

Canonical Correlation Analysis of Student Perception on Instructional Quality and Satisfaction

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Abstract - The study models student perceptions on instructional quality and student satisfaction using canonical correlation analysis. Data from two survey occasions were modeled to assess the strength and relative consistency of the instructional quality variables in predicting student satisfaction. Results show that student's perception on the adequacy, usefulness, accessibility, safety and convenience of the learning facilities and their perception on the faculty teaching strategies and subject matter knowledge are the most influential factors of student satisfaction. Canonical functions and cross-loadings derived from the data sets show similar pattern or trend which is taken to indicate consistency of the models. The implication of the findings to managing student satisfaction among higher education institutions is briefly discussed.

INTRODUCTION

Student satisfaction is an important indicator of service quality in higher education. With the students as the primary customers, student satisfaction on the services of a college or university will most likely determine student choices, loyalty and retention (Kara and Deshileds, 2004). This is often the reason why student satisfaction is considered as a key outcome among many higher education institutions (HEIs).

With the growing competition among HEIs locally and globally, students are presented not only with a lot of choices on academic programs but also on which colleges or universities to enroll in. This is where student's perception on the reputation and instructional quality of HEIs come into perspective. If the reputation or perception of instructional quality in a college or university is poor, students may likely opt for a better perceived option. If students feel unsatisfied, they may likely leave or transfer to a more favorable choice. But, if satisfied, a student can be loyal and is likely to re-enroll and even help promote the college or university among friends and colleagues.

In this context, it is imperative for higher education institutions to measure and wisely manage student's satisfaction. In doing so, HEIs can monitor if they are "doing things right" and "doing the right things" for their students. In other words, higher education institutions get to continually pursue and meet the kind of services and service inputs (such as facilities and laboratories) that students expect. Thus, measuring and managing student satisfaction promotes continuous improvements in curricular programs, teaching and support services.

Managing student satisfaction requires a deeper understanding of its key drivers or factors. In this paper, it is posited that student's perception on a combination instructional quality variables are drivers of student satisfaction. Hence, directly are also the key drivers of institutional improvement. This paper examined and derived models of student's perception on instructional quality and satisfaction using canonical correlation analysis. Data from two survey occasions were modeled to assess, the strength and relative consistency of the instructional quality variables in predicting student satisfaction. With the models presented, critical factors that influence student satisfaction are assessed. The implication of the models to managing student satisfaction is briefly discussed.

FRAMEWORK

A number of different key factors that influence customer or student satisfaction can be found in literature. These factors can be generic (see Staes, and Thijs, 2008; Zeithaml, et al., 1990 and Johnston, 1995) which is thought to be useful regardless of business-type or industry or they can be academe-based such as to those identified by Elliot (2003), Garcia-Aracil (2009) Wiers-Jenssen et al. (2002). These factors are closely tied to a) the provision of the service itself, b) service provider's competence and c) the immediate environment in which the service is delivered.

In this study, the key drivers or factors thought to influence student satisfaction are collectively referred to as instructional quality variables. These variables include student's perception on the quality of: subject matter knowledge of faculty, faculty teaching strategies, rapport with students; accessibility, convenience, adequacy, safety and usefulness of facilities.

These variables are aligned with or similar to those found in literature. For example, student's perception on subject matter knowledge of faculty can be linked to the service provider's competence and faculty teaching strategies, rapport with students are provisions of the service; whereas, accessibility of facilities, convenience, adequacy, safety and usefulness of facilities pertains to the immediate environment in which service is delivered. On other hand, student satisfaction is assessed in terms of the overall satisfaction and the student's perception of the value of their money.

Student satisfaction is thought to be dependent on the quality of services as exemplified by the different instructional quality variables. Hence, student's perception on these variables as measures of the quality of service should be directly related to student satisfaction. This study investigates this hypothesized relationship by using canonical correlations. As a multivariate procedure, the canonical correlation analysis examines the strength of student's perception on the instructional quality variables as predictors of student overall satisfaction and the perception of the value of their money.

OBJECTIVES OF THE STUDY

The study determined the canonical correlation analysis of student perception in institutional quality and satisfaction. The study also examined the consistency of the models derived by comparing two data sets taken on separate occasions.

MATERIALS AND METHODS

Participants

The study used the descriptive design with inferential techniques. A database of the Academic Quality Assurance Office of Brokenshire College on two survey occasions was accessed for this study. The first data set involved 1099 students, of which 22.12% are male and 71.79% are female. The second data set includes responses from 1193 students with 34.12% male and 65.88 female students.

Measures

A Student Satisfaction Survey Tool was administered to the participants of the study. The tool was designed to assess student's perception on the quality on instructional quality variables and their satisfaction. The tool has 3 parts: a) Teaching Service dimension which assesses Subject Matter Knowledge of Faculty, Faculty Teaching Strategies, and Rapport with Students, b) Learning Facilities dimension which Accessibility of Facilities, Convenience, Adequacy, Safety and Usefulness of Facilities and c) Student Satisfaction which assesses Overall Satisfaction and student's Perception of the Value of their Money.

For Teaching Service and Learning Facilities dimensions students are asked to rate using a 4-point scale, ranging from Very Poor to Excellent, while for student satisfaction students are asked to rate a 4-point scale, ranging from Very Dissatisfied to Very Satisfied.

Factor loadings for the Teaching Dimension ranges from 0.61 – 0.74, Learning Facilities Dimension: 0.59 – 0.75, and Student Satisfaction: 0.5 – 0.93. Goodness-fit-Statistic show a good fit with $\chi^2(18) = 79.81$, $p < 0.01$.

Procedure

Data set from this study is collected on two separate survey seasons. The first data set was obtained in a survey in August 2010 and the second was obtained in a survey conducted in February 2011, both in the same school year. The surveys did not use the same students twice since it would be technically impossible given the anonymous nature of participation. Students were explained of the purpose of the survey and were encouraged to give truthful answers. Responses of students are electronically coded and saved for analysis.

Data Analysis

The data sets were analyzed using canonical correlation procedures. The canonical functions were the first to be derived followed by the canonical loadings and cross-loadings of each variable. To assess the significance of the canonical models or functions, Wilks' Lambda, Pillai's Trace and Hotelling-Lawley Trace were computed. For simplicity, only standardized canonical loadings and cross-loadings are obtained. Since it is not the interest of the study to examine how well the dependent variables explain the independent variate, its cross-loading statistics are not reported. The consistency of the models was examined at face value by observing the highest and lowest canonical loadings and cross-loadings. Pattern similarities and dissimilarities are observed.

RESULTS

Data Set 1

Canonical correlation analysis was performed to meet the objective of developing models for *instructional quality variables* as predictors of *student satisfaction*. The analysis for the first data set yielded two canonical models or functions, with only the first function being statistically significant ($p=0.00$). Multivariate tests show that derived canonical roots, if taken together, is also significant (see Note on Wilks' Lambda, Pillai's Trace and Hotelling-Lawley Trace statistics). Since,

the derived second canonical function is of no particular significance, further analysis on its statistics is ignored. Table 1.0 shows the overall fit of the derived canonical functions for the first data set.

In the first function canonical correlation is positive and fairly strong at 0.51 ($p < 0.01$) although the variance in *student satisfaction* variate that is explained by students perception of the *instructional quality* variables is approximately 27%.

Table 1.0 Overall fit of derived canonical functions

Canonical Function	Canonical Correlation	Canonical R ²	F	df	Probability
1	0.51	0.27	21.96	16	0.00
2	0.06	0.00	0.48	7	0.85

Note: Wilks' Lambda = 0.73, $F(16, 2054) = 21.96, p < 0.01$; Pilla's Trace = 0.27, $F(16, 2056) = 20.20, p < 0.01$; Hotelling-Lawley Trace = 0.37, $F(16, 1677) = 23.74, p < 0.01$

The canonical loadings for the predictor variate showed a strong influence of learning facilities related variables. The highest canonical loadings can be observed from the students perception on the adequacy (0.76), usefulness (0.74), accessibility (0.73) and convenience of facilities (0.71). Among teaching related variables, student's perception on the teaching strategies (0.71) of the faculty has the most influence. On the other hand, canonical loadings for student's satisfaction variate show a comparable influence of student's overall satisfaction (0.87) and perception on the value of money (0.88). Figure 1.0 shows the model for the first canonical function.

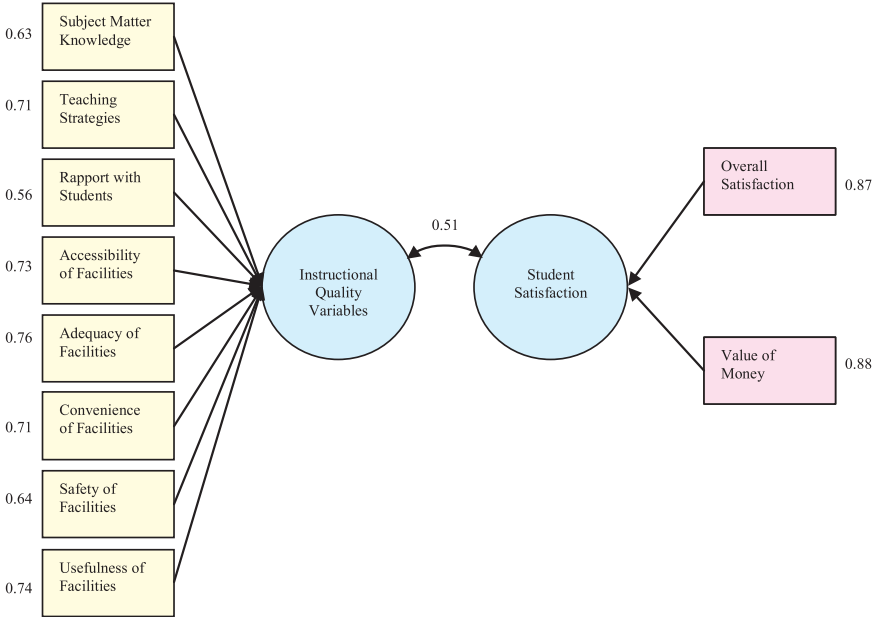


Figure 1.0 Model for the first canonical function illustrating the canonical loadings and correlation

Further examination of canonical cross-loadings, shows that the variate on *student satisfaction* is also mostly influenced by learning facilities related variables: student's perception on *adequacy* (0.40), *usefulness* (0.39), *accessibility* (0.38) and *convenience of facilities* (0.37). Among teaching related variables: student's perception on *teaching strategies* (0.37) and *subject matter knowledge* (0.32) are the most influential factors. Student's perception on *rapport* (0.29) has the least influence among the predictor variables. It can also be noted that the canonical cross-loadings are all positive, implying direct relationship between the individual predictor variables and *student satisfaction*. Table 2.0 shows the canonical cross-loadings for the first data set.

Table 2.0 Canonical cross-loadings for the first data-set

Variables	Canonical Function 1	Canonical Function 2
Subject Matter Knowledge	0.32	0.00
Teaching Strategies	0.37	-0.02
Rapport with Students	0.29	-0.01
Accessibility of Facilities	0.38	-0.02
Adequacy of Facilities	0.40	-0.004
Convenience of Facilities	0.37	-0.002
Safety of Facilities	0.34	0.02
Usefulness of Facilities	0.39	0.02

Data Set 2

Analysis for the second data set yielded two (2) statistically significant canonical functions ($p=0.00$; 0.03). Multivariate tests show that the derived canonical roots, taken together, are significant. Canonical correlation for both functions is positive and shows direct relationship between independent and dependent variate. However, the strength of the canonical correlation in first function (0.64) is more prominent than that of the second function (0.11). In the first function, the amount of variance in *student satisfaction* variate that is explained by student's perception of the *instructional quality* variables is 41% in comparison to the 1% in the other function. This means that while the second function is statistically significant, its relative importance is lesser compared to that of the first function. The analysis however, takes note of the significance that the canonical and cross-loadings of the second function.

Table 3.0 Overall fit of derived canonical functions for the 2nd data set

Canonical Function	Canonical Correlation	Canonical R ²	F	df	Probability
1	0.64	0.41	42.50	16	0.00
2	0.11	0.01	2.18	7	0.03

Note: Wilks' Lambda = 0.58, $F(16, 2176) = 42.50$, $p < 0.01$; Pilla's Trace = 0.43, $F(16, 2178) = 36.76$, $p < 0.01$; Hotelling-Lawley Trace = 0.71, $F(16, 1776) = 48.44$, $p < 0.01$

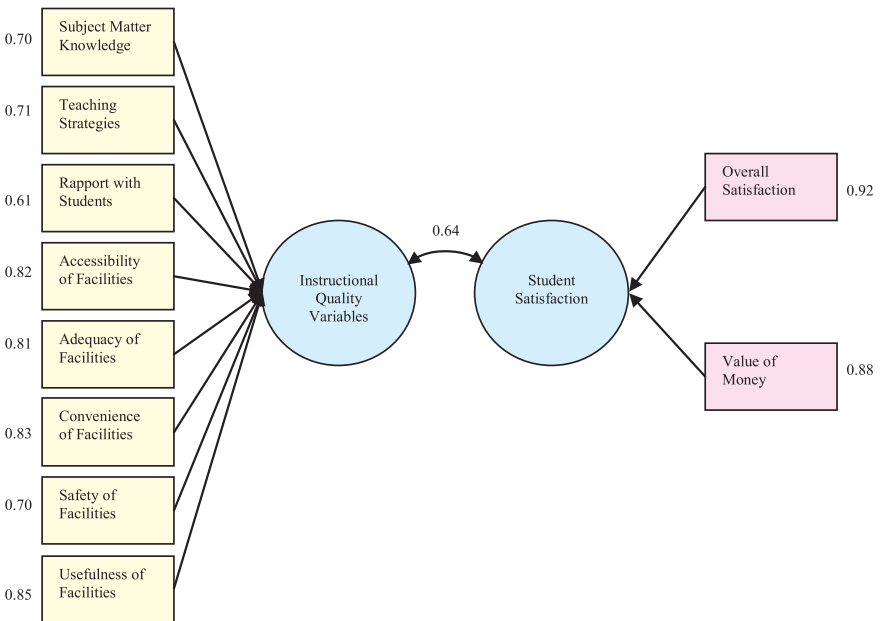


Figure 2.0 Model for the first canonical function of Data Set 2 illustrating the canonical loadings and correlation

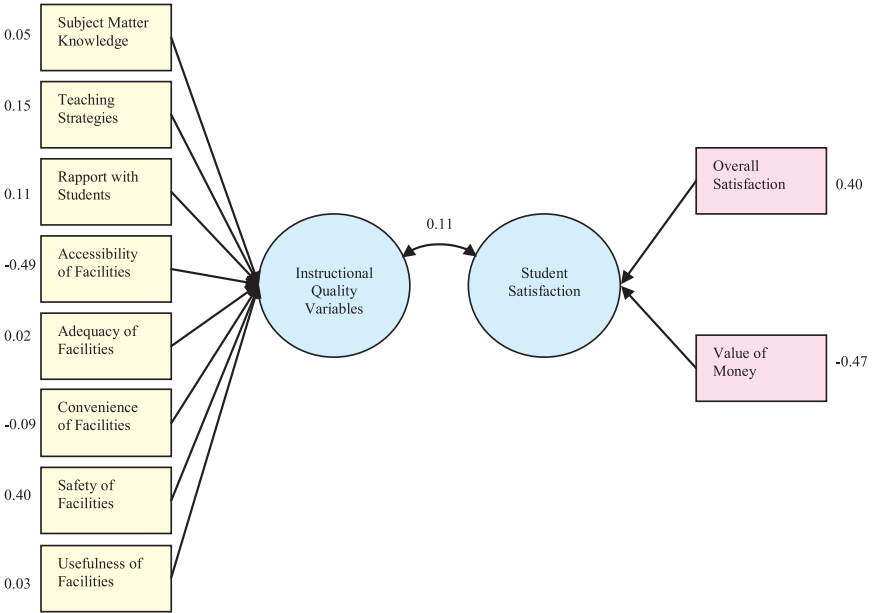


Figure 3.0 Model for the second canonical function of Data Set 2 illustrating the canonical loadings and correlation

Figure 2.0 and 3.0 shows the models for the first and second canonical functions respectively. In the first function, the variate for the predictor variable is strongly influenced by student’s perception of the *usefulness* (0.85), *convenience* (0.83), *accessibility* (0.82), and *adequacy of facilities* (0.81). Among the teaching related variables both the student’s perception of the *subject matter knowledge* (0.70) and *teaching strategies* (0.71) of the faculty has the most influence. Student’s perception on *rapport* (0.61) has, again, the least influence among the predictor variables. Figure 2.0 shows a similar trend to that of the findings in the first data set as shown in figure 1.0. This may be taken to indicate some consistency on the model.

The second function, however, shows a different structure. Some variables have showed negative canonical loadings, which indicate an inverse relationship with their respective variates. In addition, the

variables on the *safety of facilities* (0.40) and *rapport with students* (0.11) seem to influence their variates better than in the way it did in the first function. Interestingly, the student's perception on the *safety of the facilities* (0.40) *teaching strategies of the faculty* (0.15) and *rapport with students* (0.11) remained to be largely influencing its variate. This may be taken to indicate that perceptions are robust predictors of its variate.

It is also interesting to note that the findings in the canonical cross-loadings show a similar pattern or trend to that of the findings on the canonical loadings in the first data set (see Table 2.0). Facilities related variables still largely influence the variate in student satisfaction while, *subject matter knowledge* and *teaching strategies* are the most influential among teaching related variables.

On the other hand, while canonical cross-loadings are almost negligible in the second function, it is notable that the student's perception on the *teaching strategies* (0.02) of the faculty and the *safety of facilities* (0.05) remained to be positively most influential to *student satisfaction*.

Table 4.0 Canonical cross-loadings for the second data set

	Canonical Function 1	Canonical Function 2
Subject Matter Knowledge	0.45	0.01
Teaching Strategies	0.45	0.02
Rapport with Students	0.39	0.01
Accessibility of Facilities	0.52	-0.06
Adequacy of Facilities	0.52	0.00
Convenience of Facilities	0.53	-0.01
Safety of Facilities	0.45	0.05
Usefulness of Facilities	0.55	0.00

DISCUSSION

The findings of the study point to the importance of student's perception on the provisions for learning facilities and teaching to student satisfaction. Student's perception on the *adequacy, usefulness;*

accessibility, safety and convenience of the learning facilities has been observed to largely and consistently influence *student satisfaction*. While on the other hand, among teaching related variables student's perception on the *teaching strategies* and *subject matter knowledge* of the faculty are the most consistent and influential factors.

The importance of material provisions (adequacy, accessibility and convenience) and provision of its use as inputs to instructional activities has been highlighted in many quality assurance systems. ISO 9001:2008 through the International Workshop Agreement 2 (2003), for example, gives importance to the provision and management of material resources in conformance to student requirements. Local accreditation standards and systems (e.g. ACSCU-AAI, PAASCU, etc.) also emphasize the importance of facilities in achieving a certain accreditation level. The findings of this study show the primary importance of quality provisions such as adequacy, access and usefulness of facilities. It also highlighted environmental characteristics such as safety and convenience. The results also seem to suggest the stronger impact of facilities to student satisfaction in comparison to the other instructional quality variables.

In this end, it would be important for higher education institutions to ensure that there are "adequate, convenient, safe and accessible learning facilities" for students and teachers to "use" for instructional purposes. It would be wise for the management to plan for continuous investments and improvements on facilities that are useful and ensure that every student gets adequate access. It is also important to monitor facility usage and upkeep to ascertain whether there are unused facilities or there are needed facilities that are inadequate or unavailable. Most importantly, the findings point to the practical implication of linking monitoring data to planning for investments in facilities to ensure that higher education institutions gets to acquire adequate facilities for its students.

On the other hand, the importance of student's perception on the *teaching strategies* and *subject matter knowledge of faculty* give value to the quality of service that the teacher's provide in relation to student satisfaction. Shulman (1987) who described these factors as, "content knowledge" and "pedagogical content knowledge" emphasized these factors as necessary "know-how" for effective teaching practice. This

gives importance of the “teaching competence” that the faculty should demonstrate in order to satisfy their students.

To manage these key teaching drivers of student satisfaction, HEIs must a) ensure that it has qualified faculty members who act as competent service providers to students and b) that they continue to demonstrate such competence all throughout. It is also important to highlight that “qualification” includes “*subject matter knowledge*” and “*pedagogical content knowledge*” or the knowledge of using appropriate strategies to make students understand the content. In this perspective, qualifications go beyond an examination of mere educational credentials and one-shot class demonstrations. Qualifications and competence in this sense should be sustainable such that interventions and faculty development programs should seek to develop and improve both subject matter knowledge and pedagogical skills. Moreover, higher education institutions must find innovative means to monitor and ensure the quality of classroom teaching practices. This requires a thoughtful and constant rethinking of supervision and quality assurance systems in instruction.

It is also interesting to note that while “rapport with students” remained important, its value as a predictor of student satisfaction is diminished in comparison to the faculty’s competence in knowledge and pedagogy. This has been consistently shown in the results of the two survey occasions. This may mean that among the teaching factors, management priority should focus on faculty knowledge and pedagogy over rapport.

In addition, considering that the cross-variances explained in the study are only around 27% to 41%, it would be interesting to explore other factors and key drivers of student satisfaction in further studies. One possibility would be to include other areas in classroom management besides “rapport”, such as the faculty skills in “discipline” and “communication” management.

CONCLUSIONS

The canonical models highlighted the importance and influence of student’s perception on the *adequacy, usefulness; accessibility, safety and convenience* of the learning facilities, *teaching strategies* and *subject*

matter knowledge of the faculty to student satisfaction. Among these key drivers the students' perception on the quality provisions for facilities seemed to be most influential. The consistency of these models also strengthens the position that student perceptions on the identified key drivers are not to be taken lightly by higher education institutions. Poor management of these perceptions will likely lead to poor student satisfaction. Poor student satisfaction will likely result to undesirable student choices and retention outcomes. For the management of higher education institutions, student satisfaction is simply an outcome that they cannot underachieve.

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