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Analysis of Factors Affecting the Satisfaction Level of Engineering Students*

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We present and explore factors which mainly affect the satisfaction level of engineering students in Pakistan. Our questionnaire is based on student expectations from their institutions. Randomly collected data from 225 students are analysed using software MINITAB 14, six-sigma techniques of Measurement System Analysis, Affinity diagram, Pareto Analysis, SIPOC analysis, Cause and Effect matrix and Scatter plots. We find that the teaching skill of teachers is the most critical factor. This work can guide the educational leadership in focusing their resources for best satisfaction of their students.

Keywords: Engineering students, satisfaction, teaching skills, six-sigma.

INTRODUCTION

BECAUSE OF ENGINEER INVOLVEMENT in the development of new technologies and the impact of these technologies on the world economy, it is mandatory for engineering education planners to incorporate the needs of the future in their curricula, keeping themselves abreast of the expectations of their students as well [1]. Amongst different stakeholders of engineering education, students are most important. Thus, development of their intellectual and analytical skills, special technical skills and practical hands-on training [2], as well as accommodating the fast changing expectations of the industrial world [3] should be paramount in their curriculum.

Many techniques have been exercised to enhance the quality of engineering education. As an example, a small number of students in classes results in better communication [4]. Similarly, industry-related projects not only develop their personality and creativity [4] but also improve their decision making capabilities [5] and these entrepreneur skills make them good in teamwork [4]. Incorporating industrial needs [6] and real world applications [7] into curricula underwrites quality in such education. Course content shaped with this in mind not only gives satisfaction to students [8], but education and industrial training are considered equally essential for them [5].

Teachers and the learning environment tend to be given most attention [9]; student satisfaction derived from their expectations is also important [10]. Students generally give priority to aspects of teaching and learning [11] instead of physical facilities. Some findings [12] suggest that no significant correlation exists between the physical characteristics of a school and student satisfaction. However, [13] exterior building style and seating comfort sometimes affect the educational experience. Which isn't to discount the influence of teaching capabilities [14], class notes, lecture contents and up-to-date knowledge of teachers in fostering student satisfaction, as well as class schedules and development of critical thinking [5].

Because of the impact of [15] teaching staff on student satisfaction, communication skills, enthusiasm in teaching, know-how about the subject, availability outside classrooms [16] and ability to deliver lectures are all crucial factors, but Cornelius [17] feels that teachers' preoccupation with research does not give them ample time to develop their teaching methods.

Information retrieval facilities influence student satisfaction [18]. Similarly, reading from hard or soft copies, as well as studying in various environments with no restrictions of classrooms also affect performance [3]. The role of the Internet is crucial for both teachers and students in the enhancement of academic excellence. [19, 20].Online availability of lectures, assignments and their solutions increases the satisfaction level of students [21]. Conversely, lack of interaction between students and teachers due to web-based courses [3, 22] has an adverse impact on the satisfaction level of students [22, 23].

These surveys are mostly done in developed countries, and irrespective of cultural differences, conclusions are generally the same. However, any limitation of applicability is felt down to social, economic and political differences. Thus, the present study is being carried out in the engineering universities of a typical developing country, with an objective to identify those factors that affect the satisfaction level of their students.

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SCOPE

The scope of the present study is limited to institutions located in the Punjab province of Pakistan. Out of the four provinces of Pakistan, i.e. Punjab, Sind, NWFP and Baluchistan, Punjab is the biggest in terms of population and development. Islamabad, the capital of Pakistan, is also located in this province. Pakistan has 11 engineering universities with about 18,125 students out of which 11,000 are from Punjab belonging to five universities. These universities give admission to students from all provinces; however, a major share goes to the students of the home province. In population terms, it has 44.5 million voters out of 79.5 million nationally. After the 2008 elections, Punjab has 148 seats out of 272 seats in the National Assembly [24].

Brainstorming sessions were conducted initially with students to find out about their expectations, which are then transformed into questions and distributed randomly in the final questionnaire to minimize the effects of bias. Data were randomly collected and analysed using six-sigma techniques. Reliability of the measurement system was confirmed with the help of Measurement System Analysis. Pareto Analysis was used to separate a vital few factors. SIPOC analysis was done to distinguish the inputs and outputs of those short-listed factors. Cause and Effect matrix, Scatter plots and coefficient of correlation were used to further filter out the most critical factors. All data were analysed on software MINITAB 14.

STUDENT EXPECTATIONS

An affinity diagram was used to organize student expectations in broader categories based on their perceptions [25, 26] as Sunil et al. [27] used an affinity diagram to arrange customer experiences of manufactured products. Attitudes to the following were probed:

1. Regular classes
2. Timely exams
3. Up-to-date knowledge of teachers
4. Comfortable classrooms
5. Lab equipment/student ratio
6. Teaching skills of teachers
7. Availability of books in library
8. Availability of industrial projects for students
9. Library timings
10. Availability of Internet to every student
11. No politics in university
12. Recreational trips
13. Extracurricular activities
14. Availability of scholarships
15. Recognition of degree
16. University reputation in job market
17. Reasonable dues
18. Approachable location of university
19. Teacher/student ratio
20. Conferences in university
21. Teacher availability outside classroom.

DATA COLLECTION

A student satisfaction form, based on the final outcome of the affinity diagram, was used to collect data. Students were given two scales with five points each to rate the importance and satisfaction level.. 225 students, randomly selected from different private and public sector engineering universities, participated.

Two surveyors denoted in Figure 1 as 1 and 2, interviewed three different students denoted here as A, B and C, three times each with a gap of one day between every session to check their repeatability and reproducibility errors . Data from these sample students were analysed in Minitab 14.

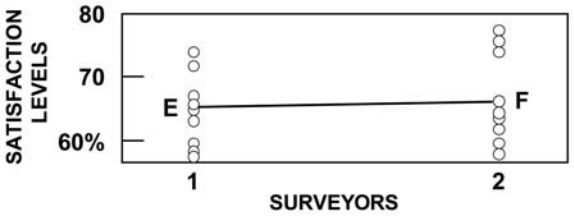

Fig. 1. Satisfaction levels observed by surveyors 1 and 2 as a result of questioning students A, B and C three times each with a gap of one day between every session; Points E and F are the mean satisfaction level of the nine interviews respectively for surveyors 1 and 2.

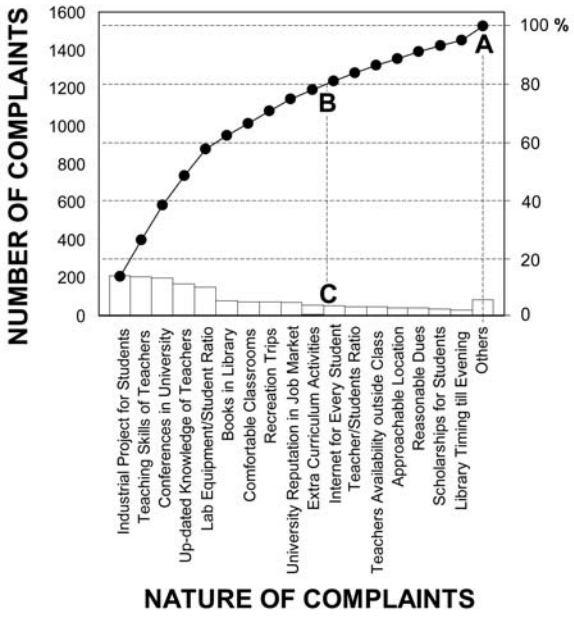

Fig. 2. Number of complaints against the nature of complaints; Cumulative line of the complaints ends at point A, which, then, represents 100% on the right vertical scale; the horizontal line of 80% meets the cumulative curve at point B, which defines point C on the horizontal axis.

Table 1. A list of the vital 10 complaints, Process; along with their inputs, outputs, suppliers and customers as identified in the present work; Persons responsible for creating inputs are the suppliers. The stakeholders of the outputs are the customers

S	I	P	O	C
Supplier	**Input**	**Process**	**Output**	**Customer**
Teacher	More interaction with industry	Availability of industrial projects for students	Increase in practical knowledge of students	Students
Chairman	More interaction with subject experts	Conferences in university	Availability of experts in university	Students/faculty
Teacher	Best teaching skills	Teaching by the teachers	Student satisfaction	Students
Teacher	More knowledge of latest research	Up-to-date knowledge of teachers	Student knowledge of current problems	Students
Chairman	More funds for labs	Lab equipment/student ratio be less	Clear concept of students	Students
Librarian	More funds for library	Availability of books in library	Sufficient reading material	Students/faculty
Chairman	More funds for classrooms	Comfortable classrooms	More concentration of students	Students
Chairman	Proper planning for trips	Recreation trips for students	Students get break from studies	Students
Faculty	High standard of faculty	University reputation in job market	Students get jobs quickly	Students/parents
Management	More societies be created	Extracurricular activities	Student participation in healthy activities	Students

Variations of these surveyors were then compared against a standard range as defined by Automotive Industry Action Group AIAG [29].

Figure 1 shows the satisfaction levels observed by two surveyors. Mean satisfaction of nine interviews for each surveyor is calculated. Line EF connects the two mean points. Figure 1 concludes that surveyor 1 is more accurate and the difference of less than one per cent between points E and F shows that both surveyors are understood in a similar manner. Variation in results due to repeatability and reproducibility error contributes 7.64 per cent, which is less than the normal range of nine per cent defined by AIAG. As a result,

Table 2. Cause and effect matrix as tailored in the present work; The second row lists an average priority for each output calculated from real data; The summation of the cross multiplication of assumed correlation values, rows 5–14, and their respective average priorities, row 2, are listed in the last column and the last row

		Average of Priority given by students										
		4.9	4.7	5	4.8	5	4.4	4.6	4.4	5	4.5	
		Process Outputs										
		Practical knowledge of students increases	Availability of experts in university	Students satisfaction	Students knowledge of current problems	Clear concept of students	Sufficient reading material	More concentration of students	Students get break from studies	Students get jobs quickly	Students participation in healthy activities	Total
Process Input	More interaction with industry	9	9	9	9	3	3	3	3	9	0	274.8
	More interaction with subject experts	9	9	9	9	1	1	0	1	1	1	197.9
	Best teaching skills of teachers	9	9	9	9	9	3	9	0	1	0	279.2
	More knowledge of latest research	3	9	9	9	9	3	9	0	0	0	244.8
	More funds for labs	9	3	9	3	9	1	3	0	1	1	190.3
	More funds for library	3	3	3	9	9	9	0	0	1	0	176.6
	More funds for classrooms	1	0	9	0	1	0	9	0	0	0	96.3
	Proper planning for trips	3	1	9	0	3	0	3	9	0	3	146.3
	High standard of faculty	3	3	9	3	9	1	3	0	9	0	196.0
	More societies be created	0	0	9	0	1	0	1	3	0	9	108.3
	Total	240.1	216.2	420	244.8	270	92.4	184	70.4	150	63	

average satisfaction level of the students was found to be 60.5 per cent.

DATA ANALYSIS

Pareto analysis, e.g. [29–32], was used to separate a vital few aspects from the trivial many. In the present analysis, any of the three points on the designated five-point scale except for satisfied and highly satisfied was considered a complaint. Thus, the total number of complaints against each question was counted. Then, these complaints were arranged and plotted in the same descending order as shown in Figure 2. The X-axis represents the type of question, whilst the Y-axis shows the total number of complaints against that question.

A cumulative line was drawn to end at point A. The vertical distance between point A and the X-axis is divided into 100 equal parts. The horizontal line is then drawn starting from the point of 80% to cut the cumulative line at point B. A vertical line was drawn from point B to intersect the X-axis at point C, thus, leaving some questions on its right and left sides. Figure 2 shows that 10 complaints, located on the left side of point C, created 80 per cent dissatisfaction amongst the students whilst the remaining 11 created just 20 per cent.

For its relevance to the present analysis, the SIPOC diagram [33–36] outlined in Table 1 provides the inputs and outputs of the 10 complaints as listed in the Process column. The inputs indicate the effect of the corresponding process, whilst the outputs indicate any change in that process. Suppliers are responsible for creating inputs and customers are the stakeholders.

Cause and effect (**C&E**) matrix, e.g. [37–39], constructed in Table 2 is based on the outcome of the SIPOC analysis. It indicates the output, which has the strongest link with the ten inputs along with those inputs capable of creating maximum effects. Outputs of the ten processes are listed in the fourth row whilst the corresponding inputs are in the second column. For each output, an average priority from real data is calculated, as given in the second row. To correlate inputs and outputs a ranking scale is assumed as follows:

No Correlation	Remote Effect
0	1
Moderate Effect	Strong Effect
3	9

Appropriate correlation values are shown in Table 2. Summations of the cross multiplication of each correlation value and its respective average priority are written in the last column and the last row.

Table 2 indicates that (a) student satisfaction is the best indicator for noticeable changes in the inputs with 420 points and (b) the three inputs of teacher's linkage with industry, teaching skills of teachers and teacher's latest knowledge with their respective total points of 274.8, 279.2 and 244.8 are capable of creating maximum changes in the outputs.

The relationship between the three complaints and student satisfaction is checked with the help of relationship charts, plotted on similar scales. The vertical axis represents the student satisfaction level of the whole questionnaire, whilst the horizontal axis shows the corresponding satisfaction level of the three relevant individual questions. A straight line is plotted to represent the mean values in Fig. 3(a, b and c). Positive relationships are observed between student satisfaction and the three complaints. It implies that any change in those complaints will result in a reciprocating change in student satisfaction. Furthermore, the strengths of the relationships between the three complaints and student satisfaction evaluated with

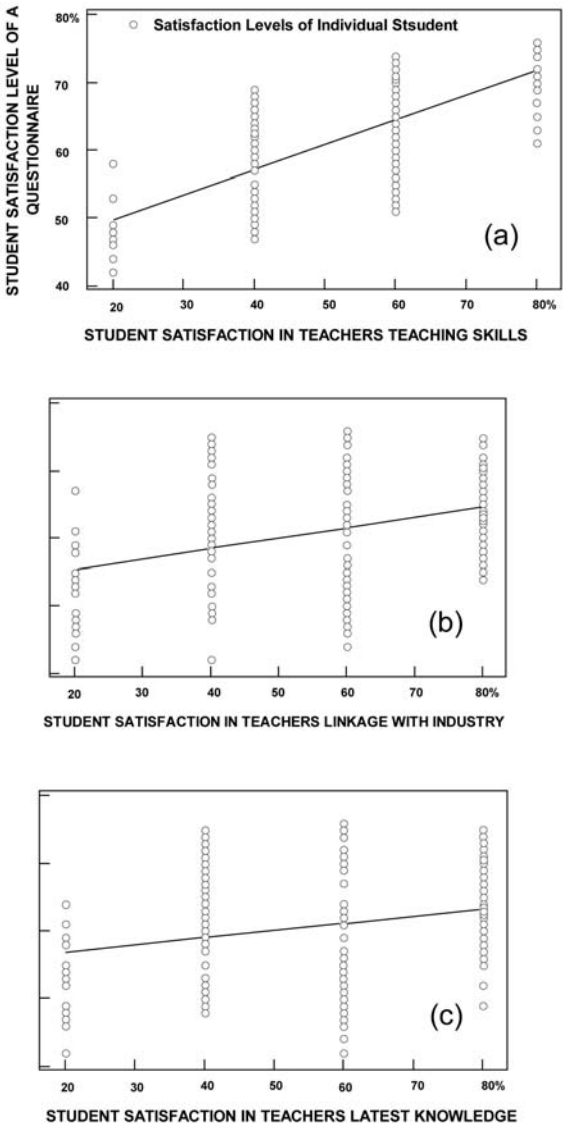

Fig. 3. Relationship between student's satisfaction against the three complaints of (a) teachers' teaching skills, (b) teachers' linkage with industry and (c) teachers' latest knowledge; the straight lines represent mean values.

the commonly known Pearson correlation coefficient are:

Teachers' teaching skills	0.758
Teachers' linkage with industry	0.376
Teachers' latest knowledge	0.270

This indicates that the teaching skills of teachers have the strongest influence on the satisfaction of students.

Although, the results are not fundamentally different from those of other studies, unless original data are collected from the sample environment to draw conclusions, they are taken as common sense ideas. The present study is based on samples from Pakistan and can be useful for countries with similar cultural traditions. However, countries with different cultures can also benefit because of the commonality of engineering culture. Another research can be carried out with the same team and questionnaire in the provinces of Pakistan having diverse cultures, to see whether engineering culture prevails over local culture.

CONCLUSION

On the basis of the surveyed sample, it is concluded that teaching skills of teachers are found mainly to affect the satisfaction level of their students, which in turn is directly related with the credibility of engineering education in Pakistan. Future research can be done to further analyse those factors, which specifically deal with the teaching skills of teachers, and then improvement strategies can be developed to enhance their teaching competencies, because the teaching approach of teachers strongly affects the satisfaction of their students [40]; those teachers who use interactive teaching are more attractive for students than those, with non-interactive methods [1].

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