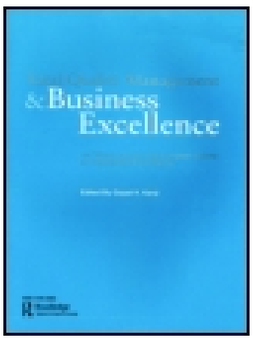

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Development of engineering education service quality model from faculty perspective

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The objective of this paper is to develop and empirically validate a service quality model for engineering education, from the faculty perspective, in the Indian context. This research was conducted in two phases: qualitative study and quantitative study. In the qualitative study, the dimensions of engineering education specific to the Indian context were identified using focus group discussions of 28 faculty members from an Indian Engineering Institute. Then the quantitative study was conducted in two stages: pilot study and main study. In the pilot study, survey questionnaire was developed and tested for reliability and validity by collecting data from 63 faculty members of three engineering colleges. In the main study, data was collected from 206 faculty members of five engineering colleges. The model was validated for reliability and validity using exploratory factor analysis.

Findings showed that the engineering education service quality model from faculty perspective consists of eight dimensions viz. research orientation, personal growth, higher-order learning, effective teaching, support processes, project opportunities, workload and infrastructure. Out of the eight dimensions, four dimensions namely research orientation, project opportunities, personal growth and higher-order learning are the unique contribution to service quality models as these were not explored by the existing studies.

Keywords: service quality; higher education; engineering education; India

Introduction

SERVQUAL (Parasuraman, Zeithaml, & Berry, 1988) and SERVPERF (Cronin & Taylor, 1992) are widely used service quality measurement models for various service types (Kilbourne, Duffy, Duffy, & Giarchi, 2004; Lam, 2002; Parasuraman, Zeithaml, & Berry, 1994). However, in higher education service quality (HESQ) domain researchers have explored different approaches. Some studies reported the application of universal service quality measures like SERVQUAL in higher education (Calvo-Porral, Lévy-Mangin, & Novo-Corti, 2013; Cuthbert, 1996a, 1996b; Galeeva, 2016). However, many studies have reported non-applicability of SERVQUAL & SERVPERF for higher education (Abdullah, 2006a; Cuthbert, 1996a, 1996b; Jain, Sahney, & Sinha, 2013). These studies reported the development of service quality measurement models specifically for higher education.

Studies explored HESQ from the perspective of various stakeholders. Most of the studies adapted student perspective approach. Few studies (Chua, 2004; Lazibat, Baković, & Dužević, 2014; Owlia & Aspinwall, 1998) explored HESQ from the perspective of multiple stakeholders. Very few studies used only faculty perspective for measurement of HESQ, and none of them developed a model for engineering education service

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quality (EESQ) from faculty perspective. This study attempts to contribute in this area by developing a model of EESQ from faculty perspective. Hence the purpose of this study is to conceptualise and empirically validate a model of EESQ from the faculty perspective.

In the next section, review of the literature is presented. It is followed by methodology and discussion sections. The final part of the paper presents conclusions and future scope for research.

Literature review

SERVQUAL (Parasuraman, Zeithaml, & Berry, 1985, 1988) and SERVPERF (Cronin & Taylor, 1992, 1994) were the first two empirically validated service quality models. Parasuraman et al. (1988) defined service quality as a gap between the perceptions and the expectations of the customers. They reported that the service quality comprises of five dimensions namely reliability, assurance, tangibles, empathy, and responsiveness. Cronin and Taylor (1992) defined service quality with the same dimensions but considered only perceptions of the customers.

Ladhari (2009) reviewed 30 studies on the application of SERVQUAL in different service settings including four on higher education related studies. The author reported that there were several limitations associated with the application of SERVQUAL. The major limitations mentioned were 'discriminant validity', 'emphasis on process (rather than outcome)', 'applicability of a generic scale for measuring service quality in all service settings', and 'applicability to different cultural contexts'.

In the higher education context, some studies adopted SERVQUAL (Calvo-Porral et al., 2013; Cuthbert, 1996a, 1996b; Dlačić, Arslanagić, Kadić-Maglajlić, Marković, & Raspor, 2014; Galeeva, 2016; Git & Sulaiman, 2012; Sahney, Banwet, & Karunes, 2004; Vajda, Farkas, & Málovics, 2015). These studies could not achieve consensus on the dimension of higher education service quality, revalidating the problem of 'discriminant validity' with SERVQUAL.

A few studies (Abdullah, 2005, 2006a, 2006b; Brochado, 2009) compared the higher education performance model – HEdPERF (Abdullah, 2006c) with other models. Abdullah (2006b) showed that the performance of the modified HedPERF scale was superior. Whereas Brochado (2009) concluded that SERVPERF and HEdPERF performed better in criterion validity relatively to the other three alternative measures.

A number of studies (Abdullah, 2006a, 2006c; Angell, Heffernan, & Megicks, 2008; Gatfield, Barker, & Graham, 1999; Jain et al., 2013; Owlia & Aspinwall, 1998; Rave & Giraldo, 2015; Senthilkumar & Arulraj, 2011; Subrahmanyam, 2017; Sultan & Tarafder, 2007a, 2007b; Sultan & Wong, 2010; Yildiz, 2014) proposed new models for higher education service quality. The dimensions of service quality revealed by these studies were different from SERVQUAL and SERVPERF. These studies also reported variation in the dimensions. The number of dimensions also varied from four (Angell et al., 2008; Gatfield et al., 1999; Yildiz, 2014) to eight (Sultan & Tarafder, 2007a; Sultan & Wong, 2010).

Sultan and Wong (2012, 2013, 2014) investigated higher education service quality based on its antecedents and consequences. They proposed three dimensions of higher education service quality namely – academic, administrative and facilities. These studies used focus group discussion to identify the three dimensions, antecedents, and consequences of the service quality.

Very few studies investigated higher education service quality from the perspectives of multiple stakeholders of higher education (Chua, 2004; Lazibat et al., 2014; Owlia & Aspinwall, 1996, 1998). Lazibat et al. (2014) studied perceptions of faculty members,

and students; Owlia and Aspinwall (1996, 1998) examined perceptions of faculty members, employers and students, whereas Chua (2004) studied perceptions of students, faculty members, employers, and parents.

Owlia and Aspinwall (1998) prepared three questionnaires with few items common for students, faculty and employers. They reported the HESQ model with 19-items and four dimensions: academic resources, competence, attitude, and content. Lazibat et al. (2014) used HEdPERF for measuring HESQ. Factor analysis resulted in seven dimensions instead of original five dimensions. The dimensions for faculty and student were different indicating variation in their perception of HESQ. Chua (2004) classified HESQ attributes using the input–process–output classification. He concluded that students gave importance to process and output characteristics, whereas teachers gave importance to all the three categories: input, process, and output.

Teeroovengadum, Kamalanabhan, and Seebaluck (2016) developed and empirically tested a hierarchical model for measuring service quality in higher education. The model considered the functional and technical aspects of service quality in higher education. The authors developed the model considering 53 service quality attributes through qualitative research methods and literature review. The conceptual model was tested by developing a survey instrument and collecting data from 207 students. The analysis indicated hierarchical nature of the service quality model with five dimensions and nine sub-dimensions.

In the Indian context, four studies (Jain et al., 2013; Sahney et al., 2004; Senthilkumar & Arulraj, 2011; Subrahmanyam, 2017) addressed higher education service quality. None of them has focused on engineering education particularly.

In the existing literature, few studies explored HESQ from the perspective of multiple stakeholders. Most of the studies adapting single stakeholder approach explored HESQ from student perspective only. HESQ has rarely been explored only from the faculty perspective. HESQ model from faculty perspective can contribute new dimensions, due to following reasons. Students may assess the HESQ with reference to their secondary education and expectations from the tertiary education. In comparison, faculty members may assess the HESQ with their educational qualification and experience. Thus, faculty members are in a better position to assess the content and the delivery methods compared to the students. Compared to the other stakeholders like administration, parents, and industry, faculty members have maximum involvement in the teaching-learning process and the maximum interaction (by duration and intensity) with the students. Hence faculty members become a better candidate to assess the HESQ. These views indicated the need for the development of an EESQ from faculty perspective.

Indian higher education system is witnessing growth in the enrolment more than 28 million students in the academic year 2015–16 and achieving gross enrolment ratio (GER) of 24.5 (AISHE, 2016). The primary focus on improvement in the GER also indicates the need for measurement of quality of higher education. Engineering education contributes 15.6% of enrolment in higher education in India. The Indian engineering education system is witnessing growth in the intake capacity. The intake capacity indicated approximately 300% growth in the last 10 years. Out of this total intake, private institutes and universities contribute approximately 91% to the intake of engineering undergraduate courses, whereas, government-funded institutes and universities contribute only 9% approximately ("AICTE Dashboard", 2017). With the increase in intake capacity, the Indian engineering education system is witnessing a decrease in enrolment. The decline in enrolment is largely affecting the private engineering colleges. It is observed from enrolment data from the year 2015–16, that enrolment for private institutes and universities was approximately 49% whereas for government-funded institutes and universities enrolment was approximately

77% ("AICTE Dashboard", 2017). The increase in the intake is also affecting the quality of engineering education. Blom and Saeki (2011) reported that quantitative expansion was widely perceived to have led to an average decline in the quality of students entering, the education system and consequently, quality of the graduating engineers. This study was focused only on the private engineering institutes, considering the high contribution of private engineering institutes and the low enrolment in these institutes. Increase in the scope of the study to include public-funded institutes may influence the results of the study due to variation in the student enrolment and infrastructure of the two types of colleges.

Blom and Saeki (2011) surveyed employers of engineering graduates in India. They found that the employers demand different skills from the engineering graduates. The skills in demand include lower-order thinking skills (knowledge and understanding), higher-order thinking skills (such as the application of appropriate tools to solve a problem, and analysis and interpretation), and soft skills (core employability skills and communication skills). These skills are unique to engineering education and found to be part of the EESQ dimensions in this study. These skills indicate that engineering education differs from other fields of education.

Thus, the limitation of generic service quality models and unavailability of established service quality model in higher education and more specifically in engineering education indicated a need for the development of service quality model for engineering education in the Indian context.

Research Method

The objective of this study was to conceptualise and validate a model of service quality for engineering education from faculty perspective in the Indian context. This research adopted qualitative and quantitative methodology. A qualitative approach was used to identify the dimensions of service quality applicable in the Indian context. Then the quantitative approach was adopted to develop and validate the measurement model.

Qualitative study

Focus group discussions method was adopted for the qualitative study. Faculty members were selected randomly from six departments of the sample institute. Total three focus groups were conducted with eight to ten faculty members in each group. The first focus group included faculty members with one to fifteen years of experience. The second focus group included faculty member with experience less than five years, and the third focus group consisted of faculty members with five to fifteen years of experience. Total sample size for the focus group discussions was 28.

The participants were informed in advance that the discussions would be audio recorded and their consent was taken for the same. They were initially briefed about the research topic by the researcher and then the moderator conducted the focus group discussions in the presence of the researcher as an observer.

Open-ended questions were asked to initiate the discussion and to keep it focused. Following are the examples of the questions asked.

> What is your idea of engineering education service quality? In your opinion, which are the important indicators of engineering education service quality? How engineering education service process affect the engineering education service quality? Which parameter influences the engineering education service quality?

All the discussions were lasted for about an hour.

Content analysis was used for analysing the focus group data. Six dimensions were identified from the content analysis viz. student engagement, student involvement, infrastructure facilities, additional support, evaluation and syllabus. Two more dimensions graduate skills and workload were added from the literature. These eight dimensions were used while developing the survey instrument in the quantitative study.

Quantitative study

The quantitative study was conducted in two stages. In the first stage, the survey instrument was developed to determine dimensions of EESQ. The first task in the process of development of survey instrument was generation of a pool of items (Sharma, 2010). In this study, items were selected from the focus groups and literature. Face and content validity of survey instruments was done with four experts. The experts were faculty members from different engineering institutes having minimum 15 years of teaching and research experience. They suggested changes in the wording of some of the items. After incorporating these changes, the survey instrument was used for the pilot study. The survey instrument at the stage of the pilot study consisted of 73-items representing eight proposed dimensions.

Stage one: pilot study

In this stage, data was collected to refine the instrument. This refinement enables to check the internal consistency and validity, to reduce possible ambiguity in the questionnaire items and their interpretation by participants as well as to condense survey instrument by retaining only those items which correlate well with their respective latent constructs (DeVellis, 2003).

Data was collected from the faculty of three private engineering institutes in the central part of India. The author selected these engineering institutes due to accessibility. The proportionate stratified sampling method was adopted for data collection (Jain et al., 2013). The stratum for data collection was the institutes, and the proportion was 0.25, i.e. 25% of faculty strength of each institute. Total 63 completed responses from faculty were received. Online form filling method was used for data collection.

The data analysis of pilot study included item analysis and exploratory factor analysis (DeVellis, 2003). The item analysis was performed to determine internal consistency reliability of the survey instrument. Items with low (< 0.3) item-to-total-correlation were dropped. The exploratory factor analysis was performed, and the items with low factor loadings (< 0.4) were dropped at this stage.

Total 11 items out of 73 were dropped from the questionnaire. After dropping those items, the Cronbach's alpha values for six dimensions were above 0.7, indicating the internal consistency reliability of the survey instrument. For two dimensions (evaluation and workload) Cronbach's alpha was acceptable (≈ 6). It was decided to retain these two dimensions in main study with the expectation that they may improve with a larger data of main survey. Thus, finding of the pilot study was the eight dimensions, namely student engagement (SE), student involvement (SI), infrastructure facilities (IF), additional support (AS), evaluation (EV), syllabus (SY), workload (WL), and graduate skillset (GS).

Stage two: main study

The objective of the main study was to develop a model to determine EESQ. For the main survey, data was collected from five private engineering institutes in and around a metropolitan city in the central part of India. The survey questionnaire was distributed to 1000 faculty members of the five institutes. Total 206 filled in questionnaires were received. The respondents were from seven different departments – applied science, computer, civil, mechanical, electronics & telecommunication, electrical and information technology.

Before doing exploratory factor analysis (EFA), appropriate tests were carried out to ensure that the data set is adequate for the analysis. Bartlett's test of sphericity was significant ($p = 0.000$). Kaiser-Meyer-Olkin measure of sampling adequacy was 0.810 which is considered as 'meritorious' (Hair, Anderson, Black, & Babin, 2016). Both the tests supported the appropriateness of the dataset for conducting EFA. Principal Component Analysis method was used for conducting EFA. Promax rotation with Kaiser normalisation was used for factor rotation as the factors were expected to correlate with each other. Factors with eigenvalue more than one were retained. Items were dropped for cross-loadings and low loadings (>0.6). The data analysis was done using the software 'Statistical Package for the Social Sciences' (SPSS) version 21.

In the EFA process, removal of the items with cross loading and low loading resulted in eight factors with 27-items. These eight factors explained 68.69% variance. Reliability of the eight factors was evaluated with the Cronbach's alpha. All the factors indicated high reliability (Cronbach's alpha $\geq$0.7) except one factor – infrastructure facilities (IF) for which the alpha value was $0.66 \approx 0.7$. All the eight factors have shown high (>0.635) factor loadings establishing discriminant validity. The result of the EFA is presented in the following Table 1.

Out of the eight dimension from the pilot study, items related to three dimensions, i.e. student involvement, syllabus and evaluation got dropped in the EFA process. Out of the remaining five dimensions, three dimensions lost few items but retained grouping of their remaining items. These dimensions were student engagement, additions support and workload. According to the remaining items, two of these three dimensions were renamed. Student engagement was renamed as effective teaching, and additional support was renamed as research orientation. Out of the remaining two dimensions, items of graduate skillset (GS) got clustered in two factors. These factors were renamed as higher-order learning (HL) and personal growth (PG). Similarly, items of infrastructure got clustered in three factors. These factors were renamed as support processes, infrastructure and project opportunities. These dimensions renamed after EFA with their items are presented in the following Table 2 according to their ranking (with decreasing factor loadings and decreasing order of variance explained) in the EFA result.

Discussions

This study empirically validated the EESQ model from faculty perspective with eight dimensions viz. research orientation, personal growth, higher learning, effective teaching, support processes, project opportunities, and infrastructure. These dimensions are defined as follows:

Research orientation (RO): It is defined as the provisions made by the Institute for developing research orientation in the faculty members such as funding for faculty research, infrastructural support for research. RO is the most important dimension as it explains 22.63% variance. This dimension indicates the importance given by the faculty members to research activity. Dužević and Časni (2015) reported research orientation as one of the

Table 1. Result of exploratory factor analysis.

	Factors							
	RO	HL	ET	PG	SP	IF	PO	WL
AS10	0.891							
AS11	0.857							
AS14	0.778							
AS13	0.700							
AS12	0.684							
AS9	0.682							
GS10		0.852						
GS9		0.828						
GS11		0.765						
GS12		0.744						
SE9			0.865					
SE5			0.769					
SE8			0.670					
SE3			0.635					
GS6				0.791				
GS4				0.780				
GS5				0.703				
GS2				0.688				
IF2					0.794			
IF6					0.764			
IF1					0.709			
IF10						0.873		
IF9						0.730		
IF12							0.839	
IF11							0.797	
WL3								0.861
WL4								0.844
%V.E.	22.631	12.448	10.120	5.926	5.173	4.633	4.222	3.535
Alpha	0.884	0.839	0.759	0.767	0.699	0.667	0.811	0.682

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalisation.

important aspects of an institute for faculty satisfaction, though they have not included it as a dimension of HESQ.

Higher-order learning (HL): It is defined as the set of skills which include evaluating a point-of-view, applying theories, understanding information and analysing an experience. This is the second important dimension as it explained 12.45% variance.

Personal growth (PG): It is defined as the set of skills which include engineering problem-solving skill, job-related skills and soft skills. This dimension explained 5.93% variance and ranked fourth out of the eight dimensions.

These two dimensions represent the skills the engineering graduates should have acquired during their engineering education. These skills were first included by Owlia and Aspinwall (1998) as one the dimensions of HESQ from the faculty and student perspectives, although they have considered it as the content rather than the outcome of the education process. Then Kuh (2009) reported these dimensions in the National Survey of Student Engagement as one of the elements of student engagement. The importance of the graduate outcome was also highlighted by studies on engineering accreditation (Prados, Peterson, & Lattuca, 2005; Woods, Felder, Rugarcia, & Stice, 2000). One

Table 2. Items and dimensions after EFA.

	Research orientation (RO)
AS9	Your institute provide your students funding for the innovative projects
AS10	Teachers are given Awards and regularly recognised in your institute
AS11	Your institute provide adequate support for your research and academic development
AS12	There is good communication between management and academics in your institution
AS13	Your institute provide adequate infrastructural support for your research
AS14	Your institute often provide you funding for research
	Higher-Order Learning (HL)
GS9	Applying facts, theories, or methods to practical problems or new situations
GS10	Analysing an idea, experience, or line of reasoning in depth
GS11	Evaluating a point of view or information source
GS12	Understanding and connecting various pieces of information
	Effective teaching (ET)
SE3	Teacher is expected to share knowledge about industrial requirements
SE5	Innovative teaching methods increase the level of students' interest
SE8	Teaching style must incorporate changes based on variations in students understanding
SE9	You modify teaching activities in order to sustain students' attention
	Personal Growth (PG)
GS2	Speaking clearly and effectively
GS4	Acquiring job- or work-related knowledge and skills
GS5	Teamwork
GS6	Identifying, formulating, and solving engineering related real-world problems
	Support processes (SP)
IF1	Your institute have counselling facility for students
IF2	Students are provided with adequate opportunities for extra-curricular activities
IF6	Many companies come for placements in institute
	Infrastructure (IF)
IF9	Your institute provide required software and hardware equipment support
IF10	Your institute have adequate number of classrooms
	Project opportunities (PO)
IF11	Your students get opportunities to work on subject related projects (in-house)
IF12	Your institute provide students opportunities to work on industry based projects
	Work Load (WL)
WL3	Evaluating assignments and exam papers
WL4	Interacting with students outside classroom

Indian study on employer satisfaction also emphasised the importance of graduate outcomes from the employers perspective (Blom & Saeki, 2011).

Project opportunities (PO): It is defined as the opportunities for the students to apply the acquired knowledge in real life situations in the form of course projects and industrial projects. It includes opportunities for course projects and industrial projects for the students. This dimension explained 4.22% variance. This is also a unique dimension as it was not explored by existing HESQ studies. This dimension emphasises the importance of course projects as opportunities for applying the knowledge and skills acquired by the students to real-life situations. One of the possible reasons behind the emergence of PO as a new dimension of EESQ may be applied nature of engineering education compared to the other fields of higher education.

Effective teaching (ET): It is defined as the effort to put in by the faculty members to improve the effectiveness of teaching process. The efforts include innovative teaching methods, variation in teaching style as per students understanding. This dimension explained 10.12% variance. This dimension is similar to the dimensions 'competence',

'attitude', 'delivery' from Sahney et al. (2004), Owlia and Aspinwall (1998) and 'academic service quality' from Sultan and Wong (2012, 2013, 2014).

Support processes (SP): It is defined as the processes which support the core teaching-learning-evaluation process. It includes placement process and counselling facility. This dimension explained 5.17% variance. This dimension is similar to the dimensions academic resources from Owlia and Aspinwall (1998), 'academic support' from Yildiz (2014), and 'administrative service quality' from Sultan and Wong (2012, 2013, 2014)

Infrastructure (IF): It is defined as the infrastructure facilities required facilities required for the core teaching-learning-evaluation process. It includes an adequate number of classrooms and well-equipped laboratories. This dimension explained 4.63% variance. This dimension is similar to the dimensions 'facilities service quality' of Sultan and Wong (2012, 2013, 2014) and 'academic resources' from Owlia and Aspinwall (1998).

Workload (WL): It is defined as the working hours faculty members should devote to various academic and administrative assignments. This dimension explained 3.54% variance. This dimension indicates the importance of faculty workload. Although this dimension was not part of any HESQ model, it was an important dimension of faculty satisfaction models (Fredman & Doughney, 2012).

Findings from the EFA indicate that the five out of eight dimensions of the proposed EESQ model namely higher-order learning, personal growth, effective teaching, support processes and infrastructure revalidate similar dimension of HESQ from the existing literature. Findings also indicate that three out of the eight dimensions namely research orientation, project opportunities and workload are the unique contribution of this study. The dimensions project opportunities and higher-order learning with their unique items indicate that these are the items and dimensions particularly relevant to engineering education.

Implications

Following practitioner's implications are possible with the EESQ model. Engineering institutes can use the EESQ model for continuous assessment and improvement of service quality. Management of the institutes can use the dimensions of the EESQ models as the prioritised areas for improving service quality of the institute. The model can also be employed by the management of a group of institutes to rank their institutes. Administrators of the institute can use the EESQ model for annual assessment of service quality of the institutes. Administrators can also use EESQ model for attracting and retaining the best faculty by working on the dimensions of the model.

Limitations of study

This study has following limitations. This study adapted single stakeholder approach and developed EESQ model from faculty perspective. The scope of the study was limited to private engineering colleges in India. The scope of the study was also restricted to engineering education, and the dimensions of the developed model may not be generalisable to other disciplines of higher education.

Conclusions and future scope

The objective of the study was to develop a model of EESQ from the perspectives of the faculty. Results have shown that there are 27-items grouped under eight dimensions in the EESQ model. The eight dimensions were: research orientation, personal growth,

higher-order learning, effective teaching, support processes, project opportunities, and infrastructure. Four dimensions namely research orientation, project opportunities, personal growth and higher-order learning, are the unique contribution to service quality models as these were not explored by the existing studies.

The current study focused on the service quality of engineering education. The similar study can be performed for other streams like arts, science, commerce, law or business. The discipline-specific service quality measures need to be explored separately given the unique characteristics of each discipline. There is scope to explore how other stakeholders like parents and employers perceive service quality of engineering education.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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