prior experience, and the research objectives to distinguish which independent variables predict each dependent variable” (Hair et al., 1998, p. 584). AMOS 7.0 (Arbuckle and Wothke, 2006), a computer programme for formulating, fitting and testing SEM to observed data, was used for SEM and the data preparation was conducted with SPSS 17.0.

2.2.2. Evaluation of Model Fit

According to the usual procedures, the goodness of fit is assessed by checking the statistical and substantive validity of estimates, the convergence of the estimation procedure, the empirical identification of the model, the statistical significance of the parameters, and the goodness of fit to the covariance matrix (Senthilkumar and Arulaj, 2011). The root mean squared error of approximation (RMSEA) is selected as such a measure. Values equal to 0.05 or lower are generally considered to be acceptable (Browne and Cudeck, 1993). The sampling distribution for the RMSEA can be derived, which makes it possible to compute confidence intervals. These intervals allow researchers to test for close fit and not only for exact fit, as the X^2 does. If both extremes of the confidence interval are below 0.05, then the hypothesis of close fit is rejected in favor of the hypothesis of better than close fit. If both extremes of the confidence interval are above 0.05, then the hypothesis of close fit is rejected in favor of the hypothesis of bad fit (Senthilkumar and Arulaj, 2011).

Several well-known goodness-of-fit indices (GFI) were used to evaluate model fit: the chi-square X^2 , the comparative fit index, the unadjusted GFI, the normal fit index (NFI), the Tucker-Lewis index (TLI), the RMSEA and the standardized root mean square error residual.

2.2.3. Data Analysis and Results

First EFA was performed and each scale was subjected to factor analysis separately. The results of EFA are shown in Table 1 indicating that all of the items constituting each factor has factor loadings that are greater than 0.50. The scales with factor loadings of 0.50 or greater are considered very significant (Hair et al., 1998). The latent factors based on the item-factor loadings with coronbach’s alpha values of each factor are shown below in Table I.

Table I. EFA Results

| Factors (Latent Variables) | Components | Loading | Cronbach’s alpha |
|----------------------------|--|---------|------------------|
| Responsiveness quality | C3. Responsiveness of professors | ,726 | ,798 |
| | C4. Responsiveness of assistants | ,651 | |
| | C5. Responsiveness of university staff | ,646 | |
| Infrastructure quality | In8. Infrastructure of classroom | ,690 | ,811 |
| | In9. Hygiene of classrooms | ,798 | |
| | In10. Hygiene of washrooms | ,768 | |
| Technical quality | T1. Emotional well being of student | ,635 | ,834 |
| | T2. Expectations satisfied by university | ,715 | |
| | T4. University concerning student needs | ,662 | |
| | T5. Performance of university when needed | ,646 | |
| Functional quality | F1. Registration process | ,787 | ,822 |
| | F2. Grade assessment process | ,608 | |
| | F3. User friendly admissions | ,814 | |
| | F4. Time between admissions and registration | ,718 | |
| Information | Info 6. Waiting time for refund | ,723 | ,825 |
| | Info7. Instructions about billing procedures | ,636 | |
| Skills of staff | In.1 Skills of assistant | ,751 | ,801 |
| | In.2 Skills of staff (lab. Staff, IT staff etc.) | ,721 | |
| | In5. Friendliness of computer labs. | ,730 | |

To ensure standardization and to make it operational, the instrument was subjected to test of reliability and validity (Sureshchandar et al., 2001). The technique used for this approach was confirmatory factor analysis. In CFA technique the researcher is a priori aware of the number of factors that are required to explain the intercorrelations among the measured variables. So, the second stage is also known as testing the measurement model where the HE scales were tested using the first order confirmatory factor model to assess construct validity using maximum likelihood. The information of number of factors and components are known from the EFA (Table I).

The six latent factors were subjected to CFA using AMOS computer program (Arbuckle and Wothke, 1999). The χ^2 statistic was 481.314 (degrees of freedom 129, $p < 0.05$), with the χ^2 / df ratio having a value of 3.731 that is less than 4.0 (it should be between 0 and 4 with lower values indicating a better fit). The goodness of fit (AGFI) index was 0.956 which is very close to 1.0 (a value of 1.0 indicates perfect fit). The comparative fit index (CFI) was .968, while Tucker-Lewis coefficient (TLI) was .957. All indices are close to a value of 1.0 in CFA indicating that the measurement models provide good support for the factor structure determined through the EFA.

Convergent validity is the extent to which indicators of a TQM construct coverage or share a high proportion of variance in common (Hair et al., 1998). The fit indices are within the acceptable range as given by Bentler (1992) for each construct. This provides a first hand support for reliability and convergent validity of the scales. Further the significance of individual factor loadings of each constituent item was determined. All individual factor loading were found to be highly significant, giving support to convergent validity (Anderson and Gerbing, 1988).

The standardized regression weights for all variables constituting each dimension were also found to be significant ($p < 0.05$), as shown in Table II.

Table II. Regression Weights

| | | | | Estimate | S.E. | C.R. | P |
|-----------------------------|-------|------|---------|----------|------|--------|-----|
| Scale1: Responsiveness | | | | | | | |
| | C5 | <--- | Factor1 | 1,000 | | | |
| | C4 | <--- | Factor1 | 1,400 | ,066 | 21,241 | *** |
| | C3 | <--- | Factor1 | 1,340 | ,064 | 21,059 | *** |
| Scale2: Infrastructure | | | | | | | |
| | In10 | <--- | Factor2 | 1,000 | | | |
| | In9 | <--- | Factor2 | ,731 | ,042 | 17,613 | *** |
| | In8 | <--- | Factor2 | ,887 | ,037 | 24,022 | *** |
| Scale3: Technical quality | | | | | | | |
| | T4 | <--- | Factor3 | 1,000 | | | |
| | T2 | <--- | Factor3 | ,980 | ,042 | 23,158 | *** |
| | T1 | <--- | Factor3 | ,963 | ,044 | 21,902 | *** |
| | T5 | <--- | Factor3 | ,973 | ,039 | 25,023 | *** |
| Scale 4: Functional quality | | | | | | | |
| | F3 | <--- | Factor4 | 1,000 | | | |
| | F2 | <--- | Factor4 | ,836 | ,039 | 21,449 | *** |
| | F1 | <--- | Factor4 | ,934 | ,033 | 28,363 | *** |
| | F4 | <--- | Factor4 | ,872 | ,039 | 22,254 | *** |
| Scale5: Information | | | | | | | |
| | Info7 | <--- | Factor5 | 1,000 | | | |
| | Info6 | <--- | Factor5 | ,801 | ,045 | 17,659 | *** |
| Scale6: Skill of staff | | | | | | | |
| | In5 | <--- | Factor6 | 1,000 | | | |
| | In2 | <--- | Factor6 | 1,085 | ,074 | 14,623 | *** |
| | In1 | <--- | Factor6 | 1,129 | ,079 | 14,212 | *** |

Discriminant validity refers to the degree to which measures of different dimensions of quality in higher education institutions are unique from each other. According to Venkatraman (1989), discriminate validity is achieved when measures of each dimension coverage on their corresponding true scores and can be tested that the

correlations between pairs of dimensions are significantly different from unity. Table III reports the results of 15 pair wise tests conducted for discriminant validity.

TableIII. Assessment of Discriminant Validity

| Test # | Description | Chi-squared Model | Chi-squared Unconstrained Model | Difference |
|--------|---------------------------------------|-------------------|---------------------------------|------------|
| 1 | Responsiveness-Infrastructure | 466.561 | 64.095 | 402.466* |
| 2 | Responsiveness- Technical quality | 538.768 | 134.787 | 403.981* |
| 3 | Responsiveness- Functional quality | 434.697 | 83.263 | 351.434* |
| 4 | Responsiveness- Information | 2.162.799 | 1.767.612 | 395.187* |
| 5 | Responsiveness- Skill of staff | 2.357.444 | 1.851.853 | 505.591* |
| 6 | Infrastructure- Technical quality | 525.438 | 253.389 | 272.049* |
| 7 | Infrastructure- Functional quality | 344.889 | 94.882 | 250.007* |
| 8 | Infrastructure- Information | 307.682 | 48.058 | 259.624* |
| 9 | Infrastructure- Skill of staff | 571.416 | 139.272 | 432.144* |
| 10 | Technical quality- Functional quality | 392.280 | 200.704 | 191.576* |
| 11 | Technical quality- Information | 367.292 | 122.667 | 244.625* |
| 12 | Technical quality- Skill of staff | 598.844 | 231.979 | 366.865* |
| 13 | Functional quality- Information | 248.659 | 64.860 | 183.799* |
| 14 | Functional quality- Skill of staff | 513.767 | 139.226 | 374.541* |
| 15 | Information- Skill of staff | 492.994 | 63.777 | 429.217* |

$p < 0.01$

Fifteen of all fifteen tests indicated strong support for the discriminant validity criterion. As all fifteen tests does not have a p-value less than 0.1, it can be concluded that the discriminant validity criterion is satisfied by these dimensions, which means that the dimensions do not overlap significantly and that they exhibit different patterns of relationships with other dimensions.

3. Conclusion

This paper introduced a conceptual model of student satisfaction with higher education experience based on the identification of the variable determinants of student perceived quality and the impact of those variables on student satisfaction and/or dissatisfaction with the overall student experience. The measures proposed were empirically based and shown to be reliable and valid.

Exploratory and confirmatory factor analyses empirically verified and validated the underlying dimensions of perception of student satisfaction, TQM and organizational performance. Decision makers can use this instrument to identify the extent of TQM implementation in higher education institutions, while researchers will be able to use it for furthering TQM research in higher education. The results can be used by higher education institutions to renovate their quality-management processes and education quality strategies.

The data utilized for testing and validating this instrument only came from 1752 student of private HEIs in Istanbul. In order to improve external validity of the instrument, further research can be done to compare private and public HEIs. Although this instrument was empirically tested and validated using data from Turkish HEIs, researchers and practitioners from other countries would be able to utilize it.

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