ENHANCED TESF METHODOLOGY FOR COURSE EXCELLENCE

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The need to achieve excellence in services provided by a University has been the object of study and research for several decades. Often, the focus is not only on the education service, but on several satellite services provided by a university. This article focuses on teaching where, according to the authors, improvement actions of an academic institution should always begin. The work describes a tool for measuring student perceptions of selected aspects of a course. This tool is part of the Teaching Experiment and Student Feedback (TESF) methodology previously developed by the authors. Here, the steps to build a student satisfaction coefficient are fully described and data collected in one specific course is analysed. The TESF methodology is in line with evidence-based management principles and helps statistics teachers make practical data driven decisions.

INTRODUCTION

In Universities the primary objective of education, intended as "knowledge/competence transfer", is mainly pursued through the design and implementation of degree programs, and of the courses there included. In general, the university course is a basic service of an academic institution (Fram & Camp, 1995), therefore, according to the authors, it would be advisable to start from that to achieve an overall improvement.

Every university is responsible of the offered courses respect to different stakeholders, whose interests are not always in agreement or considered of the same importance.

This work focuses on a single course and the possibility to improve it through the direct action of its teacher and the involvement of the attending student class. Referring to the provision in a process logic, teacher and students are the two subjects having a crucial role: the teacher owner of the course, to whom the task of transferring knowledge/skills it is assigned, and students, direct users of the provided training (Sirvanci, 1996), aiming to acquire the knowledge/skills.

The tool of the present work is part of the TESF methodology (Barone & Lo Franco, 2009), a methodology to design a course in a perspective of continuous improvement. It was inspired by the SERVQUAL (Parasuraman et al., 1988), a useful model to measure the perceptions of students on some aspects of teaching. In that work this tool was used in combination with the design of teaching experiments. This paper shows how to define an indicator (Student Satisfaction coefficient) providing a summary of the responses obtained by the feedback tool, also in absence of experiments. The coefficient here defined is a further enhancement of the TESF to obtain a synthesis of the perceptions collected through the feedback tool in a useful indicator for monitoring over time and comparisons between different courses.

The article is divided into four sections followed by conclusions and references. The Section 1 argues about the role of the student respect to the generic university course, then the measurement tool (Section 2) and the methodology (Section 3) are presented, the Section 4 is devoted to the application of the method and the analysis of results in a statistics course.

THE STUDENT: ROLE AND LIMITS

The issue of the proper role of the student in relation to the services provided by a university, especially regarding a generic course, continues to be object of a widespread debate (Barone & Lo Franco, 2009; Redding, 2005). Many consider the student as a customer of university. According to ISO 9000:2005 "a customer is anyone who receives products or services from a supplier organization. Customers can be people or organizations and can be either external or internal to the supplier organization. Examples of customers include clients, consumers, end-users, purchasers, retailers, and beneficiaries". This definition appears comprehensive and appropriate because it avoids conflicts and misunderstandings due to puns.

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Then, other subjects can be recognized as customers of the university course since they receive a service from the university. However they are not direct users.

So the student is not the only customer/user of a university course. He is the most direct, and a stakeholder among other stakeholders (Maguad, 2007). Starting from this statement, we can try to deepen the issue often debated, but not solved, of the legitimation of listening and using of the so called voice of the student. In the literature, the positions on this are controversial, ranging from those who do not recognize any usefulness to the student feedback (Richardson, 2005), to those who believe the student feedback as an essential element for the university improvement (Kember et al., 2002).

To students, as well as to any other university stakeholder, one can or cannot recognize rights, power, duties and obligations, according to the specific interest under consideration.

According to us, referring to the contents to be included in a feedback tool of student satisfaction for a course, certain aspects such as the topics to be included in the syllabus and the relative deepening, the amount of time devoted to lectures/practices and the relation between them, should not be evaluated by the students. In fact, these variables depend upon two main factors that are of direct concern to the State, not the students: the need to transfer the most appropriate knowledge and skills in relation to the scenarios of the labor market, and the need to apply the most suitable means of transferring. Moreover, students do not generally possess the necessary skills to express an opinion on these issues.

On the other hand, students may be given the option of expressing an opinion on the teacher's ability to transfer knowledge (e.g., the perceived degree of clarity, the perceived efficacy of the use of certain teaching aids, etc.), as well as on the conditions of the places where the lessons are conducted (e.g., availability of seats in the classroom, air conditioning, etc.); because these aspects directly affect the learning process (Masjuan & Troiano, 2009). In these cases the student feedback can be a valuable source of useful information to adopt improvement measures.

THE FEEDBACK TOOL

Objectives

In order to construct the feedback tool, we firstly wondered which were the elements that a student takes in consideration for a mature assessment of satisfaction for a teaching. The connection with the scheme of the five dimensions of service quality (reliability, responsiveness, tangible elements, assurance, and empathy), characterizing the well-known SERVQUAL model (Parasuraman et al., 1988), was immediate. The idea of considering the classification given by Parasuraman et al., which framework for the development of a tool for assessing customer satisfaction has been applied in other areas (Lee et al., 2000; Othman & Owen, 2001) was immediate.

Furthermore, in developing a new tool for measuring the quality of education received by students, it was considered necessary to take into consideration some issues particularly relevant to the construction of a synthetic indicator. These issues relate to: (a) the opportunity to express the position and variability of judgments through a single indicator, (b) the consideration of potential influence factors on the assessment of satisfaction, (c) the need to define a feedback tool and the associated analysis methodology to be of direct use from the teacher's perspective (Panasuk & LeBaron, 1999). Accordingly, we built a tool that: (a) defines an overall indicator of perceived teaching quality; (b) allows measuring the relative importance for students to different aspects of a course and the correlation between importance and perception; (c) can be used by any teacher, autonomously.

Structure

The main documents of the feedback tool are two: the Weighting Grid (allowing each student assigning a relative weight of importance to the five dimensions of quality) and the Evaluation Form (it coincides with the Periodic Form in Barone & Lo Franco, 2009, but it also includes the five items relating to the reliability" dimension. The "reliability" is defined as: *the reliability implies the correspondence between the perceived service and the trust that the student places on the course as a result of the information sought and received. It means the current*

capacity of the course to "keep its promises" in the sense that everything about the course that was first announced (the contents of the subject, class schedule, modalities of examinations, recommended materials for studying, etc.) occurred without any unwanted changes. The weighting grid allows recording the expectations of students and it should be submitted at the beginning of a course. Instead, the evaluation form is designed to gather the perceptions of students and it should submitted at the end of the course. This is a questionnaire consisting of *m* items expliciting the quality dimensions of a course. These documents are used together with two others useful to support students in the compilation of the formers (Barone & Lo Franco, 2009).

THE METHODOLOGY

Let *X* be the score assignable to a generic item of the feedback tool. It is a quantitative variable measured on a Likert scale (Göb et al., 2007). We call x_i with *i*=1,2,..,*N*, the score assigned by the *i*-th respondent to the item. Furthermore we indicate as $w_{\min}$, the minimum assignable score, and $w_{\max}$, the maximum assignable score.

Let $x_{\min} = 0$ and $x_{\max} = 1$. Differently, if $w_{\min}$ is not equal to zero, and/or $w_{\max}$ is not equal to 1, the collected scores, say *s*, must be normalized according to the formula:

$$x = (s - s_{\min}) / (s_{\max} - s_{\min}) \tag{1}$$

being $s_{\min}$ and $s_{\max}$ the minimum and the maximum score of the adopted scale, respectively.

We define r_i the order statistic relative to the respondents, i.e. the relative rank of the i-th respondent ordered on the basis the attributed score.

$$r_i = i/N \qquad i = 1, 2, ..., N \tag{2}$$

We furthermore define ξ_i the ratio between the cumulative score of the first *i* respondents and the maximum value obtainable if all respondents would assign $w_{\max}$.

$$\xi_i = \sum_{k=1}^{i} x_k \Big/ (N \cdot x_{\max}) \qquad i = 1, ..., N \tag{3}$$

We can plot the points with coordinates (r_i, ξ_i), on a Cartesian graph. Then we can draw a connecting line starting from the origin (Figure 1). The area between the line and the horizontal axis is said "*Area of satisfaction*" (A_S). It represents the satisfaction expressed by the respondents:

$$A_S = \sum_{i=0}^{N-1} (\xi_i + \xi_{i+1})(r_{i+1} - r_i)/2, \tag{4}$$

having posed $r_0 = 0, \xi_0 = 0$. In the hypothesis in which all respondents assign the score $x_{\max}$, the line is the bisector line. It will bound the so called "*Area of full satisfaction*" (A_{FS}) equal to the area of the triangle with vertexes (0, 0), (1, 0), (1, 1). Its value is $A_{FS} = 0.5$.

Figure 1 shows the satisfaction line for the data of one of the items in the proposed application. We define *S* the "*Satisfaction Coefficient*" given by the ratio between the Area of Satisfaction and the Area of Full Satisfaction:

$$S = A_S / A_{FS} = \sum_{i=0}^{N-1} (\xi_i + \xi_{i+1})(r_{i+1} - r_i) \tag{5}$$

It represents a summary measure of the satisfaction expressed by students with reference to a specified item. *S* is always ranging between 0 and 1. With the data of Figure 1, *S* = 0.62.

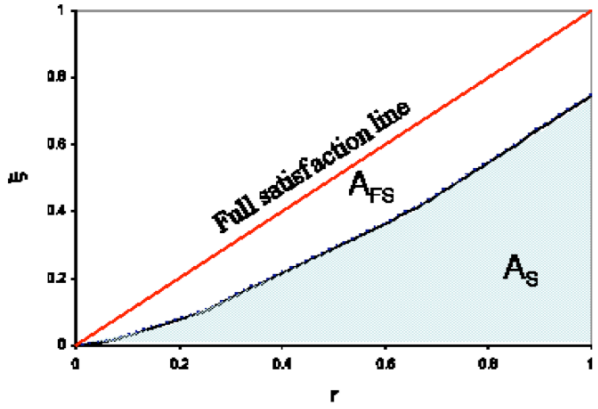

Figure 1. Areas of satisfaction and Full satisfaction

The weights of the Quality dimensions

Let w_i (i=1, 2,.., N) be the weight assigned by the i-th respondent to the quality dimension in which the considered item is included. Let indicate with $w_{\min}$, and $w_{\max}$ respectively the minimum and the maximum attributable weight. We pose:

$$w_{\min} = x_{\min} = 0; \quad w_{\max} = x_{\max} = 1 \tag{6}$$

If the weight range is different from (0,1), it is necessary to adopt a normalization an in (1). To formally consider the weights, we define a variable x_i' (i=1,2,..,N):

$$x_i' = x_i - (w_i - w^*) \tag{7}$$

where w^* is the "neutral" weight in the hypothesis of indifference between the D dimensions:

$$w^* = \left(w_{\max} - w_{\min}\right)/D \tag{8}$$

The application of (7) implies, in general, an extension othe score range such that: $x'_{\max} - x'_{\min} = (x_{\max} - x_{\min}) + (w_{\max} - w_{\min}) > x_{\max} - x_{\min}$.

Basically, the formula (7) implies a lowering of the assigned score if the assigned weight is higher than w^*, and vice versa. Using the (7) we get:

$$A'_S = \sum_{i=0}^{N-1} \left(\xi'_i + \xi'_{i+1}\right)\left(r_{i+1} - r_i\right)/2 \tag{9}$$

Since A_{FS} is a constant, the coefficient S', taking into account the weighting will be given by:

$$S' = \frac{A'_S}{A_{FS}} = \sum_{i=0}^{N-1} \left(\xi'_i + \xi'_{i+1}\right)\left(r_{i+1} - r_i\right) \tag{10}$$

Correlation between weights and scores

A more careful analysis shows the possibility that there might be a correlation between the scores and the weights assigned by a student to the items of the evaluation form. Therefore we can review the weighed scores considering also the coefficient of correlation weights-scores

$$x_i'' = x_i - (w_i - w^*) - \rho_i \cdot \tau \tag{11}$$

where ρ_i is the Pearson linear correlation coefficient weights-scores for the *i*-th respondent calculated over the set of *m* items. Being x_{ij} the score given by the *i*-th respondent to the *j*-th item ($j = 1,...,m$) and w_{ij} the weight given by the same respondent.

$$\rho_i = \frac{\sigma_{x_i w_i}}{\sigma_{x_i}\sigma_{w_i}} = \frac{1}{m}\sum_{j=1}^{m}\left(x_{ij} - \overline{x}_i\right)\left(w_{ij} - \overline{w}_i\right) \Bigg/ \left[\sqrt{\frac{1}{m}\sum_{j=1}^{m}\left(x_{ij} - \overline{x}_i\right)^2}\sqrt{\frac{1}{m}\sum_{j=1}^{m}\left(w_{ij} - \overline{w}_i\right)^2}\right] \quad (12)$$

The constant τ is the unit step of the metric scale used for the satisfaction judgment.

The implementation of (11) determines in general a further extension of the scores range, i.e. $x''_{\max} - x''_{\min} > x'_{\max} - x'_{\min}$.

Therefore, a correction of the score down in the presence of positive correlation will result, while, a correction of the score up will result in the presence of negative correlation.

As in the transition from *x* to *x'*, even when passing from *x'* to *x''* the aim is to try to correct the scores assigned by respondents to take into account variables affecting them and to make them more homogeneous, and finally drive the teacher to the most appropriate improvement actions. While in the case of weights these values are explicitly given by the respondents, in the case of the correlation we are investigating a possible hidden factor of variation.

By applying the (11), the satisfaction coefficient becomes:

$$S'' = A''_S / A_{FS} = \sum_{i=0}^{N-1}\left(\xi''_i + \xi''_{i+1}\right)\left(r_{i+1} - r_i\right) \quad (13)$$

We must consider that the range of S'' is wider than the range of *S* containing also negative values. In order to compare the *S* values with the values obtained through the (13) we transform the S'' values by a linear transformation.

APPLICATION OF THE METHODOLOGY

The feedback tool was submitted to sixty-nine students i.e. the population of students attending the Statistics course included in the degree program in Environmental Engineering at the University of Palermo, in the academic year 2006/2007.

The items: 2.1 “Classroom comfort” and 2.2 “Functionality of the tools used for lessons” get low scores, indicating the “Tangibles” as the most critical area. Conversely, the dimension "Assurance" is the most satisfactory, particularly for the items: 3.1 “Teacher’s mastery on the topics of the course”, 3.4 “Possibility for the students to make statements during the lesson”, and 3.5 “Teacher’s kindness and availability”.

The satisfaction coefficients S, calculated for each item, are aligned with the average scores (see Table 1), but mostly lower. Instead, the dispersion of the data does not undergo substantial changes. Table 1 shows also the values of S'^* and S''^*. The asterisks indicate that the values of S' and S'' were normalized to the same range of *S*. As can be seen from the Figure, the consideration of the weights and the correlation weights-scores results in a reduction of dispersion in comparison with that of the averages. Moreover, the average value of the S''^* is lower than the average of the averages scores. The student satisfaction of the course is rather equally distributed between dimensions, nevertheless it seems that priority should be placed on the improvement of Tangibles.

CONCLUSIONS

Thanks to the application of the tool here presented for measuring and analysing the student feedback, a university teacher, considered as a designer and provider of education, acknowledges the "voice of the student" the role of a valuable resource in order to improve his course. Indeed, this tool allows measuring the perceptions of students attending a course, taking into account the relative importance accorded by them to five course quality dimensions (adapted

from the SERVQUAL model). Furthermore, thanks to the consideration of weights assigned by the students to the quality dimensions, the relationship between such weights (expression of the recognized importance and therefore of the expectations placed on the course) and the assigned scores (expression of the perceptions on the carried out lessons) are also taken into account. The nature of the tool as it was conceived, is complementary to other tools designed to provide the teacher inputs to improve its performances; eg. those aimed at verifying knowledge and skills acquired by students through a course. In this sense, it responds to a self-evaluation logic. Therefore it gives the teacher a predisposition to accept the opinions expressed by his students as a feedback of his teaching activities, together with other feedback, such as the level of acquired preparation.

Table 1. Satisfaction coefficients and average scores vs. item

Item	*I.1*	*I.2*	*I.3*	*II.1*	*II.2*	*II.3*	*III.1*	*III.2*	*III.3*	*III.4*	*III.5*	*IV.1*	*IV.2*	*IV.3*	*IV.4*	*IV.5*	*V.1*	*V.2*	*V.3*	*V.4*	*V.5*	*Ave.*	*std.dev.*
S	0.62	0.49	0.50	0.22	0.44	0.53	0.75	0.54	0.52	0.80	0.74	0.61	0.68	0.50	0.45	0.43	0.52	0.57	0.48	0.60	0.62	0.55	0.13
S ' *	0.68	0.61	0.62	0.52	0.63	0.66	0.76	0.66	0.64	0.78	0.76	0.70	0.73	0.64	0.61	0.60	0.66	0.68	0.64	0.70	0.71	0.67	0.06
S " *	0.64	0.58	0.59	0.51	0.59	0.62	0.69	0.61	0.61	0.71	0.70	0.65	0.68	0.60	0.58	0.58	0.62	0.64	0.60	0.65	0.66	0.62	0.05
Aver.ge Scores	0.75	0.63	0.63	0.37	0.57	0.64	0.84	0.66	0.63	0.88	0.84	0.71	0.77	0.62	0.58	0.56	0.65	0.69	0.61	0.73	0.75	0.67	0.11

Dimension	*I.Responsiveness*	*II.Tangibles*	*III.Assurance*	*IV.Empathy*	*V.Reliability*
S	0.54	0.40	0.67	0.53	0.56
S ' *	0.64	0.60	0.72	0.66	0.68
S " *	0.61	0.57	0.67	0.62	0.64
Average Scores	0.67	0.53	0.77	0.65	0.68

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