

# Measuring Service Quality of a Multi-Disciplinary Engineering Course

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## Abstract

A non-traditional engineering design course for undergraduates is introduced to simulate multi-disciplinary team setting in actual working environment. In the course, students of various engineering disciplines work in groups of six, to develop conceptual prototypes using fundamental engineering knowledge under the supervision of lecturers. With the enrolment of about 500 students in every semester, effective administration is crucial in ensuring satisfactory operation of the course. Furthermore, the involvement of large numbers of lecturers and academic departments increase the complexity of the course management. To ensure smooth operation of the course, it is important for the course coordinators to be able to measure the quality of the services provided to the students based on their level of satisfaction. The present paper demonstrates the use of SERVQUAL as an effective approach to measure the service quality of the course. The study is done empirically by analysing the difference between expectations and perceptions of the students, vis-à-vis service quality. The outcome of the analysis would enable identification of the scope of future improvement in the aspect of administration of the course. From the reliability testing, the items within the quality dimensions are found to measure the same attribute as intended, and thus, satisfactorily indicate the reliability of SERVQUAL for quantification of service quality. The findings from the present study as well as those in the future would be useful indicators for the course coordinators to achieve sustained satisfaction among the students in the course.

**Keywords:** education; engineering; multi-discipline; service Quality; SERVQUAL

## 1. Introduction

Course delivery in institutes of higher learning focuses mainly on the design of curriculum and the capability of the teaching force to achieve effective learning in students. In certain courses, another aspect of concern may be the service quality of the administration or coordination. At Universiti Teknologi PETRONAS (UTP), there is an engineering design course that requires good service by the course coordinators and other facilitators in order to achieve effective course delivery. Identified as the Engineering Team Project (ETP), the course is compulsory for all third-year engineering undergraduates.

The course aims to simulate multi-disciplinary team setting that engineering graduates will experience in actual working environment. The student enrolment for the course ranges from 400 to 500 in every semester and they are divided into groups of six that are composed of members of various engineering programs. Each group is responsible to develop a working prototype of conceptual design using fundamental engineering knowledge under the supervision of a lecturer. The administration of the course is complicated since the operation of the course is not similar to traditional engineering courses (neither lecture nor laboratory

based), and also due to the involvement of large number of students, lecturers, and academic departments. In addition, engineering lecturers who are not supervising become the examiners in the project evaluation at the end of the semester.

Since the administration of the course is crucial to the effectiveness of the delivery of ETP, it is important to gauge the service quality based on the level of students' satisfaction. However, it is difficult to quantify the service quality provided by the course administrator, and thus appropriate method of measurements is vital. Over the recent years, significant number of researches and literature has explored the use of industrial-based quality measurement tools within the academic setting. One of the popular quality measurement tools adapted from the industry is SERVQUAL.

The use of SERVQUAL in education system is relatively new. An empirical study using SERVQUAL was conducted [1] with the aim to obtain students' perception of the quality of selected educational institutions in India. Further, the process was applied to reveal priority areas for improvement, while another quality tool, Quality Function Deployment (QFD) was employed to identify design characteristics that would meet the requirements of customers (students). The versatility of SERVQUAL was demonstrated [2] by assessing the quality of

higher education from various perspectives; parents, students, faculty members and employers; this study would have a far reaching implication to pave the way for a more holistic approach to address quality issues in higher education. In the evaluation of the service quality of Chinese higher education [3], SERVQUAL was conceptually employed with the incorporation of Strength-Weakness-Threat-Opportunity (SWOT) analysis. More recently, SERVQUAL was also used to measure the quality of classroom experience [4]. In academic administration, a study on students' satisfaction in areas of support services; academic records, admissions, career services and financial aid was demonstrated using SERVQUAL [5].

This paper presents an empirical study of measuring service quality of the ETP course by using SERVQUAL. The study involves modelling the course as a service oriented architecture, development of survey instrument based upon SERVQUAL statements, data collection by means of online survey, data analysis including reliability testing and the conduct of gap analysis to identify the areas for improvement. The present study is confined to the engineering programs in UTP.

## 2. An Overview of SERVQUAL

In the face of increasingly intense competition, many companies in various industries look to service quality as a major differentiating factor to beat their competitors. The pursuit for service quality improvement leads to the research and development of service quality measurement tools, such as SERVQUAL and services blueprinting [6].

Table 1. Attributes of SERVQUAL Service Quality Dimensions

Service Quality Dimensions	Attributes
Tangibles	<i>The physical facilities and equipment, and the appearance of personnel</i>
Reliability	<i>The ability to provide what was promised, in a dependable and accurate manner</i>
Responsiveness	<i>The willingness to help customers and provide prompt service</i>
Assurance	<i>The knowledge and courtesy of employees, and their ability to convey trust and confidence</i>
Empathy	<i>The degree of caring and individual attention provided to customers</i>

Developed in 1985 [7], SERVQUAL is a measurement tool for service quality with the aim to

measure service quality along several dimensions, namely tangibles, reliability, responsiveness, assurance and empathy. Brief descriptions of the attributes for each dimension are given in Table 1.

SERVQUAL functions by assessing the differences between customer expectations and customer perceptions in the specified quality dimensions. These differences are commonly known as gaps. The gap analysis can be achieved by the administration of a survey to customers before and after the delivery of the intended service. The outcome of SERVQUAL shows the gaps that may exist along the service quality dimensions. These gaps point to the weaknesses that need to be addressed in order to improve customers' satisfaction.

## 3. Course Description

The Engineering Team Project (ETP) is a team-based engineering design course offered to all third-year engineering students in the university. Every semester, enrolment is open to students of the engineering programs; Chemical, Civil, Mechanical, Electrical and Electronics, and Geosciences and Petroleum Engineering. The students are divided into groups of six that are composed of members of the various programs. Each group is responsible to design and fabricate the working prototype of a product, which is conceptualised by the team members. A supervisor, who is a lecturer of the engineering programs, is assigned to each group to guide and advise the students on various aspects of the project till completion. The course coordinators, normally two, whom are appointed among the lecturers, are responsible in coordinating and facilitating the delivery of the course, in accordance to the course guidelines [8].

Throughout the period of the project, the group members are expected to hold discussions and review sessions with their supervisor on a weekly basis. They have to ensure that substantial fundamental engineering knowledge is applied in developing the product. The fabrication of prototypes is usually accomplished with the support and assistance of laboratory technicians. At stipulated dates, the groups are required to produce specific project deliverables such as progress reports, working prototypes, posters, final reports and oral presentations. The supervisors are responsible to evaluate the reports and the prototype. In addition, a panel of examiners whom are non-supervising engineering lecturers will evaluate the posters, oral presentations and demonstration of the prototypes three weeks before the semester ends. Details of the operation, expectations and requirements of the course are explained in the ETP guidelines [8], which are circulated to students and supervisors at the beginning of the course.

#### 4. Methodology

##### 4.1. Service Oriented Architecture

Since SERVQUAL is a measurement tool for service quality, the present study began with modeling of the ETP course as service oriented architecture. In essence, the students were considered as the customers. The coordinators, supervisors, laboratory technicians and examiners were the service providers who ensured the availability of services in the forms of coordination, supervision, technical assistance in fabricating prototypes and evaluation. Other supporting elements in the delivery of the course such as physical facilities (meeting venues, laboratories, equipment, etc.), funding,

timeframe, course guidelines and multimedia services were regarded as the enablers.

Fig. 1 depicts the modelling of ETP as service oriented architecture. At the beginning of the semester, the expectations were formed with regards to the quality of various elements that the customers anticipated to encounter throughout the semester. During the delivery of the course, interactions occurred between the customers and the 'service providers' as well as the 'enablers'. The experiences from these interactions would eventually influence the perceptions of the customers with regards to the quality of the 'services' received. At the end of the semester, the discrepancies between the perceptions and expectations could be evaluated by using the gap analysis.

Fig. 1. Modeling of ETP as Service Oriented Architecture.

Upon obtaining the results from the Expectation and Perception surveys, basic calculations were performed for the mean score and the corresponding standard deviation of each attribute. Further, individual gap score, GS, was computed using the formula given as:

$$GS = PS - ES \quad (1)$$

where PS was the perception score and ES was the expectation score. The gap score for each quality dimension (*tangibles, reliability, responsiveness, assurance and empathy*) was also accounted for by subtracting the average of expectation score from perception score within the same dimension. Positive gap scores would indicate that the service

quality exceeds the expectation, which was the desired outcome. On the other hand, negative values would imply that the expectations were not fulfilled by the actual service quality.

Before performing the gap analysis, the elements inside the model must first be conceptualised as items within the five SERVQUAL quality dimensions. The enablers were related to the physical facilities (meeting venues, laboratories and equipment), monetary support (funding), scheduling (timeframe) and communication materials (course guidelines and multimedia services), hence they could be categorised under *tangibles*. The service providers, all of whom are individuals, could reasonably be included in the remaining four quality dimensions, which are strongly biased to human attributes.

#### 4.2. Construction of Survey Instrument

The overall methodology adopted for the study is represented by the flowchart in Fig. 2. Based on the original SERVQUAL statements, as shown in Table 2, two sets of relevant statements were formulated according to course setting. Since the SERVQUAL statements could be customized [9], they were tailored according to the conditions of the course while maintaining the fundamental purpose of SERVQUAL. The first set of statements aimed to obtain students' expectations (E) on the determined service attributes. The second set of statements served to gather students' perception (P) to the

same list of service attributes. The modified SERVQUAL statements are listed in Table 3. The E and P statements were very similar as they correlate to the same content. The differentiating aspect was on the use of appropriate phrases; underlined-phrases imply E statements, while bracket-enclosed phrases are applicable for P statements.

Survey statements were formulated according to the model in Fig. 1 to ensure alignment with the five SERVQUAL quality dimensions. The *tangibles* dimension has seven statements as compared to only four in the original SERVQUAL list, as shown in Table 2. The increase in the number of statements was justified with the increased elements, notably funding, timeframe, course guidelines and elearning. These features are not typically found in conventional service entities such as restaurants.

Only four out of five original items were extracted for the *reliability* dimension. The item on 'performing the service right the first time' seemed more applicable for non-repeating encounters, again drawing comparison with restaurants. This is analogous to serving the right dish to the customers the first time. Generally, encounters with the service providers within course setting are repetitive and progressive, for example, weekly consultations with supervisors. The significance of 'performing the service right the first time' could somewhat be moderated due to the subsequent opportunities for amendments.

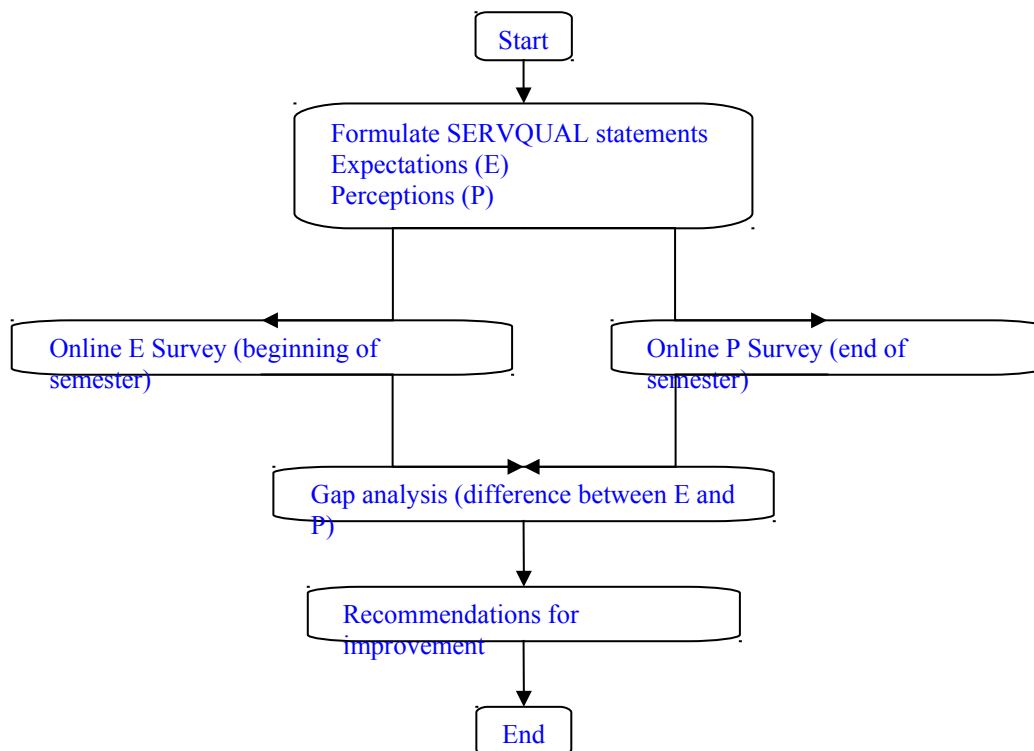


Fig. 2. Methodology Flowchart.

There was equal number of statements in the *responsiveness* dimension, although the contents slightly differed. In the original statements, ‘give prompt service’, ‘willing to help’ and ‘never too busy to respond’ seemed to suggest the same notion. In the modified survey, the phrase ‘give prompt response’ was used as a substitute for the above phrases. The phrase was used in Items 13 – 15 of Table 3, to measure the attainment of the attribute of promptness of the course coordinators, supervisors and technicians.

Within the *assurance* dimension, the survey statements were modified quite significantly by considering the nature of the course delivery, which is different as compared to conventional service entities. In ETP, the assurance stemmed much from the confidence of students based upon the behaviour or conduct of the service providers, particularly course coordinators and supervisors whom they frequently dealt with. Another notable adaptation was the inclusion of the examiners in providing assurance by giving fair and consistent evaluation.

In the *empathy* dimension, motivation and support provided by supervisors were viewed as a

critical attribute, considering the frequent interactions between the students and the supervisors as well as the potential influence of such attribute to the quality of the students’ experience. The ‘operating hours’ of the original statement could easily be modified to ‘consultation hours’, whilst the last two statements conformed quite fittingly to the original statements, with the retention of the same key phrases; ‘best interest at heart’ and ‘understand the specific needs’.

The response to each statement or survey item was in terms of a numerical score based on a seven-point Likert scale; 1 for strongly disagree to 7 for strongly agree with 4 for neutral. The two sets of statements (E and P) were transferred into online survey formats to exploit the use of the Internet for data collection. The collected survey data was automatically saved in Microsoft Excel format to facilitate subsequent result analysis. The E survey was administered at the beginning of the semester. At that time, students had little or no experience of the many service attributes. The P survey was administered at the end of the semester when the students had gone through the experience in the course delivery.

Table 2. List of original SERVQUAL statements for expectations (adapted from S. Thomas Foster, *Managing Quality – Integrating the Supply Chain* [6]) Attributes.

Dimension	Item	SERVQUAL Statements
Tangibles	1	XYZ Company should have modern-looking equipment
	2	The physical facilities of XYZ Company should be visually appealing.
	3	The employees of XYZ company should be neat-appearing.
	4	Materials associated with the service (such as pamphlets or statements) should be appealing in XYZ Company.
Reliability	5	When XYZ Company promises to do something, they will do so.
	6	When a customer has a problem, XYZ Company should show a sincere interest in solving it.
	7	XYZ Company should perform the service right the first time.
	8	XYZ Company should provide their services at the time they promise to do so.
	9	XYZ Company should insist on error-free records.
Responsiveness	10	Employees in XYZ Company should tell customers exactly when services will be performed.
	11	Employees in XYZ Company should give prompt service to customers.
	12	Employees in XYZ Company should always be willing to help customers.
	13	Employees in XYZ Company should never be too busy to respond to customers’ requests.
Assurance	14	The behaviour of employees in XYZ Company should instil confidence in customers.
	15	Customers of XYZ Company should feel safe in their transactions.
	16	Employees in XYZ Company should be consistently courteous with customers.
	17	Employees in XYZ Company should have the knowledge to answer customers’ questions.
Empathy	18	XYZ Company should give customers individual attention.
	19	XYZ Company should have operating hours convenient to all their customers.
	20	XYZ Company should have employees who give customers individual attention.
	21	XYZ Company should have the customers’ best interests at heart.
	22	The employees of XYZ Company should understand the specific needs of their customers.

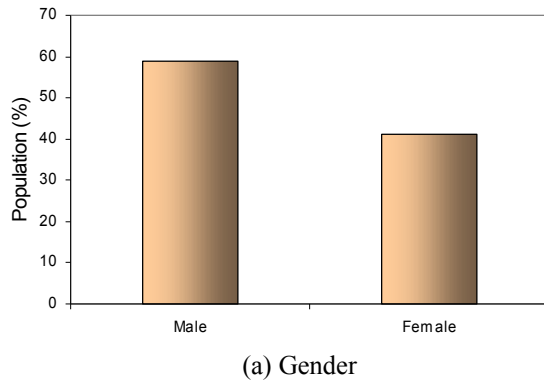
Table 3. List of modified SERVQUAL statements for the service quality within the ETP course administration/delivery.

Dimension	Item	SERVQUAL Statements; <u>underlined-phrases</u> are for Expectations and square bracket-enclosed phrases are for Perceptions
Tangibles	1	The related facilities for the implementation of ETP projects <u>should be</u> [are] adequate.
	2	The venues for meetings with Supervisors and coordinators <u>should be</u> [are] conducive (proper place, air-conditioning, accessible, etc.)
	3	The fund allocated for the project <u>should be</u> [is] sufficient.
	4	The allotted timeframe for the project planning and implementation <u>should be</u> [is] adequate.
	5	The laboratories and work space <u>should be</u> [are] clean and safe.
	6	The ETP Guidelines (downloadable from elearning) <u>should be</u> [are] comprehensive and clear.
	7	The content and layout of the ETP course website in elearning <u>should be</u> [is] informative, visually appealing and user-friendly.
Reliability	8	When the ETP coordinators promise to do something with regard to the ETP operation by a certain time, they <u>should do so</u> [do so].
	9	When you have a problem with regards to the operation of ETP, the coordinators <u>should respond</u> [respond] positively and show an interest in solving it.
	10	The ETP coordinators <u>should provide</u> [provide] their services at the time which they have committed.
	11	The ETP coordinators <u>should keep</u> [keep] their records accurately.
Responsiveness	12	The ETP coordinators <u>should inform</u> [inform] students exactly on the dates of evaluations and submissions within the ETP course.
	13	The ETP coordinators <u>should give</u> [give] prompt response to your enquiries / requests.
	14	The Supervisor <u>should give</u> [give] prompt response to your enquiries / requests.
	15	The Supporting Staff (e.g. Technicians) <u>should give</u> [give] prompt response to your enquiries / requests.
Assurance	16	The behaviour of ETP coordinators <u>should give</u> [give] you confidence.
	17	The behaviour of Supervisor <u>should give</u> [gives] you confidence.
	18	The operation of ETP <u>should be carried out</u> [is carried out] in a reliable manner.
	19	The Examiners <u>should provide</u> (provide) fair and consistent evaluation.
Empathy	20	The Supervisor <u>should provide</u> [provides] motivation and support in your activities.
	21	The consultation hours of the Supervisor <u>should be</u> [are] convenient to you.
	22	The Supervisor <u>should have</u> [has] your best interest at heart.
	23	The Supervisor <u>should understand</u> [understands] your specific needs.

#### 4.3. Population of Respondents

The target respondents of this study consisted of engineering undergraduates who were enrolled for the course in the January 2008 semester. Shown in Fig. 3 is the distribution of students by programme and gender. The total population size was 414, of which 58.9% were male and 41.1% female. The students were from the chemical engineering (29.1%), civil engineering (16.0%), electrical and electronics engineering (25.4%) and mechanical engineering (29.5%) programmes. Only 26.3% of

the students responded the survey on expectations and 31.9% on perceptions. The rate of response was acceptable because the students participated in the survey on voluntary basis. Due to the very large number of students, it was difficult to obtain a high response rate from all of them. A similar trend of response rate was observed in a different study [4] of which the number of population was about half of that in the present work.



(b) Programme

Fig. 3. Distribution of students who enrolled in the ETP course for the January 2008 semester, by (a) gender and (b) programme.

## 5 Results and Analysis

### 5.1. Reliability Testing

Considering that each quality dimension consists of multiple items, it was important to ensure that all the items were measuring the same attribute within the respective dimension. For example, there were seven items within the *tangibles* dimension. It would be expected that all the seven items served to provide information about the tangible factor. The reliability of the survey items in measuring the intended attribute was determined using Cronbach's alpha [10] given as:

$$\alpha = \frac{k}{k-1} \left( 1 - \frac{\sum s_i^2}{s_T^2} \right) \quad (2)$$

where  $k$  was the number of items,  $s_i^2$  was the variance of  $i$ th item, and  $s_T^2$  was the variance of the total score formed by summing all the items. The Cronbach's alpha value could only range from 0.0 to 1.0, of which a high value would indicate a high positive correlation among the items, or in

other words, high internal consistency. A value of Cronbach's alpha of between 0.7 and 0.8 would be widely accepted as satisfactory, although higher values would be needed for areas that desired high reliability; e.g. clinical application. For the purpose of this study, values of 0.7 and above would be considered favourable.

As shown in Table 4, the Cronbach's alphas for all the quality dimensions are higher than 0.7, which indicates a high degree of internal consistency. This implies that the items within each quality dimension were positively correlated and hence the items measured the same attribute as intended. High values of Cronbach's alpha (between 0.82 and 0.94) were also reported in a study that used SERVQUAL to measure the quality of the classroom [4]. This previous work can be referred to as a valid comparison since it shared the same intent with that of the present study: measuring quality within an educational setting.

Table 4. Cronbach's alpha for expectation items.

Quality Dimension	Cronbach's Alpha
<i>Tangibles</i>	0.983
<i>Reliability</i>	0.995
<i>Responsiveness</i>	0.998
<i>Assurance</i>	0.996
<i>Empathy</i>	0.999

### 5.2. Gap Analysis

Shown in Table 5 are the scores for the gaps between perceptions and expectations for individual items and across the quality dimensions. Obviously the scores registered negative values throughout. The items in each dimension were subjected to statistical analyses via calculations of the mean and standard deviations for perception and expectation. Clearly, the negative scores suggested that there was a shortfall of the service quality across all the quality dimensions. The largest average gap appeared for *tangibles*, with a mean score of -1.13, while the smallest gap was for *empathy* with a mean score of -0.41. On individual account, Item 3 (the fund allocated for the project should be/is sufficient) had the highest gap score of -2.19, while Item 2 (the venues for meetings with Supervisors and coordinators should be / are conducive) with the lowest gap of -0.07, both of the items contributed to the *tangibles* dimension. The high gaps for the *tangibles* and also for Item 3 indicate

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the scope of improvement in the aspect of  
administration of the ETP course in the future.



Table 5. Gap Scores between Expectations and Perceptions.

Quality Dimension	Item	Expectation Score	Std. Dev.	Average for Dimension (Expectation)	Perception Score	Std. Dev.	Average for Dimension (Perception)	Individual Gap Score	Average Gap Score
Tangibles	1	6.54	0.82	6.57	5.14	1.43	5.44	-1.40	-1.13
	2	6.14	1.04		6.07	1.09		-0.07	
	3	6.46	1.10		4.27	1.78		-2.19	
	4	6.42	0.95		5.10	1.53		-1.32	
	5	6.74	0.57		5.69	1.21		-1.05	
	6	6.84	0.47		6.03	1.10		-0.81	
	7	6.83	0.48		5.80	1.22		-1.03	
Reliability	8	6.69	0.66	6.69	6.02	1.07	6.05	-0.67	-0.64
	9	6.80	0.52		6.08	1.10		-0.72	
	10	6.61	0.72		6.08	1.04		-0.53	
	11	6.67	0.72		6.04	0.98		-0.63	
Responsiveness	12	6.76	0.62	6.69	6.32	1.06	6.11	-0.44	-0.59
	13	6.62	0.72		6.07	1.09		-0.56	
	14	6.72	0.61		6.31	0.97		-0.40	
	15	6.68	0.69		5.73	1.37		-0.95	
Assurance	16	6.50	0.79	6.62	6.08	1.02	6.00	-0.42	-0.62
	17	6.64	0.66		6.19	0.99		-0.45	
	18	6.58	0.71		5.95	1.04		-0.62	
	19	6.77	0.59		5.80	1.38		-0.98	
Empathy	20	6.64	0.71	6.56	6.27	1.06	6.14	-0.37	-0.41
	21	6.60	0.73		6.01	1.29		-0.59	
	22	6.49	0.82		6.14	1.08		-0.34	
	23	6.50	0.78		6.14	1.06		-0.36	

There was a considerable difference in the average of standard deviation between expectation and perception scores. The average of standard deviation was 0.72 for expectation and 1.17 for perception. The low standard deviation for expectation suggested that students had the same level of expectation for the quality attributes within each dimension. The high variation in responses for perception could be attributed to a few main factors, namely diversity in supervision, team members, and evaluation by examiners, as well as the level of achievement in individual projects. Students were not subjected to the same conditions, and therefore this gave rise to a range of experiences that influenced the students' opinions and perceptions of the quality dimensions.

## 6 Conclusions

This paper has provided a new perspective to assessment of effectiveness of course delivery that departed from the conventional assessment methods in the academia, wherein the core interest lies on the learning effectiveness of students. In this research, however, the main attention has been shifted to the effectiveness of administration of a course that involves multi-disciplinary teams, which is called the Engineering Team Project (ETP). SERVQUAL has been used as a tool to identify the gaps between the expectation and perception of students with respect to the critical attributes that underscore the effectiveness of administration in ETP. The gap scores from

SERVQUAL will guide the ETP coordinators to prioritize areas for improvement, in order to 'close the gaps'.

The reliability of the SERVQUAL survey was good, with values for Cronbach's alpha for all the five dimensions being above 0.98. To facilitate continuous improvement in ETP, SERVQUAL should be administered every semester to verify on the effectiveness of any improvement initiatives that may have been put in place. Additionally, the results of SERVQUAL can highlight the areas where performance is at acceptable or exceptional level. This would guide the ETP coordinators in maintaining good performance with the aim to achieve sustained satisfaction.

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